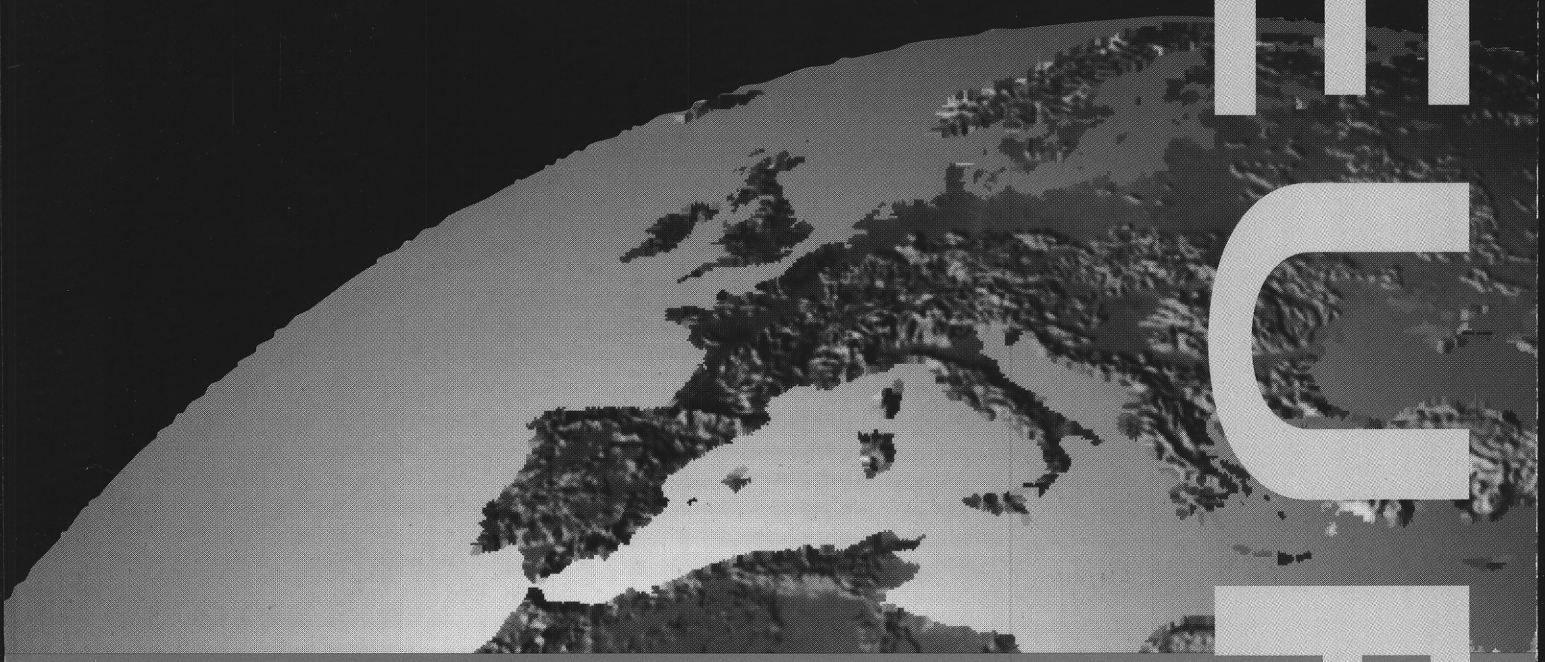
The Single Market Review



EUROPE

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Volume 9:

Single information market

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The Single Market Review

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SINGLE INFORMATION MARKET

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The Single Market Review

IMPACT ON SERVICES

SINGLE INFORMATION MARKET

The Single Market Review

SUBSERIES II: VOLUME 9

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This report is part of a series of 39 studies commissioned from independent consultants in the context of a major review of the Single Market. The 1996 Single Market Review responds to a 1992 Council of Ministers Resolution calling on the European Commission to present an overall analysis of the effectiveness of measures taken in creating the Single Market. This review, which assesses the progress made in implementing the Single Market Programme, was coordinated by the Directorate-General 'Internal Market and Financial Services' (DG XV) and the Directorate-General 'Economic and Financial Affairs' (DG II) of the European Commission.

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Table of contents

List of tables ix

List of figures xi

List of abbreviations xiv

1. Summary 1

1.1. Scope and structure of the report 1
1.2. Regulatory developments and scenarios 2
1.3. Impact on telecoms 3
1.3.1. Revenue 3
1.3.2. Capital expenditure 3
1.3.3. Employment 3
1.4. Impact on the single market 3
1.5. Impact on the economy 4
1.6. The telecoms challenge 5

2. The economic role of information and telecoms: micro–macro links 7

2.1. Towards a single integrated information market 7
2.2. Approach to the study and structure of the report 8
2.2.1. Logical structure 8
2.2.2. Methodological approach 10
2.3. Conceptualizing micro–macro links: how far does theory take us? 11
2.3.1. Defining the policies whose impact is to be measured 11
2.3.2. Identifying how advances in telecoms affect the behaviour of economic agents 12
2.3.3. Quantifying the microeconomic benefits of advances in telecoms 15
2.3.4. Mapping microeconomic benefits into macroeconomic variables 16
2.3.5. Forecasting macroeconomic outcomes 18
2.3.6. Conclusions 19

3. Telecoms liberalization: processes and scenarios 21

3.1. The liberalization process 21
3.1.1. Process drivers 21
3.1.2. Agreed policy 23
3.1.3. Regulatory framework 26
3.1.4. Implementation 28
3.2. The liberalization scenarios 29
3.2.1. The scenarios 29
3.2.2. The country groupings 32
3.2.3. Conclusions 43

4.	**Development of the telecoms sector within the EU**	**45**
4.1.	Introduction	45
4.2.	Developments in the traditional services market	46
	4.2.1. Market structure	46
	4.2.2. Overall reduction in prices	50
	4.2.3. Traffic volume	52
	4.2.4. Improved level of service	54
	4.2.5. Investment in new technologies	54
	4.2.6. Operator revenues	54
4.3.	Developments in the mobile services market	55
	4.3.1. Market structure	56
	4.3.2. Extent of network coverage and service take-up	57
	4.3.3. Price reductions and increased range of tariffs	59
	4.3.4. Impact on operator revenues	60
4.4.	Developments in the multimedia bearer services market	61
	4.4.1. ISDN	61
	4.4.2. ATM	66
4.5.	Developments in the value added services market	68
	4.5.1. Market structure	68
	4.5.2. Expansion of the range of services	69
	4.5.3. Operator revenues	70
4.6.	Developments in the telecoms sector as a whole	71
	4.6.1. Total sector revenues	72
	4.6.2. Comparison with results of econometric (top-down) model	74
	4.6.3. The impact on telecoms employment	76
	4.6.4. The impact on telecoms capital expenditure	79
4.7.	Summary of the impact of liberalization on the telecoms sector	82
5.	**Impact on the EU economy: sector studies and location**	**83**
5.1.	Introduction	83
5.2.	Business strategies	84
5.3.	Business pressures and sector dynamics	84
	5.3.1. Sector importance of business strategies	85
	5.3.2. Impact of telecoms services on business strategies	87
5.4.	Overall impact of telecoms liberalization measures	90
5.5.	Impact on the location of economic activity	91
	5.5.1. Telecoms networks and their relationship to spatial organization	91
	5.5.2. Sectoral impacts	93
	5.5.3. Regional impacts	96
5.6.	Impact on EU integration and the promotion of the single market	97
6.	**Macro-level impacts on the EU economy**	**101**
6.1.	Introduction	101
6.2.	Modelling approach	101
6.3.	Quantitative scenario results	105
6.4.	The challenge	113

Appendix A: Statistical analysis of the impact of telecoms liberalization on telecoms sector revenues **115**

A.1. Overview 115
A.2. Factor analysis on telecoms sector indicators of regulation and market structure 115
A.3. Econometric analysis of the impact of liberalization on telecoms sector performance 118
A.4. Forecasting telecoms sector revenues 119

Appendix B: Telecoms employment and capital expenditure: the recent UK experience **123**

B.1. Employment 123
B.2. Capital expenditure 126

Appendix C: Sector descriptions **129**

C.1. Aerospace, automotive and engineering manufacturing sector 130
C.1.1. Business pressures 130
C.1.2. Telecoms impact 131
C.1.3. Key applications 132
C.2. Healthcare sector 134
C.2.1. Business pressures 134
C.2.2. Telecoms impact 135
C.2.3. Key applications 136
C.3. Travel and transport sector 137
C.3.1. Business pressures 138
C.3.2. Telecoms impact 138
C.3.3. Key applications 139
C.4. Finance sector 140
C.4.1. Business pressures 141
C.4.2. Telecoms impact 142
C.4.3. Key applications 143
C.5. Electrical and electronic manufacturing sector 145
C.5.1. Business pressures 146
C.5.2. Telecoms impact 147
C.5.3. Key applications 148
C.6. Retail and distribution sector 149
C.6.1. Business pressures 149
C.6.2. Telecoms impact 150
C.6.3. Key applications 151
C.7. Chemical, pharmaceutical and oil sector 152
C.7.1. Business pressures 153
C.7.2. Telecoms impact 154
C.7.3. Key applications 155
C.8. Entertainment, printing and publishing sector 156
C.8.1. Business pressures 156
C.8.2. Telecoms impact 157
C.8.3. Key applications 158
C.9. Education sector 159

C.9.1. Business pressures 160
C.9.2. Telecoms impact 160
C.9.3. Key applications 161
C.10. Other government sector 163
C.10.1. Business pressures 163
C.10.2. Telecoms impact 163
C.10.3. Key applications 164

Appendix D: Modelling micro–macro links: a review of methodological approaches and empirical results 167

D.1. Econometric models 167
D.1.1 Arbitrary selection of explanatory variables 167
D.1.2. Difficulty in establishing causality 167
D.1.3. Structural stability of estimated parameters 168
D.1.4. Consistency of results 169
D.2. Input–output models 169
D.3. Computable general equilibrium models 171
D.4. Ad hoc models based on multipliers and identities 172
D.5. The role of telecoms in economic development: a survey of the empirical literature 173

Appendix E: Modelling approach and detailed results 177

Bibliography 183

List of tables

Table 3.1.	Summary of price regulation in the Member States	27
Table 4.1.	Traditional services market structure and coverage	47
Table 4.2.	Number of cellular telephony providers operating in each EU Member State	57
Table 4.3.	Comparison of ISDN operators and population coverage	62
Table 4.4.	Comparison of number of ATM-based carriers	67
Table 4.5.	Comparison of value added service providers and population coverage	69
Table 4.6.	Assumed percentage growth in labour productivity	78
Table 5.1.	Sector importance of business drivers	86
Table 5.2.	Assessment of the impact of telecoms services on the sectors via the business strategies	90
Table 6.1.	Macroeconomic performance under alternative liberalization scenarios	103
Table 6.2.	Key model parameters	105
Table 6.3.	Growth rates in trade and GDP	111
Table A.1.	Indicator variables used to construct the liberalization indices	116
Table A.2.	Summary statistics for the factor analysis to determine the regulatory and market indices	118
Table B.1.	Roll-out of new backbone and local loop operators in the EU	127
Table B.2.	Roll-out of new mobile operators in the EU	127
Table C.1.	Distribution of value added in the EU: aerospace, automotive and engineering manufacturing sector, 1992 (%)	131
Table C.2.	Contribution of telecoms services to shaping business activities: aerospace, automotive and engineering sector	132
Table C.3.	Overall impact of telecoms liberalization on aerospace, automotive and engineering sector revenues and costs	132
Table C.4.	Contribution of telecoms services to shaping business activities: healthcare sector	136
Table C.5.	Overall impact of telecoms liberalization on healthcare sector revenues and costs	136
Table C.6.	Contribution of telecoms services to shaping business activities: travel and transport sector	138
Table C.7.	Overall impact of telecoms liberalization on travel and transport sector revenues and costs	139
Table C.8.	Distribution of value added in the EU: finance sector, 1992 (%)	141
Table C.9.	Contribution of telecoms services to shaping business activities: finance sector	142
Table C.10.	Overall impact of telecoms liberalization on finance sector revenues and costs	143
Table C.11.	Distribution of value added in the EU: electrical and electronic manufacturing sector, 1992 (%)	145

Table C.12. Contribution of telecoms services to shaping business activities: electrical and electronic manufacturing sector 147
Table C.13. Overall impact of telecoms liberalization on electrical and electronic manufacturing sector revenues and costs 148
Table C.14. Distribution of value added in the EU: retail and distribution sector, 1992 (%) 149
Table C.15. Contribution of telecoms services to shaping business activities: retail and distribution sector 151
Table C.16. Overall impact of telecoms liberalization on retail and distribution sectors revenues and costs 151
Table C.17. Distribution of value added in the EU: chemical, pharmaceuticals and oil sector, 1992 (%) 153
Table C.18. Contribution of telecoms services to shaping business activities: chemical, pharmaceutical and oil sector 154
Table C.19. Overall impact of telecoms liberalization on chemical, pharmaceutical and oil sector revenues and costs 155
Table C.20. Distribution of value added in the EU: entertainment, printing and publishing sector, 1992 (%) 156
Table C.21. Contribution of telecoms services to shaping business activities: entertainment, printing and publishing sector 158
Table C.22. Overall impact of telecoms liberalization on entertainment, printing and publishing sector revenues and costs 158
Table C.23. Contribution of telecoms services to shaping business activities: education sector 161
Table C.24. Overall impact of telecoms liberalization on the education sector revenues and costs 161
Table C.25. Contribution of telecoms services to shaping business activities: other government sector 164
Table C.26. Overall impact of telecoms liberalization on other government sector revenues and costs 164

Table E.1. Annual EU-wide telecoms sector projections 179
Table E.2. Differences in macroeconomic performance among telecoms liberalization scenarios 180
Table E.3. Summary of results 181

List of figures

Figure 1.1.	Logical structure of the report	1
Figure 2.1.	The drivers of telecoms demand	7
Figure 2.2.	Logical structure of the report	8
Figure 2.3.	Methodological structure of the report	10
Figure 2.4.	Impact of telecoms liberalization on the telecoms market	12
Figure 2.5.	Firm-level effects of telecoms liberalization	13
Figure 2.6.	Aggregate microeconomic effects of telecoms liberalization	17
Figure 2.7.	Macroeconomic effects of telecoms liberalization	19
Figure 3.1.	The impact of liberalization on telecoms supply, and the relationship between sector forces and the economy	21
Figure 3.2.	The process of regulatory reform	22
Figure 3.3.	The changing role of telecoms regulation (rapid scenario)	31
Figure 4.1.	A model of the impact of telecoms liberalization	45
Figure 4.2.	Evolving TO organizational structure	49
Figure 4.3.	Indexed average price per minute of intra-EU calls	50
Figure 4.4.	Average price per minute for basic telephone service, low-usage customers	51
Figure 4.5.	Average price per minute for basic telephone service, high-usage customers	52
Figure 4.6.	Number of PSTN lines in the EU	52
Figure 4.7.	Indexed total call minutes in the EU	53
Figure 4.8.	Indexed intra-EU traffic volume	53
Figure 4.9.	Revenue from traditional Services, all scenarios	55
Figure 4.10.	Mobile telephony penetration in Scandinavia and the UK since launch	58
Figure 4.11.	Projected number of mobile subscribers, all scenarios	59
Figure 4.12.	Comparison of average revenue per subscriber with the total cost of service for three customer types, rapid scenario	60
Figure 4.13.	Comparison of average revenue per subscriber, all scenarios	60
Figure 4.14.	Projected mobile telephony revenues, all scenarios	61
Figure 4.15.	Projection of ISDN capacity in B channels, all scenarios	64
Figure 4.16.	Comparison of average revenue per ISDN channel, all scenarios	65
Figure 4.17.	Projection of EU ISDN revenues, all scenarios	65
Figure 4.18.	Projection of ATM revenues, all scenarios	68
Figure 4.19.	Projection of VAS revenues, all scenarios	71
Figure 4.20.	Breakdown of European telecoms revenues, rapid scenario	73
Figure 4.21.	Breakdown of European telecoms revenues, unsynchronized scenario	73
Figure 4.22.	Breakdown of European telecoms revenues, *Antimonde*	74
Figure 4.23.	Projection of EU telecoms revenues from statistical analysis, all scenarios	75
Figure 4.24.	Comparison of forecast telecoms sector revenues	76
Figure 4.25.	Projection of EU telecoms sector employment, both scenarios	77
Figure 4.26.	Telecoms sector employment – employees of incumbent operators and new entrants	79
Figure 4.27.	Core and access network stylized investment cycles	80

Figure 4.28.	World-wide capital expenditure by TOs as a proportion of worldwide telecoms revenues	81
Figure 4.29.	Forecast of capital expenditure by new TOs, all scenarios	81
Figure 4.30.	Forecast of telecoms capital expenditure by all operators, all scenarios	82
Figure 5.1.	Business strategy implications of telecoms liberalization	83
Figure 5.2.	Telecoms impact on the ten sectors (illustrative)	91
Figure 5.3.	Number of banks per 10,000 population, 1994	93
Figure 5.4.	Production co-ordination: soft drinks manufacture	94
Figure 5.5.	Impact of telecoms on spatial distribution of sectors (illustrative)	95
Figure 6.1.	Macroeconomic effects of telecoms liberalization	104
Figure 6.2.	EU GDP projections: differences from base case	107
Figure 6.3.	EU non-residential investment projections: all scenarios	108
Figure 6.4.	Total and telephone sector employment projections: differences from base case	110
Figure A.1.	Outline of statistical methodology	116
Figure A.2.	The relationship between GDP per capita and the national average telecoms penetration rate	118
Figure A.3.	Predicted value of regulatory index for each group of countries, unsynchronized scenario	121
Figure A.4.	Predicted value of regulatory index for each group of countries, rapid scenario	121
Figure A.5.	Total sector revenue forecast by regression methodology	122
Figure B.1.	Employment in the UK telecoms sector, 1985–95	124
Figure B.2.	Lines per employee for the major European TOs, 1985–94	125
Figure B.3.	Hypothetical development of UK telecoms sector employment if BT had a lines per employee ratio equal to France Telecom's, 1985–95	125
Figure B.4.	Telecoms capital expenditure in the UK, 1990–94	126
Figure C.1.	Application usage in the aerospace, automotive and engineering manufacturing sector, 1995 and 2000	133
Figure C.2.	Average Telecoms expenditure (1995, 1997 and 2000) by aerospace, automotive and engineering manufacturing sector organizations interviewed	134
Figure C.3.	Application usage in the healthcare sector, 1995 and 2000	137
Figure C.4.	Average expenditure (1995, 1997 and 2000) by healthcare sector organizations interviewed	137
Figure C.5.	Application usage in the travel and transport sector, 1995 and 2000	140
Figure C.6.	Average Telecoms expenditure (1995, 1997 and 2000) by travel and transport sector organizations interviewed	140
Figure C.7.	Application usage in the finance sector, 1995 and 2000	144
Figure C.8.	Average telecoms expenditure (1995, 1997 and 2000) by finance sector organizations interviewed	144
Figure C.9.	Consolidation of the world telecoms equipment market, 1983–92	146
Figure C.10.	Application usage in the electrical and electronic manufacturing sector, 1995 and 2000	148

Figure C.11. Average telecoms expenditure (1995, 1997 and 2000) by electrical and electronic manufacturing sector organizations interviewed 149
Figure C.12. Application usage in the retail and distribution sector, 1995 and 2000 152
Figure C.13. Average telecoms expenditure (1995, 1997 and 2000) by retail and distribution sector organizations interviewed 152
Figure C.14. Application usage in the chemical, pharmaceutical and oil sector, 1995 and 2000 155
Figure C.15. Average telecoms expenditure (1995, 1997 and 2000) by chemical, pharmaceutical and oil sector organizations interviewed 156
Figure C.16. Application usage in the entertainment, printing and publishing sector, 1995 and 2000 159
Figure C.17. Average Telecoms Expenditure (1995, 1997 and 2000) by entertainment, printing and publishing sector organizations interviewed 159
Figure C.18. Application usage in the education sector, 1995 and 2000 162
Figure C.19. Average telecoms expenditure (1995, 1997 and 2000) by education sector organizations interviewed 162
Figure C.20. Application usage in the other government sector, 1995 and 2000 165
Figure C.21. Average telecoms expenditure (1995, 1997 and 2000) by other government sector organizations interviewed 165

Figure E.1. Functional representation of macro model 178

List of abbreviations

ADSL	Asymmetric Digital Subscriber Loop
ATM	Asynchronous Transfer Mode
BR-ISDN	Basic Rate ISDN
CAD	Computer Aided Design
CAGR	Compound Annual Growth Rate
CAM	Computer Aided Manufacturing
CBDS	Connectionless Broadband Data Service
CD-ROM	Compact Disk Read Only Memory
DCS1800	Digital Communications Service 1800MHz (digital cellular telephone standard)
DECT	Digital European Cordless Telecommunications
EC	European Commission
ECTRA	European Committee of Telecoms Regulatory Authorities
ECU	European Currency Unit
EDI	Electronic Data Interchange
EFT	Electronic Fund Transfer
EFTPOS	Electronic Fund Transfer at the Point of Sale
EU	European Union
EU15	The 15 EU Member States
EUTC	European Union Telecoms Committee
GDP	Gross Domestic Product
GSM	Groupe Spéciale Mobile (global system for mobile communications)
ICE	Information, Communication and Entertainment
IN	Intelligent Network
ISDN	Integrated Services Digital Network
ISR	International Simple Resale
LAN	Local Area Network
MAN	Metropolitan Area Network
NRA	National Regulatory Authority
OECD	Organization for Economic Co-operation and Development
ONP	Open Network Provision
PC	Personal Computer
PDH	Plesiochronous Digital Hierarchy
PMR	Private Mobile Radio
PSTN	Public Switched Telephony Network
RBOC	Regional Bell Operating Company
SDH	Synchronous Digital Hierarchy
SMDS	Switched Multi-megabit Data Service
SME	Small or Medium-sized Enterprise
SMS	Short Message Service
SS7	Signalling System 7 (International Telecommunication Union standard)
TO	Telecommunications Operator: term used to describe both a national monopoly supplier of public telecoms services and infrastructure, and a private company operating public telecoms services and infrastructure, nationally or locally, either as a concessionary monopoly or in competition with others
VAS	Value Added Service
VPN	Virtual Private Network

1. Summary

... on the completion of our liberalization process in 1998, the European Union will have the potential to be the largest telecoms market in the world.

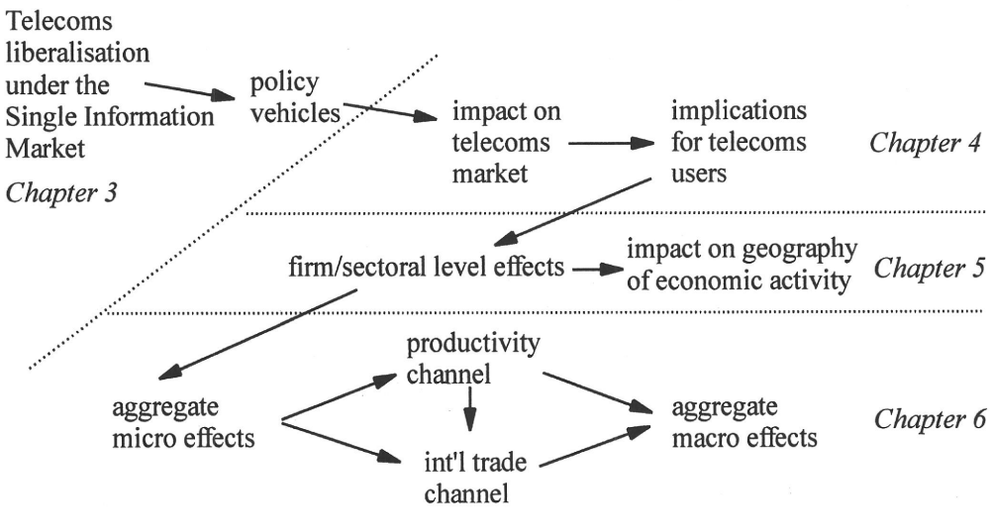
Jacques Santer, President of the European Commission. Speech at the opening of the World Telecommunications Forum, Geneva, 3 October 1995.

1.1. Scope and structure of the report

The Single Information Market was commissioned by the European Commission's Directorate-General for the Internal Market and Financial Services (DG XV) in order to assess the overall impact of liberalization of telecoms on the functioning of the internal market.

This summary follows the same structure as the report, which is illustrated in Figure 1.1. We first consider developments in liberalization in the telecoms sector and, using the identified policy vehicles, assess the impact of this liberalization on the telecoms market in terms of sectoral indicators such as operators' revenue, capital expenditure, employment and market structure. We then examine the impact on users of telecoms, including the influences on various economic sectors and on spatial location. Finally, we use the projections of the evolution of the telecoms sector and the assessed impacts on users to drive a macroeconomic model to compute overall macroeconomic effects.

Figure 1.1. Logical structure of the report



It is important to note that there are still significant gaps in economists' understanding of how information affects economic activity at the firm level. There is considerable agreement that telecoms has significant additional economic benefits; however, there is no adequate measurement system for tracking the interactions between information and other productive and marketing inputs. This is shown by the 'productivity paradox' – the fact that the widespread use of computers appears not to have been matched by improvements in productivity. The implication is that it is difficult to derive an objective benchmark against which effects may be measured, and hence, when quantifying the benefits of integration of

information markets, expert judgement as much as empirical research must be relied upon. We have used both in this report.

We believe that the fundamental dynamics and economic impacts of advanced communications and information markets will be significantly different to the effects observed to date. The transition to an environment with advanced communications and greater accessibility of cross-border information is much more than a technology change – it will open up a wide range of new applications, and allow traditional applications to penetrate commercial, administrative and social processes to a much greater extent than is currently observed.

1.2. Regulatory developments and scenarios

The importance of this change in the impact of telecoms and information markets has been reflected in the accelerating telecoms liberalization process in the European Union (EU). This began in the mid-1980s: the Green Paper in 1987[1] was followed by the Terminals Directive 1988,[2] the Services[3] and Framework[4] Directive in 1990 and the Services Directive Review[5] in 1993. The Bangemann Report in 1994 called for immediate deregulatory action and the Council Resolution of 22 December 1994 set a deadline of 1 January 1988 for full competition in telecoms (with time extensions for some Member States). In order to project forward possible future evolution of this liberalization trend, we have created three regulatory scenarios:

(a) A *rapid scenario* in which there is a swift and uniform implementation of pro-competitive liberalization throughout the EU. Competition is rapidly established and homogeneous European regulatory frameworks enable efficient interconnection and separation of services and networks.

(b) An unsynchronized scenario in which liberalization measures are introduced inconsistently and with delays in several Member States. Competition is slow to develop in many parts of the market and significant barriers to entry exist as a result of differing interpretations and uneven enforcement of both national and European legislation.

(c) An *antimonde* which sets out a view of what would have happened if there were no further changes to the degree of liberalization in the EU. This generates a number of negative effects as a result of current expectations not being met. Nevertheless, it represents a reference against which the other scenarios can be judged.

---

1 'Green Paper on the development of the common market for telecommunications services and equipment', COM(87) 290 final, 30 June 1987.

2 Commission Directive 88/301/EEC of 16 May 1988 on competition in the markets in telecommunications terminal equipment (OJ L 131, 27.5.1988, p. 73).

3 Commission Directive 90/388/EEC of 28 June 1990 on competition in the markets for telecommunications services (OJ L 192, 24.7.1990, p.10).

4 Council Directive 90/387/EEC of 28 June 1990 on the establishment of the internal market for telecommunications services through the implementation of open network provision (OJ L 192, 24.7.1990, p. 1).

5 Communication to the Council and the European Parliament on the consultation on the review of the situation in the telecommunications services sector, COM(93) 159 final, 28 April 1993.

1.3. Impact on telecoms

Significant differences exist between the scenarios:

1.3.1. Revenue

Telecoms revenue in the 15 EU Member States, in 1995, stood at ECU 134 billion (1994 ECU). By far the largest part of this revenue came from providing ordinary telephony services. The emphasis on these traditional sources of revenue for telecoms operators will decrease in the future as the services are complemented, and in some cases supplanted, by mobile, multimedia and value added services. Total revenues under the rapid scenario are expected to exceed ECU 232 billion (1994 ECU) in the year 2005, with non-traditional services accounting for 61% of the total (an increase from the current figure of under 20%). This compares with the unsynchronized scenario where total revenues reach ECU 214 billion, with non-traditional services accounting for 59% of revenues. The *antimonde* yields total revenues of ECU 185 billion with non-traditional services accounting for 57% of revenues. Over the period to 2005, cumulative revenues are ECU 89 billion (1994 ECU) higher under the rapid scenario than under the unsynchronized scenario, and ECU 225 billion higher under the rapid scenario than under the *antimonde* scenario.

1.3.2. Capital expenditure

Telecoms operators' capital expenditure rises very sharply with increased liberalization; much of the increase is derived from new operators as they establish their networks. We project that capital expenditure will rise at around 5.3% per annum under the unsynchronized scenario, and 6.7% per annum under the rapid scenario. This compares with growth of 2.5% per annum under the *antimonde* scenario. By 2005, new operator investment will have risen to between ECU 11 billion and ECU 15 billion per annum under the liberalization scenarios; under the *antimonde* it will not rise above ECU 3.4 billion per annum. Annual investment by incumbent operators will stand at ECU 48 billion in 2005 in the *antimonde* scenario, at ECU 57 billion for the unsynchronized scenario and ECU 62 billion under the rapid scenario (1994 ECU).

1.3.3. Employment

Despite the significant sectoral employment reductions experienced in the United Kingdom (UK) following liberalization, we find that pan-European telecoms liberalization will help employment by stimulating demand. Currently monopolistic providers are also relatively efficient. Under the rapid scenario, employment in the telecoms sector will rise to 1.1 million by 2005 from 985,000 today. This is 83,000 greater than under the unsynchronized scenario and just under 200,000 greater than for the *antimonde* scenario. The definition of the telecommunications sector used included systems integrators; future growth in the cable TV industry in Europe will be strongly associated with the ability of cable TV operators to offer telephony services.

1.4. Impact on the single market

The advancement of communications brought about by telecoms liberalization will induce the creation and destruction of jobs and prosperity in Europe outside the telecoms sector itself. Overall, the integration of information markets is more of an opportunity than a threat for Europe, as it will accelerate the development of the EU single market for goods, services and

factors of production, and will increase the ability of European businesses to project themselves into global markets. The intensifying competition brought about by the single market is putting pressure on EU firms to contain costs and to embark on risky and complex initiatives to expand their geographic reach. They are likely to rely on the advanced communications made possible by telecoms liberalization when seeking to improve the flexibility and effectiveness of their processes, and reviewing their cost structures and marketing strategies on a continuous and intensive basis.

The report identifies significant impacts that telecoms have on ten sample economic sectors (which together represent 70% of business telecoms services revenues in the EU). These impacts include increased revenues through market and product innovation, and reduction of costs through better management of processes, supplier relationships and resources. There could also be significant impacts on the location of economic activity, particularly as liberalization of telecoms enables remote access to, and exploitation of, previously inaccessible markets. This extension of the economic range of operations is likely to accelerate the process of European integration for all sizes of enterprises and, because we also expect liberalization to bring about more efficient information markets and greater flexibility in plant location and work patterns, social and economic disruption will be mitigated.

1.5. Impact on the economy

The results of the macroeconomic modelling indicate that full telecoms liberalization may increase EU gross domestic product (GDP) by 1.18% cumulatively by the year 2005 under the rapid scenario, and 0.70% under the unsynchronized scenario (both in relation to the *antimonde*). Intra-EU trade grows more rapidly than external exports or imports, reflecting further European integration. External EU trade grows roughly in line with GDP, although there is a slight worsening of the overall trade balance. Rapid liberalization may generate some 641,000 net new jobs by 2005 in the EU, compared with 263,000 under the unsynchronized scenario (relative to the *antimonde*).

These results should be interpreted with care since they are derived from differences between scenarios which, while plausible, may not represent true alternative futures. Moreover, the macroeconomic model is driven by estimated multiplier effects and does not have a predictive capacity for detailed quantification of the impact of the EU single information market. It should also be noted that there are significant lags involved in reaping the benefits of increased telecoms-related investments at the firm level, due to obsolescence of previous equipment, re-mapping of workflows, labour retraining needs and technological learning curves. Tangible productivity benefits are slow to emerge. Thus, the overall macroeconomic benefits may take longer to show up, and may not materialize to the same degree in the absence of other conducive circumstances such as flexible labour markets, investment in education and training, removal of remaining barriers to the single market and the funding of necessary investments.

1.6. The telecoms challenge

As a result of technological advances, previously distinct boundaries between telecoms, broadcasting, computing and other industrial sectors are disappearing. Simultaneously, the significant potential benefits to be gained from the use of telecoms are becoming apparent. Providing the right conditions to enable information infrastructures to be built, and ensuring

that the benefits of the emerging Information Society are distributed widely, efficiently and equitably, must be a priority for the European Commission and Member State governments. We expect that the economies of the EU will reap a significant fraction of the full benefits of liberalization even under the unsynchronized scenario, so that individual action is still of benefit even if other countries fail to act reciprocally and in concert. Whilst it would be better if the Commission could ensure joint and synchronized action by Member States, this objective should not obstruct progress towards liberalization in as many Member States as possible. The Commission should aim to raise the *average* level of liberalization within the EU by getting as many countries to liberalize as possible and not hold up this process by attempting to match the pace of Member States which are liberalizing more slowly. It should also provide a more precise definition of the regulatory ground-rules that are expected to apply in the medium term, including licensing conditions and the implementation of open network provision (ONP).

Liberalization in telecoms offers Europe a challenge in terms of implementation of regulations, institutional and market structures, data protection, intellectual property, content and culture. In the wider economy, the challenge is to seize the opportunity being presented, to innovate and to learn how to exploit the immense possibilities that the information revolution offers. These processes are not always beneficial for all concerned; in regional development and employment, policies may be necessary to assist organizations, individuals and communities. Nevertheless, the overall benefits are substantially positive for both the telecoms sector itself and the EU as a whole.

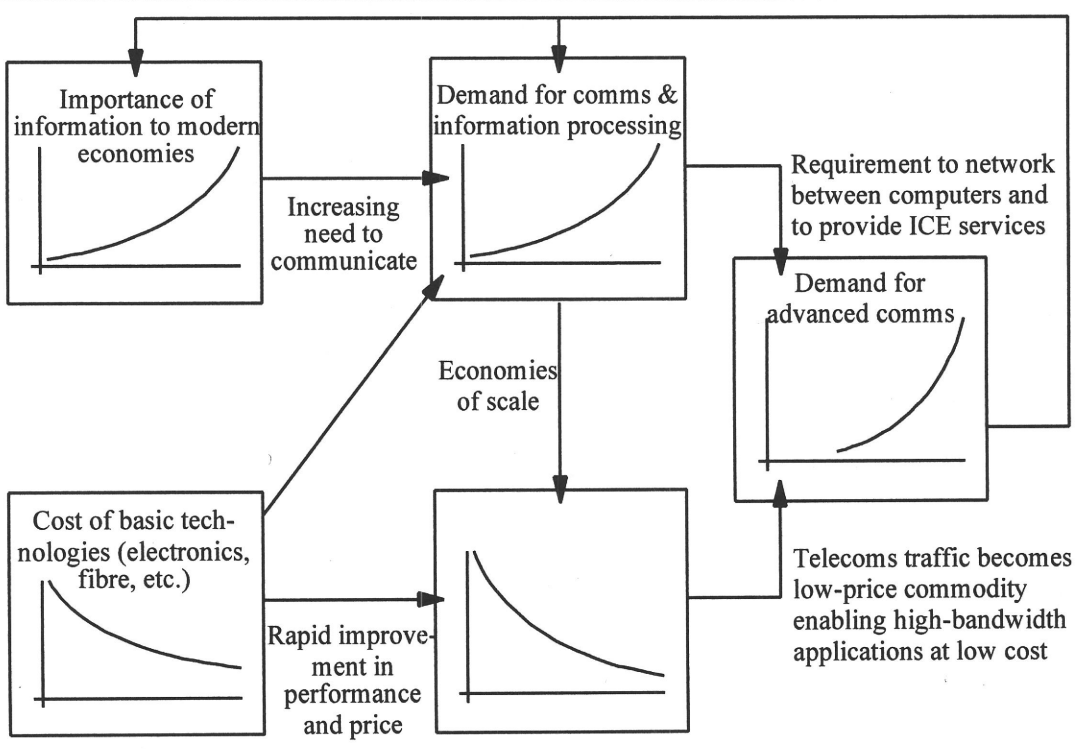
The economic benefits of telecoms liberalization will occur largely by restoring power to customers (through greater accessibility and affordability). Customers will be in a better position to influence the nature of service offerings (greater emphasis on quality of service and functionality). Making telecoms services more responsive to customers' needs and conditions is essential for them to become an important 'driver' for the new service-oriented economy.

2. The economic role of information and telecoms: micro-macro links

2.1. Towards a single integrated information market

The development of economies and the need to communicate have been linked since the industrial revolution. Since Adam Smith first identified that specialization in processes led to improvements in efficiency, many economic developments have been based on specialization, organization and communication, i.e. the functional and spatial division of labour (Smith [1776]).[6] The increasing need to co-ordinate different activities in the economy effectively creates a demand for communications and information-processing at all levels, from senior management to shop floor, from local to global. Even without improvements in information and communications technologies, the importance of information to modern economies would continue to grow, but improvements in technology have reinforced this underlying trend and will lead to a vast increase in the demand for communications (see Figure 2.1).

Figure 2.1. The drivers of telecoms demand



Source: Analysys [1993].

Demand for communications and information-processing is being met by cheaper and cheaper systems based on technology such as electronics and optical fibre. Furthermore, as this demand increases, another important factor comes into play: economy of scale. The greater

6 See also Ergas [1994], Kogut [1992], Porter [1990].

the demand, the cheaper the unit cost. While this is true for almost every industry, economies of scale are particularly strong in modern communications systems. Technical improvements and growth in demand both lead to very low per-bit costs. This will inevitably lead to telecoms traffic becoming a low-priced commodity, and enable high-bandwidth applications to be provided at very low cost.

Finally, the need to network between different computers and the demand for information, communication and entertainment (ICE) services will lead to an inexorable growth of advanced communications, including broadband, mobile and other value added communications. In turn, the availability of these forms of communication both fuels the short-term growth of demand through direct price effects, and enables long-term structural changes in the economy, which lead to further increases in demand.

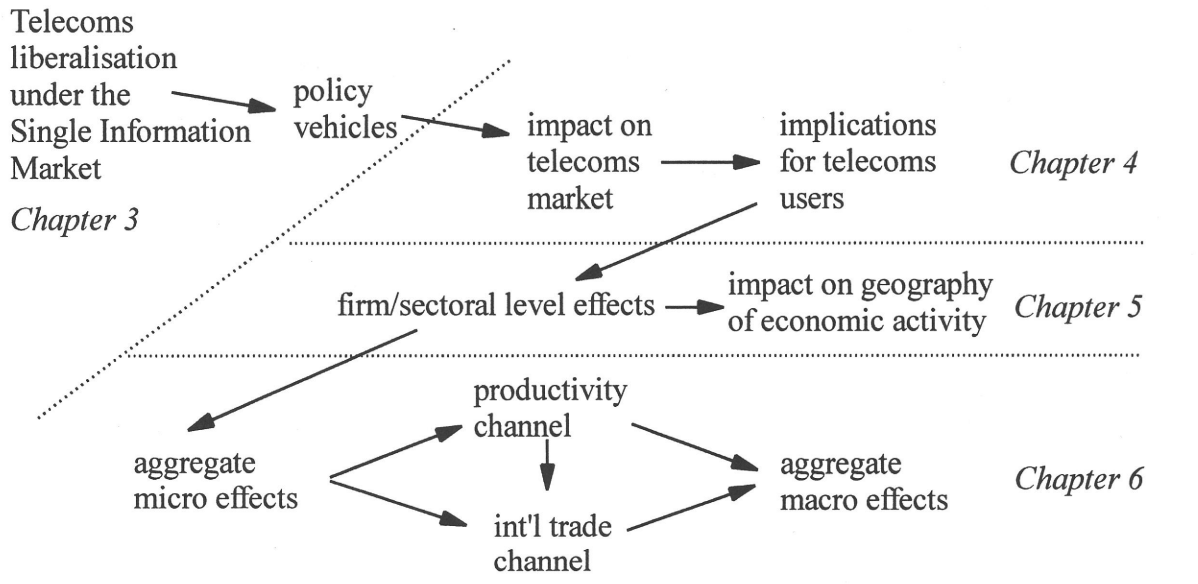
It is apparent, however, that the rate and manner in which EU liberalization directives are implemented into national law varies between Member States. This report considers how variation in the pace and nature of implementation of these measures will affect the revenues earned by the players within the EU telecoms sector, and the evolution of advanced telecoms services over the next ten years. It then looks at how increased availability and affordability of existing and new telecoms services will affect the EU economy as a whole, and in so doing will draw conclusions on the effect that the liberalization measures agreed by Member States will have on the realization of a single integrated information market.

2.2. Approach to the study and structure of the report

2.2.1. Logical structure

The report is structured in six chapters, which trace the impact of the telecoms liberalization policy through its effects on markets, users and different sectors and match this impact with the aggregate effects on the EU economy as a whole. The logical structure of the report is depicted in Figure 2.2.

Figure 2.2. Logical structure of the report



Chapter 2 discusses in conceptual terms how the effects of telecoms liberalization and the consequent integration of information markets might ripple through the EU economy. Following this conceptual overview, Chapter 3 identifies the key elements of the regulatory process driving the telecoms liberalization agenda, and describes the ways in which regulation influences the development of the telecoms sector. In addition, three regulatory scenarios are defined in Chapter 3 and used throughout the study in order to assess the impact that different levels of liberalization have on the telecoms sector. The scenarios may be summarized as follows:

(a) The *rapid* scenario reflects a speedier liberalization of national telecoms markets than required under the timetable of the agreed measures, with more consistency in the scope and timing of implementation across the Member States.
(b) The *unsynchronized* scenario reflects a multi-speed process of liberalization, with Member States liberalizing at their own pace, and no faster than their obligations under EU law. This results in a piecemeal liberalization of EU markets by 2005.
(c) The *antimonde* permits a comparison of these two scenarios against a benchmark of no further progress in telecoms liberalization throughout Europe.

Chapter 3 also includes a qualitative description of the regulatory environment under each scenario across the Member States, expressed in terms of five indicative categories of countries.

Chapter 4 describes the evolution of the EU telecoms sector until 2005 under each of the regulatory scenarios. It assesses the likely impact of prospective regulatory changes on the supply of telecoms services and infrastructure, and in particular on the mix of services supplied by players. Two models are used in this chapter to provide estimates of the impacts of liberalization:

(a) A bottom-up forecasting model is used to assess the likely growth of each service category, the incremental capital expenditure and employment requirements of telecoms operators, and the prospective changes in market structure for each of the four telecoms market segments: traditional services, mobile, multimedia and value added services.
(b) A separate econometric model relates regulatory and market conditions to telecoms spend. This model is used to check the results derived from the bottom-up approach.

Chapter 5 discusses the key trends that are expected to result from enhanced accessibility, affordability and functionality of information for each of ten economic sectors. It examines the drivers of organizational change that will help companies in each sector to gain competitive advantage and the importance of the imputed communications benefits in facilitating these drivers. Chapter 5 relates systematically and qualitatively the benefits from enhanced communication to improvements in operating efficiency for the sectors and improvements in the products and services offered by the sectors. It draws together the results of telecoms liberalization measures and the key industry trends to demonstrate the benefits of telecoms liberalization to sectors of the European economy, and develops a view on the qualitative impacts on European integration.

Chapter 6 sets out a quantification of the benefits of telecoms liberalization at the macro-economic level. Given the widely recognized difficulty of modelling micro-macro links, we have opted to construct a model in which the collective impact of the various effects can be

described in a straightforward and consistent fashion. The objective is to demonstrate the relative magnitudes of the various effects on growth, employment, trade and investment and to show how they interrelate. The quantitative scenarios generated by the model reflect our understanding of the dynamics of the telecoms sectors (as described in Chapter 4) and its interaction with the major sectoral users (derived from Chapter 5).

2.2.2. Methodological approach

Our methodological approach to the study is based on a representational model, as illustrated in Figure 2.3. Development of this representational model requires three supporting elements:

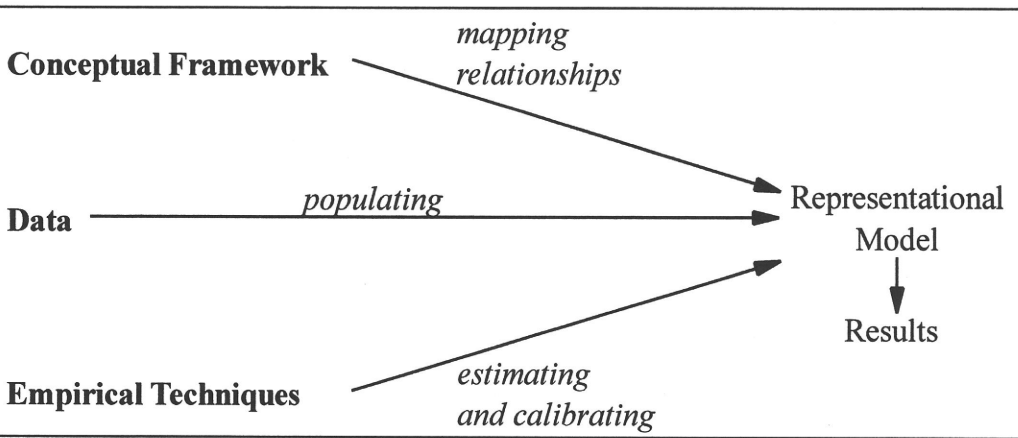
(a) A *conceptual framework*, which defines (and hence limits) the system under investigation, and establishes drivers of processes and associated causal relationships. The rest of this chapter explains the conceptual framework for this study, by highlighting the steps required in mapping the EU's single information market legislative agenda into macroeconomic outcomes.

(b) *Data*, which includes quantifiable inputs such as the telecoms sector data utilized in Chapter 4 and the macroeconomic inputs into Chapter 6. Data can also be of a qualitative nature, of the kind that drives the discussion and inferences in Chapter 5. Finally, data also encompasses the regulatory scenarios developed in Chapter 3 to the extent that these are not theoretically derived but rather reflect our own judgement of potential policy outcomes.

(c) *Empirical techniques*, which are used to manipulate the data as constrained by the relations established by the conceptual framework. Appendix D discusses the adequacy of different empirical modelling techniques in the light of data availability and the support that can be derived from established theory.

A representational model is thus a characterization of a conceptual framework in terms of observable relationships and measurable quantities.

Figure 2.3. Methodological structure of the report



2.3. Conceptualizing micro-macro links: how far does theory take us?

Few would question the firm-level benefits accruing from greater accessibility, affordability and functionality of information that would be derived from EU-wide telecoms liberalization. This position can be supported by a mass of anecdotal evidence, conventional wisdom and innovative business theories. Most would agree that telecoms integration has a positive impact on overall economic growth and trade. Indeed, intensive use of information is generally deemed to be one of the principal economic driving forces – if not an essential requirement for survival – in the competitive, post-manufacturing age.

Despite this, the specific links that drive micro-macro interactions can at best be characterized as a tenuous thread. The intangibility of the micro-macro links is a result of the lack of a systematic way to measure the role of information and communications in economic development, discussed in more detail in Section 2.3.3. Although there are established conceptual notions of the role of information in production and decision-making processes, we cannot reliably quantify the effects of cheaper and better access to information at the firm level, much less aggregate them over all economic agents.

The discussion in the rest of this chapter is centred around the five logical steps that are involved in assessing the macroeconomic impact of the single information market policies:

(a) defining the policies whose impact is to be measured;
(b) identifying how advances in telecoms affect the behaviour of economic agents;
(c) quantifying the microeconomic benefits of advances in telecoms;
(d) mapping them into macroeconomic variables;
(e) overlaying these macro variables with a full macroeconomic forecasting model.

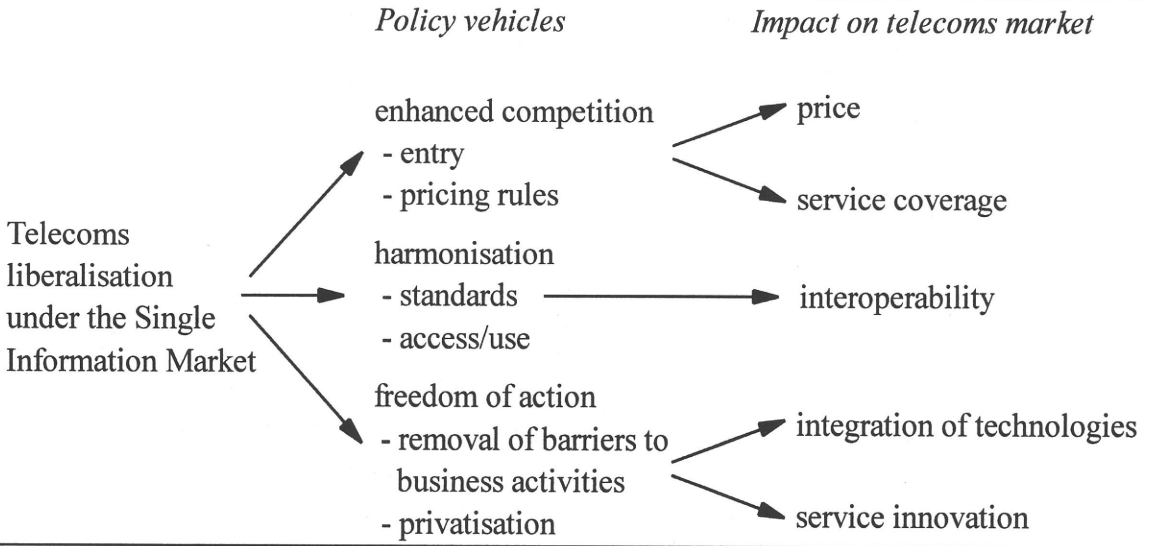
This chapter is concerned exclusively with the conceptual framework of the study. The empirical implementation of these five steps (including model structure and data inputs) is detailed in Chapter 6.

2.3.1. Defining the policies whose impact is to be measured

A direct (and plausible) relationship can be described between liberalization measures and the development of the telecoms sector, as illustrated in Figure 2.4. However, the figure neglects the fact that this relationship operates in two directions: the market affects regulation, as suppliers and consumers bring pressure to bear on policy makers, and policy makers affect the sector through regulation.

The plausibility of a scenario depends on the likelihood that, given the state of the sector and the wider economy, policy makers would have chosen a particular set of liberalization measures. Correspondingly, the state of the sector and, ultimately, that of the wider economy, depends on the choices of policy makers. This two-way relationship makes it difficult to set out a counterfactual regulatory scenario. In addition, although one can easily pinpoint the specific legal or regulatory measures put in place directly by the EC to launch the single information market, it is harder to assess what the actions of national legislatures and national regulatory agencies would have been in the absence of the EU agenda.

Figure 2.4. Impact of telecoms liberalization on the telecoms market



Source: Analysys.

The potential for overestimating the benefits of liberalization may be seen from Figure 2.4:

(a) Associating the *antimonde* with a scenario of no progress in telecoms liberalization biases the estimation of the benefits of telecoms liberalization upwards because it may be unlikely that such a policy would be pursued. But, paradoxically, the higher the imputed benefits of liberalization, the harder it is to argue that there would have been no action at the national level without EU prompting.

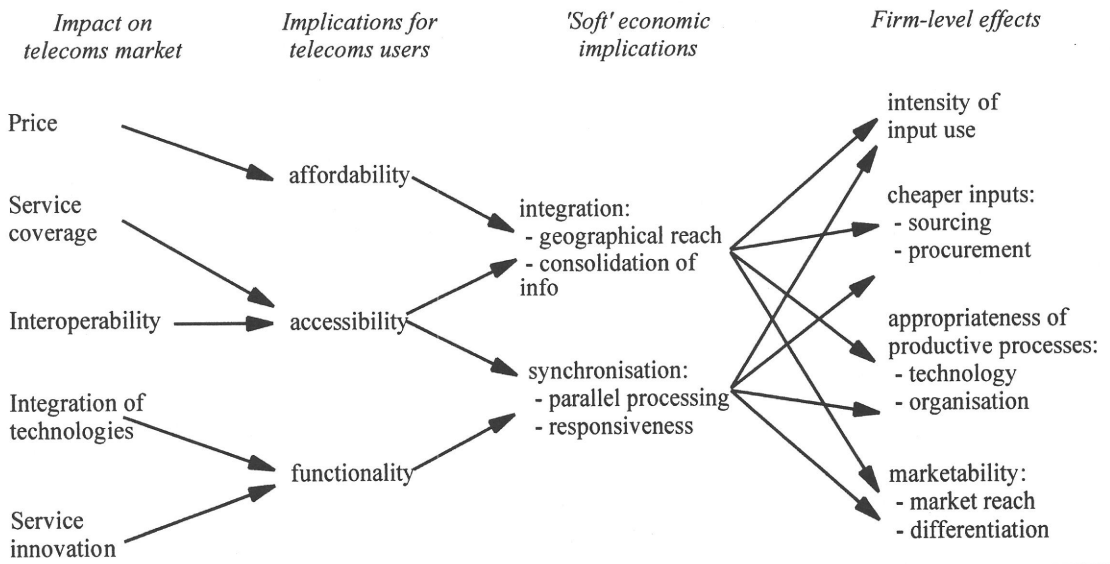
(b) If the EU had not taken action to liberalize, it could be argued that the individual Member States would take such steps anyway. From a political economy perspective, 'demand' for liberalization is driven by its expected benefits, and this demand can be focused at either the EU or the national level. To the extent that telecoms liberalization is seen as a positive sum game (analogous to the gains from trade), focusing the 'demand' for liberalization at the EU level might be thought to be appropriate. However, if the EU had not been a willing actor in this process, the 'demand' for liberalization would have found alternative channels, through national legislation. The resulting liberalization drive might have been weaker than under current EU prompting because of the reduced benefits and the arguably weaker political sustainability of reforms when undertaken in an isolated fashion, but it might still have happened.

2.3.2. Identifying how advances in telecoms affect the behaviour of economic agents

This step requires identifying how direct usage of telecoms affects the economic activities of individual agents (as producers, consumers or policy makers) at the microeconomic or behavioural level. While recent academic literature contains many innovative ideas in this area, there is no established model that is both concrete and complete. Many links have been suggested between the usage of telecoms and various economic activities, some of which are illustrated in Figure 2.5. These links appear plausible both from common sense and from detailed measurement of benefits through either direct calculation or revealed preference, for example, NERA [1990], Hansen et al. [1990], Cronin et al. [1993a, 1993b, 1994], Cohen

[1992].[7] However, no model exists which accounts for all links between telecoms and all economic agents.

Figure 2.5. Firm-level effects of telecoms liberalization



Source: Analysys.

The economic benefits of telecoms relate to the expansion of each agent's information set as regards markets, technologies, and product or service quality. Telecoms helps expand each agent's information set by broadening its geographical reach when searching for information, and by allowing it to get information on a more timely basis. Each agent will utilize the broader and quicker access to information made possible by liberalization of telecoms in different ways, some of which are discussed below.

Producers

Producers can expect to incorporate information in how they make their products (supply side) and in how they sell them (demand side).

(a) On the production side, firms might boost efficiency through more intensive usage of certain inputs, cheaper procurement of inputs or by updating appropriately their technology and internal processes. DIW [1984] points to the direct cost reductions achievable from the substitution of telecoms for other factor inputs, as well as indirect cost reductions when telecoms enables a more fundamental change in production patterns. Leff [1984] and Röller and Waverman [1994] argue that advances in telecoms generate cost-saving externalities that improve the functioning of product and factor markets. In particular, they emphasize the reduction in transaction costs associated with gathering and analysing information on products and services.

(b) On the demand side, producers might be in a better position to access formerly inaccessible markets whose market potential and risks could not be previously assessed properly. Improved communications systems might also permit the introduction of new

[7] Chapter 5 provides qualitative illustrations of how these links operate at the sectoral level; see also NERA [1990].

or improved products, especially in service activities that require access to databases or real-time customer service (e.g. financial sector, entertainment, travel planning). Other firms might use newly accessible market intelligence to expand margins through product differentiation and customization strategies.

Appropriate use of information may also enable exploitation of dormant economies of scope (in production or marketing), as information derived in one process (such as selling one product) is transferred to the benefit of another process (such as marketing a new or related product). At the same time, the geographical expansion of markets, made possible by access to information, might serve to limit the degree to which information can be exploited to achieve market dominance, using such emerging economies of scope or scale. This combination of improved economies of scope combined with limitations on the degree to which these confer dominance, would imply a consolidation of some industries, resulting in efficiency benefits but without a parallel increase in market power, to the benefit of the overall economy.

Improved advanced communications affect corporate management functions and organization at many levels. Eliasson [1994] points out that most of what is generally referred to as technical change is really composed of changes in the technology of economic information processing, which in turn originates innovative organizational change.[8] Improved decision making should follow from an enhanced ability to track developments internally in the company and externally in the market. Advanced communications also open up possibilities for corporate flexibility in terms of the structure, workflow, degree of decentralization and even location of the various business units. As a result there will be more efficient market entry and, in particular, exit decisions, allowing a nimbler redeployment of resources in the economy in response to changing economic circumstances. DIW [1984] stresses the role of information in enhancing 'entrepreneurial experimentation'.

Consumers and intermediaries

The economic benefits of information go far beyond these direct gains to producers. By using new and improved communications and information services, consumers will be in a better position to assess value and to distribute their expenditures accordingly – and such decision making is of crucial importance to the working of an efficient economy.

Individuals' decisions on work versus leisure may also be affected, both as a result of new time-saving products and services, and because of changes in work habits and patterns that are made possible by telecoms. DIW [1984] points out that communications can affect the distribution of population and structure of communities, which can have very important economic implications. Moreover, cheaper and more widespread access to communications could enhance accessibility to, and the effectiveness of, education, thereby fundamentally affecting individuals' opportunities in the economy.

A similar argument applies to intermediaries in the economy. For example, the efficiency of financial intermediation can be expected to increase with cheaper and better channels for transfer and diffusion of information as intermediaries become more able to assess, and hence

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[8] See Section 2.1 above for a discussion of the interaction between technology and short- and long-term changes in economic structure.

price, risk. Reducing intermediaries' vulnerability to information asymmetries should result in a wider accessibility to credit – particularly to small- and medium-scale enterprises – and the development of improved market-based financial instruments. As markets for risk broaden and deepen, capital costs might fall for particular firms (as it becomes easier for them to establish credibility in the capital markets) and in the aggregate (if the economy is in a better position to reallocate systemic risk to those in the best position to assume it).

Policy makers

The benefits from dissemination of information are not only enjoyed by producers, consumers and intermediaries. Policy makers can and should be expected to evaluate, calibrate and time their policies better on the basis of sounder cost-benefit analyses. At an even more basic level, access to information could conceivably increase enforcement of property rights, speed up judicial procedures, and reduce the inefficiencies of the tax system. These constitute generic but important elements of the general business and social environment.

To sum up, cheaper and better access to information can translate into a more efficient co-ordination of demand and supply, an increase in efficiency of arbitrage, greater economic discipline and greater rationality of the expectations formation process. Potential benefits include greater stability of asset values as expectations become less fickle and information is more evenly distributed. Information dissemination can play a role in smoothing out business cycles and result in a more efficient and beneficial economic environment. It is clear that the availability of more efficient mechanisms for dissemination of information can have indirect effects that go far beyond the cost savings reaped by producers.

2.3.3. Quantifying the microeconomic benefits of advances in telecoms

The previous section illustrated the many ways in which an economy that utilizes available information more fully might become more efficient. The overall economic benefits would be the cumulative gain from the elimination or reduction of a plethora of losses generated by higher transactions costs, ill-informed decisions and weak market discipline. Estimating such benefits requires two critical steps: quantification and aggregation.

Quantification is difficult because of the intangibility of many of the ideas expressed above. This intangibility is because we do not have a conceptual classification or measurement system which allows us to identify specific elements.

At a basic level, information-based processes appear to be intangible because 'much of it occurs within the heads of individuals' (Eliasson [1994]). However, this kind of intangibility is shared by most economic processes, including all consumer spending decisions and most corporate pricing decisions, and it would be a mistake to believe that these effects are intangible as a result of a lack of appropriate data. Any economist would be hard pressed to come up with a 'wish list' of data that is observable in principle which could clarify all these processes, whether information-based or not.

The problem is that one cannot collect data meaningfully in the absence of a conceptual classification or measurement system. Indeed, the intangibility of the microeconomic effects of information reflects the failure of translating existing theoretical ideas into empirically-relevant constructs. Without a proper representational model of the kind described in Figure 2.3, we cannot turn historical data into 'experiments' that might reveal the nature of

interactions in the system. In analogous fashion, it is not possible to understand how price and quantity data are interrelated without a demand-supply construct. Paradoxically, tangibility is gained through abstraction.

This position is shared by Brynjolfsson [1993] who cogently argues that the 'productivity paradox' (the shortfall in productivity from what would be expected with higher telecoms or IT spending) stems largely from researchers' 'deficiencies in the measurement and methodological toolkit'. He argues that the increased difficulty in tracking the microeconomics of service sectors is due to their 'idiosyncracies' – but that idiosyncracy is, of course, relative to the prevailing observation systems.

A full representational model should capture how information is traded (communicated) and how its quality is assessed; how sources of information are created, searched for and exploited; and what the dynamics of dissemination of information and technology are. More importantly, it needs to define the role of information in economic processes, such as whether information is intrinsically a 'good', or whether it is merely an attribute that other 'goods' have to varying degrees (e.g. stemming from their randomness, uniqueness or innovativeness).

2.3.4. Mapping microeconomic benefits into macroeconomic variables

However, even if we assume that the micro-quantification problem is tractable, we are still faced with the task of aggregating the microeconomic effects into quantities that are meaningful and material at a macroeconomic level. Aggregation would be trivial if the whole was equal to the sum of the parts – aggregation would then be merely a process of summation. Unfortunately, such a procedure would ignore externalities and substitution effects induced by relative price changes. These two effects are described thus:

(a) Advances in communications are believed to generate numerous externalities. Consumption externalities arise because the value of network services depends on the number of other potential or actual users. Access to information also has some 'public good' characteristics to the extent that the availability of information for one user increases its availability to all. The presence of these externalities means that the social benefits are more than the sum of private benefits (or, correspondingly, social costs are less than the sum of private costs).

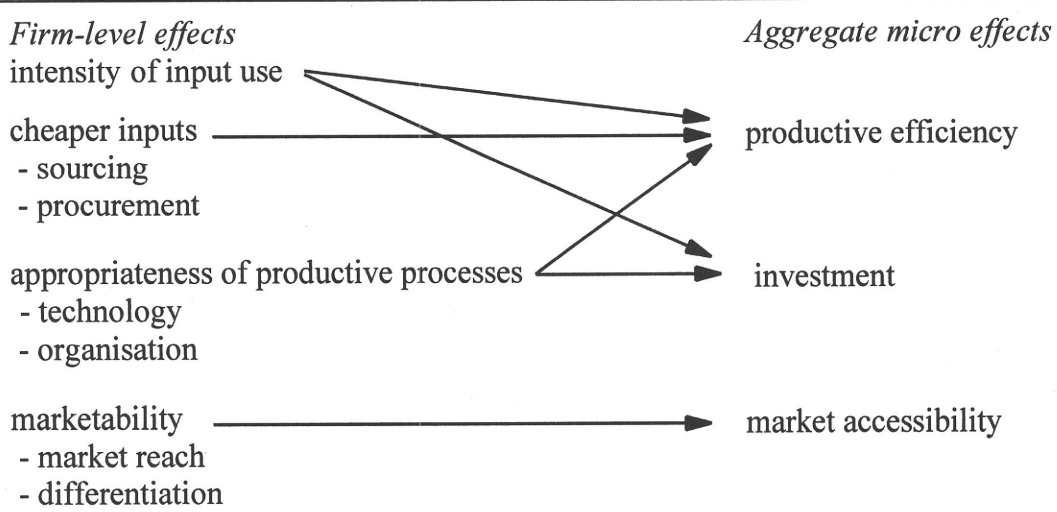
(b) Substitution effects arise because markets for different goods do not operate in isolation. Changes in production and consumption patterns induced by information innovations put pressure on some resources and liberate others. In a fully competitive environment, this should feed through the price system into a reallocation of resources so that they are all fully utilized. In an imperfectly competitive environment, this process of resource re-allocation is even more complex as it is the result of interactions (which are the subject of game theory). In either case, aggregation by summation ignores relative price changes that might be brought about precisely by the effects that one is trying to capture.

In other words, the macroeconomic effect of telecoms liberalization is not simply the sum of the benefits from savings or additional consumption calculated from partial equilibria in individual markets. The value of individual benefits or costs calculated through partial equilibrium analysis may be no guide to the final macroeconomic effect. Indeed, DIW [1984] suggests that productivity gains may be employment-reducing in a microeconomic framework (a particular industry), but employment-increasing in macroeconomic terms. Partial

equilibrium analyses may serve to illustrate the effects of telecoms in particular industries, but by definition cannot be relied upon to measure the macroeconomic effects.

Given the insurmountable problems of micro-level quantification and aggregation, the most common approach is notionally to map microeconomic effects into one or more macroeconomic variables acting as a proxy for 'things micro': see, for example, NERA [1990], Hansen et al. [1990], Cronin et al. [1993a, 1993b, 1994], Cohen [1992]. This process is illustrated in Figure 2.6. The most common such variables are productivity and international competitiveness. These variables capture – among other things – how efficient an organization generally is, and how efficient it is relative to its competitors. We consider each in turn.

Figure 2.6. Aggregate microeconomic effects of telecoms liberalization



Source: Analysys.

Productive efficiency – or, more specifically, total factor productivity – is defined as the change in final output per unit of combined labour, capital and material inputs. Thus it takes account of the joint effects of the various factors of production, including technological advances, economies of scale, changing composition of the labour force and changes in the organization of production. This very broad definition belies the fact that total factor productivity is typically calculated as a residual: that part of growth in output which cannot be explained simply by the expansion in the use of inputs. Since the value of information in production is not yet well captured theoretically in production functions, one would indeed expect to find it reflected in the total factor productivity residual. It is no surprise, then, that Cronin et al. [1993a, 1993b] can establish a Granger-causal relationship between telecoms infrastructure and productivity, or – more indirectly – that Aschauer [1989] can find a correlation between the level of investment in publicly owned infrastructure investment and productivity.

The inability to measure information-based inputs and outputs directly is behind what is commonly referred to as the 'productivity paradox' of service-based activities. This problem has been described in graphic terms: 'How to measure, and thus enhance, productivity in a

business where it's hard to tell selling from schmoozing, research from woolgathering and brainstorming from BS-ing?' (Davis [1993]).

Cohen's [1992] methodology illustrates the hurdles that need to be cleared to map micro-level data onto macro-level variables. First, he assesses firm-level gains in productivity attributable to advances in broadband communications, via interviews with corporate managers and articles in trade-related newspapers. Then he extrapolates these firm-level productivity gains to estimate the corresponding industry-level gains, using an input-output table for aggregation. Finally, he assesses the macroeconomic implications of industry-level gains in productivity by assuming that, for each percentage increase in productivity achieved by industries that were using broadband communications, national output would increase by 1% (a relationship which he claims is econometrically derived, and which represents a constant level of employment). Teknibank [1993] adopts a similar methodology but allows for a different relationship between industry-level productivity gains and national output by sector and by country.

The productivity gains described above will translate into greater international competitiveness of export products. Competitiveness will also improve as advanced communications permit exploitation of previously untapped foreign trading opportunities given the greater accessibility to foreign markets. Firm-level investments induced by cheaper and more accessible telecoms will also have macroeconomic effects through the Keynesian multiplier.

To sum up, in the same way as aggregation of micro-level effects (the bottom-up approach) can be misleading in macroeconomic terms as it ignores general equilibrium effects, these proxy macro variables (the top-down approach) have very weak microeconomic underpinnings. They can be informed by observation of firm-level or sectoral-level impacts, but for the reasons stated above cannot be derived rigorously. In view of this, the quantitative choices for these variables adopted in Chapter 6 are informed by the qualitative sectoral analyses of Chapter 5.

2.3.5. Forecasting macroeconomic outcomes

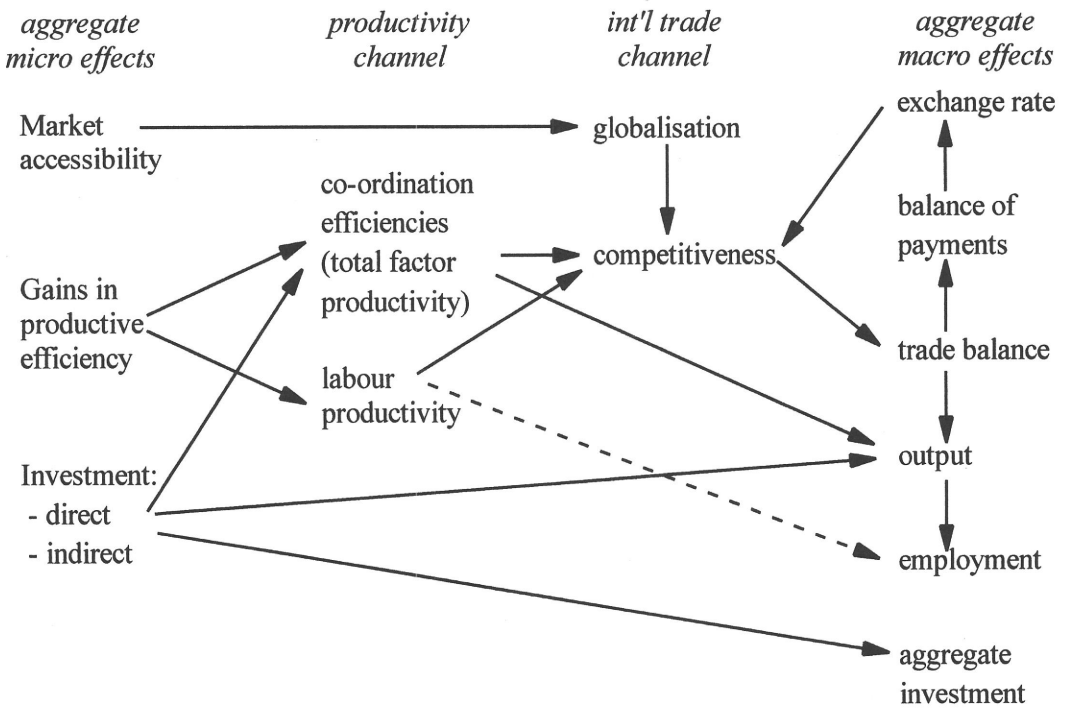
To understand the macroeconomic implications of changes in these proxy macro variables one needs to define a formal macroeconomic model. Proxy macro variables represent the instrument through which we can 'shock' the macro model to simulate macroeconomic outcomes.

Thus, the final step is to overlay a full macroeconomic forecasting model on the representation of the micro-level effects of telecoms liberalization. Figure 2.7 suggests how the proxy macro variables might interrelate with each other and with other macro variables to generate macroeconomic outcomes. The extent to which improvements in firm-level productivity result in economy-wide employment gains will depend on the nature of structural rigidities and the government's macroeconomic policy stance.

Unlike the other steps specified above, there are many more precedents of macro-economic forecasting models, although none are universally accepted. It is beyond the scope of this study to review the theoretical underpinnings and shortcomings of the gamut of macro forecasting models (see Appendix D). However, some general comments can be made.

Some macroeconomic models are criticized for not being explicitly derived from microeconomic first principles. However, in those cases where macro models have microeconomic foundations, information is treated in a rather crude fashion: these models tend to invoke the existence of a 'representative' agent, implicitly assuming that all agents have access to the same pool of information or, equivalently, that information is costless. Thus, strictly speaking, such models are fundamentally inconsistent with the informational benefits that we would be seeking to capture through them.

Figure 2.7. Macroeconomic effects of telecoms liberalization



Source: Analysys.

2.3.6. Conclusions

This section has argued that while one can think of many ways in which telecoms affects organizations, information markets and the wider economy, the quantification of the associated benefits is very difficult. This observation lies at the heart of the 'productivity paradox' literature, which is best encapsulated by a popular quote attributed to Robert Solow: 'You can find computers everywhere except in the productivity numbers'. The macro effects of increased computerization and communication still elude academic researchers.

The difficulty lies in the absence of a proper measurement system. In the terminology of Figure 2.3, established representational models still fail to translate generally accepted intellectual constructs into observable relationships and quantities. Our starting point is therefore the realization that the lack of an established measurement system prevents objective measurement. Accordingly, in the following sections we exploit our subjective knowledge and sectoral expertise to construct 'reasonable' scenarios. The rest of this report constitutes our best efforts at empiricism, despite the conceptual shortcomings described in this chapter.

3. Telecoms liberalization: processes and scenarios

3.1. The liberalization process

Historically, national governments have played a major role in shaping the structure of their country's telecoms industry, as governments have seen domestic and international telecoms services as being vital to both the economy and the security of a nation. As a result, telecoms services have traditionally been provided by a single, publicly accountable organization, which has either been an arm of government, or a corporation wholly owned by the state.

However, since the early 1980s, the digitalization of communications, coupled with rapid advances in computing technology, has changed the nature of telecoms and telecoms regulation. The existing state monopolies, hindered in part by public sector budgetary constraints, have been unable to take full advantage of these developments. Member States have realized that private capital and market forces can deliver the benefits of new telecoms technologies and services to users much more rapidly than publicly funded monopoly telecoms operators (TOs). Hence, Member States have collectively decided to move towards the liberalization of the supply of telecoms services and infrastructure. In order to bring about this transition from state-controlled monopoly to multiple private operators and service providers, the regulations governing the sector must be altered. Implementation of a liberalization policy has considerable implications for the telecoms sector and for the economy of each Member State and the EU as a whole, as illustrated in Figure 3.1.

This chapter discusses the process that has driven the development of this new regulatory framework, and the manner in which that framework will affect the telecoms sector. The process breaks down into four elements, shown in Figure 3.2 and discussed below:

(a) *process drivers:* the basic principles that lie behind a movement for change;
(b) *agreed policy:* the fundamental objectives that the process aims to achieve;
(c) *regulatory framework:* specific measures that are agreed by governments at EU level in order to achieve the policy objectives;
(d) *implementation:* the manner in which specific measures are enacted by those empowered to monitor and control the sector in the Member States.

3.1.1. Process drivers

The process of telecoms reform is underpinned by two factors: political will and technological advances. The political context for a telecoms policy leading to the liberalization of services and infrastructure is well established. Member States have for some time agreed that efficient and effective supply of telecoms networks and services are necessary to realize the benefits of the emerging information society for their citizens. As stated in the key policy document on this topic, the 1993 White Paper on *Growth, competitiveness and employment*, telecoms networks (and the services they deliver) are the 'lifeblood of competitiveness': they are the primary mechanism used to circulate information within the EU, information that is vital to organizations and individuals wishing to participate fully in the economic life of the EU.[9]

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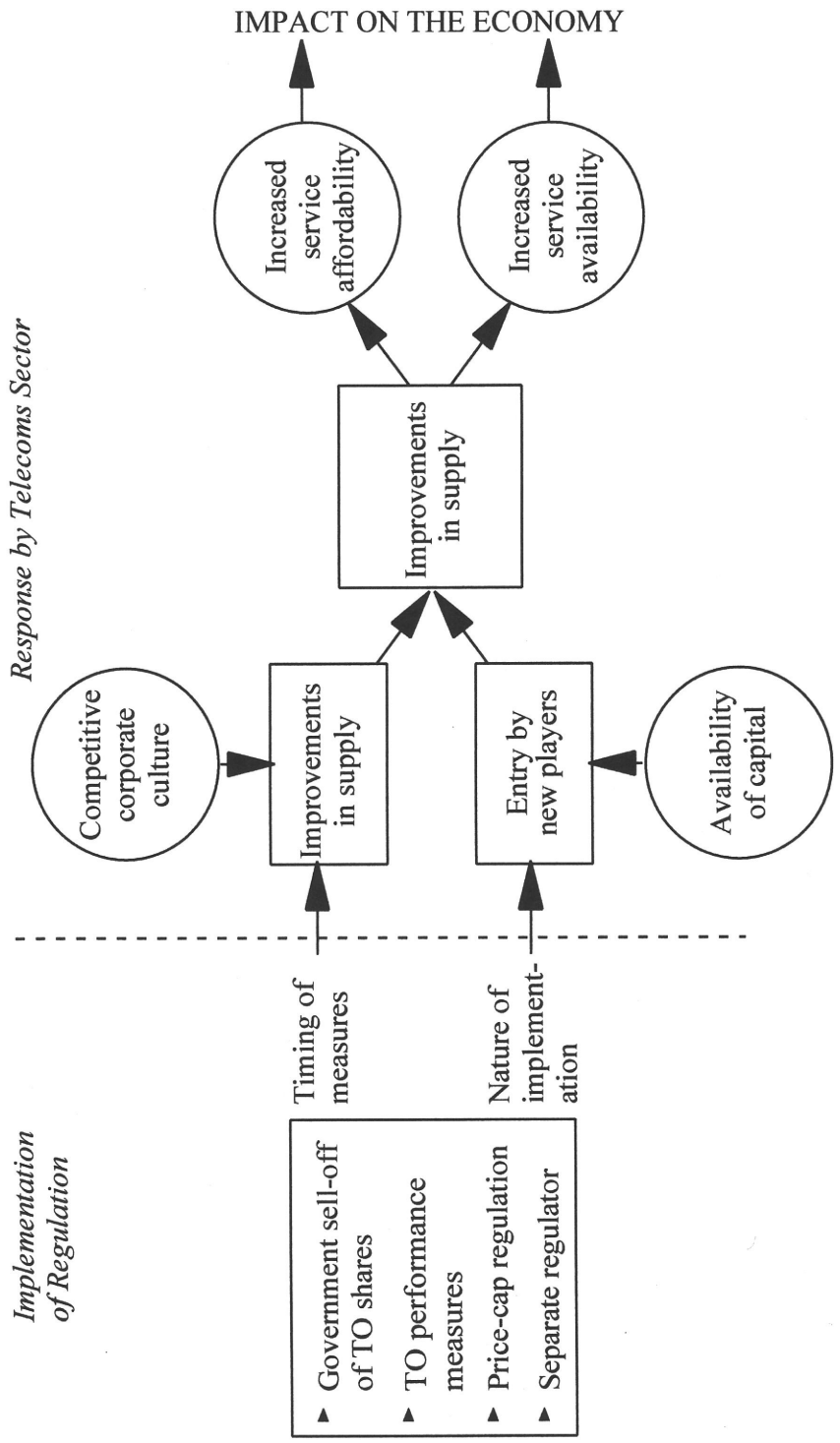
[9] White Paper on *Growth, competitiveness and employment – the challenges and ways forward into the 21st century*, COM(93) 700 final, 5 December 1993.

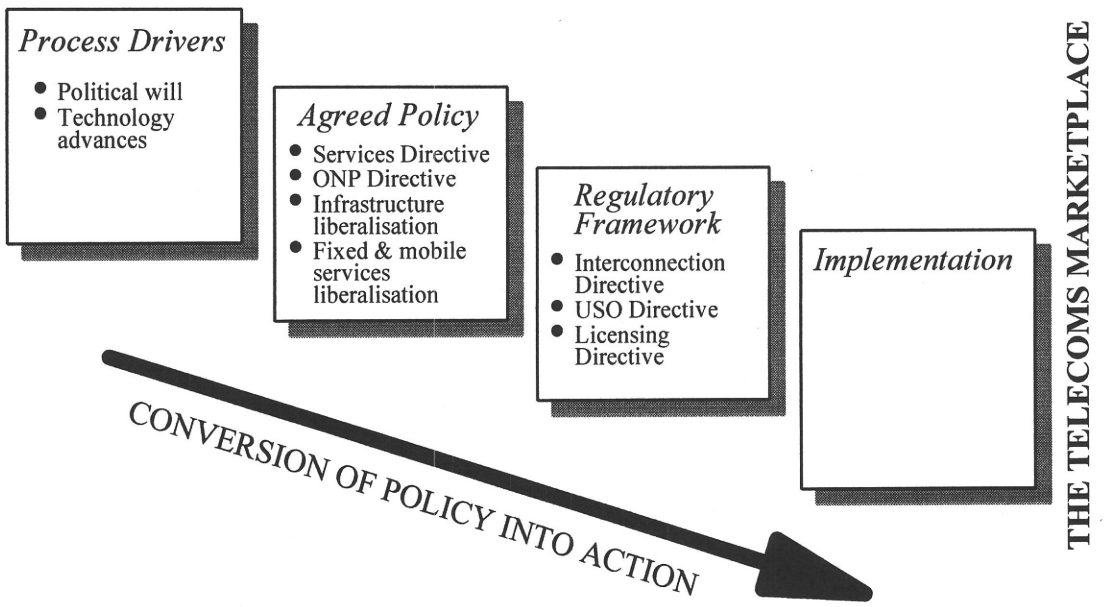
Figure 3.1. The impact of liberalization on telecoms supply, and the relationship between sector forces and the economy



Source: Analysys.

The realization by Member States that efficient and affordable telecoms networks and services are fundamental to economic prosperity, and that monopolistic organizations are ill-suited to delivering those services, has led to a growing belief that the structure of telecoms supply must change. Political will has generated a momentum for change that has now reached a point where the process of reform appears unstoppable.

Figure 3.2. The process of regulatory reform



Source: Analysys.

Advances in information and communications technology are also a key driver of change within the telecoms sector, not least because they have made the provision of infrastructure and services by alternative suppliers economically viable. Advances have included the digitization of communications, improvements in computing power, the development of cellular mobile communications systems and terminals, wireless radio access, and intelligent network (IN) architectures in fixed networks. These advances have allowed multiple network operators to establish alternative ways of meeting users' communications needs, and hence provide users with choice.

3.1.2. Agreed policy

The principles of market liberalization that were established in the Treaty of Rome, and which are at the heart of the EU, assume that allowing the operation of market forces is the best way of maximizing efficiency while ensuring a wide choice of service and operator within a specific sector. The EU Member States believe that these objectives can be best achieved through a policy of liberalization of services and infrastructure in all sectors of the economy. This policy will also contribute towards the success of the Member States' stated goal of maximizing participation by their citizens in the information society. Telecoms policy can make a key contribution to this goal by:

(a) expanding the availability of the means of access to the information society;
(b) increasing the affordability, functionality and accessibility of such access.

Maximizing the affordability of access will be achieved by ensuring that the industry supplies services to users in the most efficient manner at the lowest possible cost. Improved functionality will result from suppliers responding to users' needs and realizing the opportunities for new services brought about by technological change. Easier accessibility to the information society will be achieved by ensuring that a comprehensive service portfolio is offered across as wide a geographical and economic spectrum within the EU as is practical.

Since the mid-1980s, there has been a process of developing a common policy framework that will liberalize telecoms within the EU and realize the potential benefits to the economy and society. The European Commission (EC) proposed the first elements of that framework in 1984,[10] and followed this with the Green Paper in 1987[11] and the first use of a directive under Article 90 in 1988.[12] Two major components were the Commission's 1990 Services Directive which liberalized all non-reserved services, and the Council Directive on Open Network Provision (ONP) adopted at the same time.[13] The ONP Directive laid down a set of principles for fair, non-discriminatory and harmonized access to the dominant TO's network. Those principles specified that a standard set of conditions for usage and supply should be adopted, that tariffs for services be cost-oriented and unbundled, and that harmonized technical standards for services be agreed across the EU. The Services Directive was reviewed in 1993 and this review formed the basis of the Council Resolutions setting out the initial framework for further liberalization.[14]

In 1994, the Bangemann Group of experts was asked by the European Council to consider specific measures that the EU should take to encourage the development of infrastructures and promote the information society. In its report, the group stated that telecoms networks are vital in enabling the development of the information age and in realizing its benefits for both the economy and society.[15] It advocated rapid liberalization of telecoms infrastructure and services in order to achieve a single integrated information market. Subsequently, a Council Resolution of 22 December 1994 set out agreement on the liberalization of telecoms infrastructure, and set a deadline of 1 January 1998 for implementation of these measures (with derogations for some Member States).[16] Other measures under discussion or recently agreed include liberalization of alternative networks prior to 1998; liberalization of cable TV networks for the supply of telecoms services, and the liberalization of mobile services and infrastructure;[17] guidelines for the development of Euro-ISDN as a trans-European network;[18]

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10 'Council Recommendation concerning the implementation of harmonization in the field of telecommunications', 84/549/EEC (12 November 1984), OJ L 298, 16.11.1984, p. 49.

11 'Towards a dynamic European economy – Green Paper on the development of the common market for telecommunications services and equipment', COM(87) 290 final (30 June 1987).

12 'On competition in the markets for telecommunications terminal equipment', 88/301/EEC (16 May 1988), OJ L 131, 27.5.1988, p. 73.

13 'On competition in the markets for telecommunications services', 90/388/EEC (28 June 1990), OJ L 192, 24.7.1990, p. 10. 'On the establishment of the internal market for telecommunications services through the implementation of open network provision', 90/387/EEC (28 June 1990), OJ L 192, 24.7.1990, p. 1.

14 'Council Resolution on the review of the situation in the telecommunications sector and the need for further development in that market', 93/C 213/01 (16 June 1993). 'Council Resolution on the principles and timetable for the liberalization of telecommunications infrastructures', 94/C 379/03 (22 December 1994).

15 'Europe and the global information society – recommendations to the European Council', Members of the High Level Group on the information society, Luxembourg, Office for Official Publications of the EC, 1994.
See http://www.ispo.cec.be:81/infosoc/backg/bangeman.html

16 'Council Resolution on the principles and timetable for the liberalization of telecommunications infrastructure', 94/C 379/03 (22 December 1994).

17 'Directive 95/51/EC amending Directive 90/388/EEC with regard to the abolition of the restrictions on the use of cable television networks for the provision of already liberalized telecommunications services', (18 October 1995), OJ L 256, 26.10.1995, p. 49. Directive 96/2/EC of 16 January 1996 amending Directive 90/388/EEC with regard to mobile and personal communications, OJ L 20, 26.1.1996, p. 59.

18 'Guidelines for the development of Euro-ISDN as a trans-European network', 2717/95/EC; OJ L 282, 24.11.1995, p. 16.

a proposal for a European Parliament and Council decision on a series of guidelines for trans-European telecommunications networks; and a methodology for the implementation of information society applications.[19]

Ideally, this market environment will be managed by *ex post* application of the Treaty of Rome competition rules, as implemented by the European Commission's Directorate-General for Competition (DG IV), together with national competition authorities. *Ex ante* provisions would be kept to a minimum, aimed at satisfying certain public service objectives (e.g. securing universal service). However, at present and for the foreseeable future, significant distortion of the market is occurring as a result of the power of incumbent TOs. Even in those Member States where competition has already been introduced, such as the UK, the former monopoly operator still has a dominant position in the marketplace: it controls the majority of customer accesses, has vast amounts of market information at its disposal, and is by far the best-known 'brand' in the sector. If left unchecked, this monopoly power could be used to control physical access to customers by new competitors, and to manipulate prices to the detriment of the competition.

In order to move on from this situation, there is a need to establish an *ex ante* regulatory framework which will reduce the risk that existing players may use their strength either to discourage market entry by new operators and service providers, or to force players out of the market. It is also recognized by regulators, operators, and potential investors that there is scope for significant improvement in the performance of incumbent TOs, and that there are measures that can be put in place by national regulatory authorities (NRAs) to encourage such improvements. Such measures include the implementation of caps on the tariffs charged by operators for services, to encourage the rebalancing of tariffs in line with costs. NRAs can also impose specific performance targets on, for example, the maximum time to install a line from time of order, or the maximum time before a fault is repaired. Given the dominant position of each incumbent in its market, and the likelihood that this will continue to be the case for some years, measures to encourage better TO performance are likely to have a greater impact on the sector as a whole in the short term than those encouraging new entrants.

At the same time as allowing free competition in the delivery of services, it is important to ensure that all citizens of the EU have access to a basic telecoms service at an affordable and non-discriminatory rate. This is necessary in order to avoid those who are less able to pay for service becoming 'disenfranchised' in the information society. Maintaining the delivery of universal service in a post-liberalization era is therefore an essential part of the policy.

The local loop is the primary bottleneck in telecoms: the constraint on bandwidth represented by twisted copper pair local loop is significant and expensive to remedy. The key question is whether liberalization will allow the flow of investment to be directed at relieving the local loop bottleneck on a market-driven basis or whether a regulatory (industrial policy) approach is required. Means of achieving this that are implicit within the sectoral evolution alternatives identified in this study include:

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19 'Towards the information society: communication from the Commission to the Council, the European Parliament, the Economic and Social Committee, and the Committee of the Regions for the implementation of information society applications. A proposal for a European Parliament and Council Decision on a series of guidelines for trans-European telecommunications networks (presented by the Commission)', COM(95) 224 final, 31 May 1995.

(a) the use of effective market segmentation to identify and provide for customers who require expanded local loop capacity and functionality;
(b) the use of new technologies with lower fixed costs to address the local loop bottleneck (fixed radio, cellular, DECT, ADSL, cable modems, etc.);
(c) the development of industry standards that allow sophisticated interaction between operators (SS7 and more advanced technologies such as ATM and SDH);
(d) ensuring that operators have access to each other's networks on cost-based non-discriminatory terms (interconnection under the framework of ONP).

The extent to which government action is required to instigate or support each of these alternatives is a basic policy choice.

3.1.3. Regulatory framework

The regulatory framework proposed by the EC and agreed by Member States addresses the above issues. Building on the principles of ONP, the framework consists of three major elements: network interconnection, universal service, and licensing and price control, and contains specific measures that are agreed by government in order to achieve the policy objectives.

Network interconnection

Network interconnection is the means by which providers of alternative infrastructures can access the public network and each other's networks. The conditions under which interconnection is provided are crucial to the economic viability of these businesses. A draft directive on interconnection has been produced by the EC.[20] It is structured on the premise that the NRAs will be largely responsible for its implementation. It includes an outline of the general responsibilities of NRAs and basic principles for regulating universal service provision, charging and cost accounting, numbering, and technical standards. However, in a number of areas (notably universal service, charging structures, and dispute resolution) the discussion of these principles leaves significant scope for interpretation by the NRAs.

Universal service

As described above, continued provision of universal service is a key policy objective. However, liberalization and the privatization of national operators require new approaches to universal service. The approach evolving in the EU is set out in a 1996 EC Communication.[21] The Communication builds on progress made during the Infrastructure Green Paper[22] consultation on the issues of scope, costing and financing of universal service, and subsequently in the proposed Interconnection Directive, thus reflecting the fundamental importance placed on the delivery and development of universal service within the EU.

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20 'Proposal for a European Parliament and Council Directive on interconnection in telecommunications with regard to ensuring universal service and interoperability through application of the principles of Open Network Provision', COM(95) 379 final, 19 July 1995.

21 'Communication to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions on universal service for telecommunications in the perspective of a fully liberalized environment' COM(96) 73 final, 13 March 1996.

22 'Green Paper on the liberalization of telecommunications infrastructure and cable television networks': Part I: Principle and timetable, COM(94) 440 final, 25 October 1994; Part II: A common approach to the provision of infrastructure for telecommunications in the European Union, COM(94) 682 final, 25 January 1995.

Licensing

A draft directive on licensing has recently been published.[23] This goes some way towards ensuring harmonization of licences across Member States, but at the same time suggests that NRAs should retain their responsibility for issuing licences. It proposes the adoption of strict guidelines to prevent NRAs from favouring domestic operators, and to ensure that licensing procedures are open, transparent and non-discriminatory. Limits on the number of licences to be issued will be prohibited, except where there are constraints on the radio spectrum.

Price control

The process of rebalancing tariffs has begun in most Member States. Determining the correct level of rebalanced prices requires the establishment of adequate cost-accounting systems, which will include accounting separation, a measure which is not yet fully implemented in all Member States (see Table 3.1). In state-owned monopoly TOs, prices have traditionally been set by ministerial decree. However, with government ownership weakening and with the introduction of competition, more and more Member States are following the practice, first used in the UK, of price capping. Price capping is increasingly being favoured over rate-of-return regulation as the best way of delivering price reductions and tariff rebalancing, and encouraging improved economic performance and competition. Germany, Italy and Spain have all announced their intentions to move to a price-cap regime in the foreseeable future.

Table 3.1. Summary of price regulation in the Member States

Country	Accounting separation	Fixed services	Leased lines	Mobile
Austria	No	Ministerial decree	Ministerial decree	Ministerial decree
Belgium	Yes	Price cap	Price cap	Price cap
Denmark	Yes	Price cap	Price cap	Price cap
Finland	Yes	Market share capped	Market share capped	Market share capped
France	Yes	Price cap	Price cap	Price cap
Germany	Yes	Ministerial decree	Ministerial decree	No price controls[1]
Greece	No	Price cap	Not known	Price cap
Ireland	No	Ministerial decree	Ministerial decree	Ministerial decree
Italy	No	Ministerial decree	Ministerial decree	Ministerial decree
Luxembourg	No	Ministerial decree	Ministerial decree	Ministerial decree
Netherlands	Yes	Price cap	Price cap	Price cap
Portugal	No	Price cap	Price cap	No price controls
Spain	Yes	Ministerial decree	Ministerial decree	Ministerial decree
Sweden	Yes	Price cap	No price controls	No price controls
UK (BT)	Yes	Price cap	Price cap	No price controls

[1] However, interconnection between fixed and mobile operators is price-capped.
Source: Analysys.

Despite their early stage of development, the intention of these measures is clear. New entrants will be encouraged into the market in order to foster competition and thereby deliver a telecoms sector that is responsive to the needs of consumers.

23 'Proposal for a European Parliament and Council Directive on a common framework for general authorizations and invidual licences in the field of telecommunications services', COM(95) 545 final, 14 November 1995.

3.1.4. Implementation

The manner and speed of implementation of the above framework will determine the rate at which competition can develop.

(a) A regulatory environment that is rapidly established, perceptibly fair to market entrants and meets the aims of EU telecoms policy will create a climate of relative stability. New entrants will be able to plan business ventures with confidence and enter the market quickly, and so potential benefits to the economy will be realized rapidly. The incumbent will readily respond to measures implemented to encourage improvement in its own performance, since it will recognize that its future success depends on its ability to compete effectively in the open market.
(b) Conversely, a perception that an NRA is procrastinating in its implementation of the framework, biasing its decisions in favour of the incumbent, or is inconsistent and confused in its implementation of policy, will lead new entrants to scale down or delay their entry into the market. It will also encourage the incumbent to delay the implementation of internal performance improvement measures. Clearly, if this happens, the benefits of competition will not be realized.

The implementation of regulation in Member States will be the responsibility of NRAs, in accordance with the principle of subsidiarity. To that end, the proposed Interconnection Directive lays down general responsibilities of NRAs, and specific guidelines on how certain aspects of the directive should be implemented. These guidelines leave significant scope for the basic principles of a competitive telecoms sector to be adapted to reflect the situation in each Member State. Although development of these principles is still at an early stage, subsidiarity may result in significant variations between Member States in their application of directives. Variation between Member States in their application of EU directives can occur in two ways:

(a) the timing of their implementation of directives;
(b) the nature of that implementation.

Timing

Many Member States have already made considerable progress towards liberalizing their national telecoms market, for example by establishing an NRA which is separate from the incumbent operator and removed from politics, privatizing the national operator, and implementing a regime to ensure that interconnection between operators and service providers is established on fair and reasonable terms. Some Member States (Finland, Sweden and the UK) impose no regulatory restrictions on market entry, other than meeting pre-defined licence conditions. In contrast, a number of other Member States have only recently embarked on the liberalization process, and it is far from clear when – and how quickly – some Member States will start to implement the directives.

The EC is considering legal action against Germany, Italy, and Spain over their failure to implement various agreed measures from the 1990 Services Directive. Legal action has already been taken by the EC against Greece for failing to appoint an independent telecoms regulator as required by EU law. The reasons for such failures are manifold, but these examples clearly illustrate how practical implementation of agreed measures can be delayed.

Nature of implementation

How policy is implemented in individual Member States is determined in large part by the attitude and commitment of the NRA and its degree of independence from the political environment. This in turn is a function of the commitment of the Member State government and of individuals within the NRA to market liberalization. The stronger the commitment by government and individuals to liberalization measures, and the higher the level of stability in the regulatory environment, the more attractive a national market will appear to operators and investors. National implementation can also vary in terms of the balance of *ex ante* versus *ex post* regulation, the balance of fixed rules versus regulatory discretion, and the extent of judicial or administrative oversight over the NRA.

Variations in the nature of implementation have an EU-wide impact: national variations reduce opportunities for cross-border revenue generation, economies of scale and scope in service implementation. For example, it is only with the recent implementation of the Euro-ISDN standard across Member States that the full potential of ISDN is beginning to be realized. As a direct result of the service being available across national borders, ISDN connections and traffic increased dramatically in the 12 months to September 1995 (six-fold in some cases).

The current environment in Europe is far from being homogeneous or stable. Investment decisions must therefore be considered and justified on a country-by-country basis, rather than across the EU as a whole. This runs counter to the objective of creating a stable, broadly homogeneous, competitive environment that encourages investment.

3.2. The liberalization scenarios

3.2.1. The scenarios

In the process of reform on which the EU has embarked, it is the timing and the nature of implementation of measures to improve TO performance and encourage entry of new players that are most important in achieving the policy objectives that Member States seek. Three regulatory scenarios for 1995 to 2005 were defined in order to illustrate how differences in the rate and nature of liberalization affected key indicators in the EU telecoms sector (as discussed in Chapter 4) and the wider economy (discussed in Chapters 5 and 6).

Scenario 1: the rapid scenario

The basic premise of the rapid scenario is that there is a swift and uniform implementation of the pro-competitive liberalization framework proposed by the EC, with some Member States seeking to introduce liberalization in advance of the 1998 deadline. The scenario is founded on an optimistic view about how rapidly measures can be translated into practical action, and about the effectiveness of implementation. It takes full account of variations in the starting positions of each Member State, but assumes that Member States move rapidly to create a stable and pro-competitive environment for investors, that investment opportunities are many and varied, and that the incumbent TO can also benefit from these opportunities.

Under this scenario, the incumbent responds swiftly to measures designed to encourage performance improvements, motivated by competition or the threat of competition in a fully liberalized environment. Some form of network and service separation takes place as the incumbent seeks to minimize the effect of telecoms regulation on its business. New operators

are granted licences without delay and with the minimum of procedure and protocol. In most cases, new operator licences are granted in 1996 to allow new entrants ample time to prepare for competition. Spectrum licences are made available to multiple players by the end of 1998, significantly enhancing the competitive environment for delivery of a cellular service. Disputes concerning interconnect arrangements and access rights are addressed speedily by authoritative and independent NRAs.

Figure 3.3 illustrates the key role that telecoms regulators will play in the development of the marketplace under the rapid scenario, and how the role of telecoms regulation is likely to change. Until 2001, regulators will act as proxies for market forces, after which there will be an increased reliance on general competition policy rules (in particular for telecoms services) rather than telecoms-specific regulation.

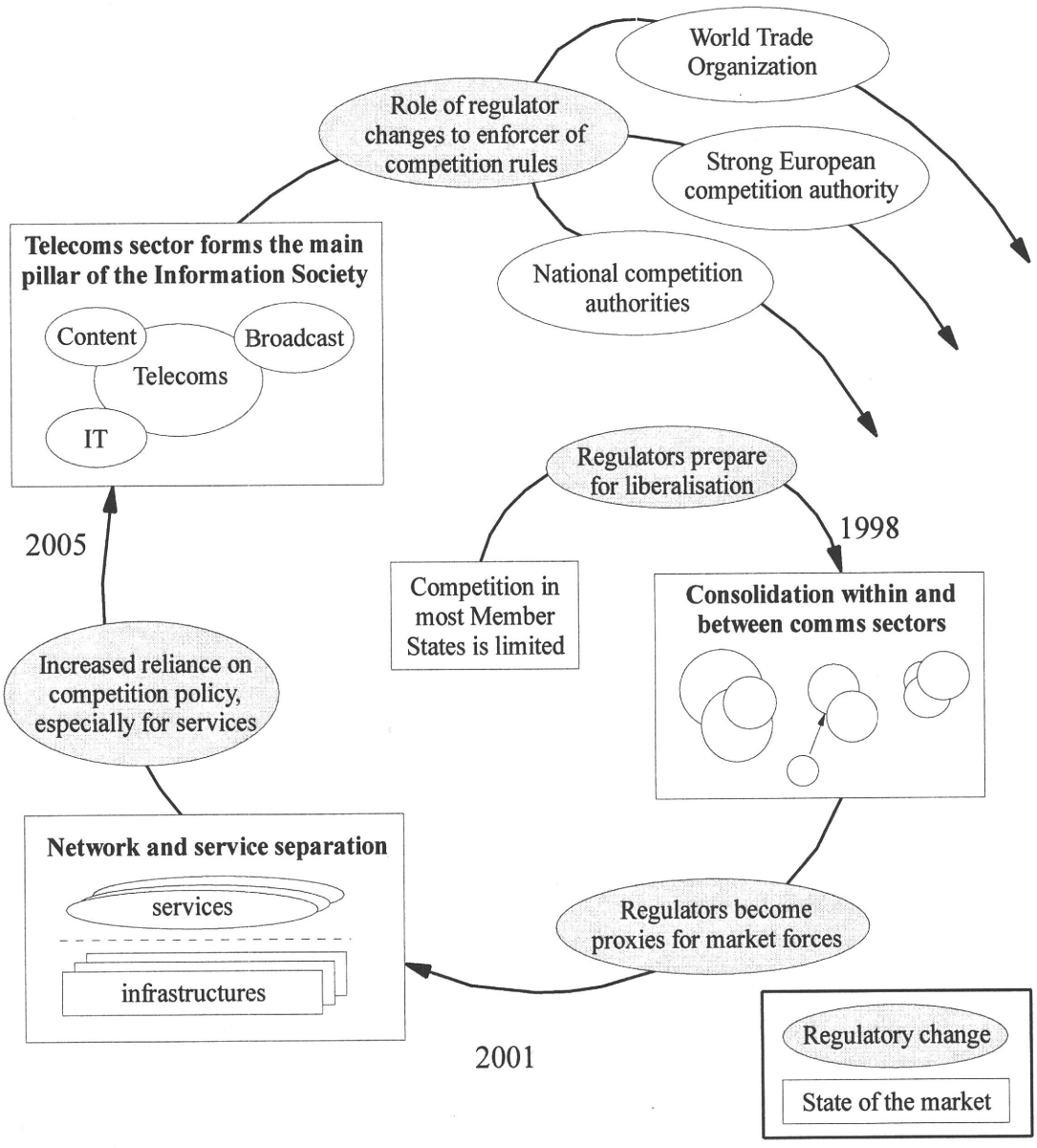
There is a rapid convergence in the nature of regulatory environments in individual Member States, which produces a relatively homogeneous operational structure across the EU. This leads to a strong role for the EC in ensuring regulatory co-operation across the EU; the role of the EU Telecoms Committee (EUTC) is extended beyond dealing with problems resulting from divergent licensing regimes, to a mandate to co-ordinate wider telecoms policy matters. Co-operation between ECTRA (European Committee of Telecoms Regulatory Authorities) and the EC is strengthened significantly. Trans-European networks will develop as operators form alliances and move into one another's traditional territory. This scenario will see a considerable reduction in the importance of national borders in telecoms within the EU.

Scenario 2: the unsynchronized scenario

The unsynchronized scenario assumes that implementation of liberalization measures will be slow, inconsistent, and pro-incumbent in a number of EU countries. Under this scenario, although all Member States agree in principle to the early adoption of legislative measures on liberalization within the EU, in many Member States practical implementation of such measures is delayed beyond the proposed timetable. NRAs are established and/or empowered only after extensive discussion over how measures should be transposed into national legislation, and as a result their effectiveness as proxies for competition is impaired. Programmes to privatize incumbent TOs stall, TO rationalization is implemented more slowly, incentives to improve performance diminish, and improvements in service delivery and support systems are delayed.

New operator licences are issued only after extensive debate on how to structure licensing procedures and supervise licensees. The financial and technological qualifications required of new entrants, and the processes they need to follow to obtain licences vary significantly from one Member State to another. Arguments over the exact terms of interconnection and access to key elements of incumbents' networks are resolved largely in favour of the incumbent operator. Differing interpretations of EU legislation cause significant variations in the environment in which new operators and service providers build their businesses, variations which continue into the next decade. This discourages new entrants from entering the market, and inhibits the development of pan-European operations.

Figure 3.3. The changing role of telecoms regulation (rapid scenario)



Source: Analysys.

In this scenario, Member States are moving towards liberalization at different rates, and telecoms policy is determined at national rather than EU level. The key issues of developing effective regulatory frameworks, promoting competition, implementing ownership strategies for incumbent TOs, pricing and tariff rebalancing, are implemented in some Member States, but receive little attention in others. The consequence is regulatory confusion and market fragmentation.

Scenario 3: the antimonde

Under the *antimonde*, there are no changes to the current regulatory situation anywhere in the EU. This has a negative effect on the marketplace since it means that plans to introduce regulatory changes are halted and investor confidence is undermined. In liberalized countries (Finland, Sweden and the UK), current intentions to open international telecoms to competition are shelved, and plans to license new local loop operators are put in doubt. In the other Member States, governments return to the traditional view of the telecoms sector as a public utility which requires state control over key decisions such as level of investment. Political concerns over potential lower levels of employment in the incumbent TO come to the forefront. Member States do not ensure there is a strong independent regulatory authority, and there is no application of competition rules in the telecoms sector beyond those which currently apply. Competition is discouraged across borders as TOs revert to protecting their domestic market in the absence of rules to open up markets. TOs which are not yet corporatized or privatized remain in state ownership, and the incentives for new entrants to set up operations are removed or at least diminished considerably.

3.2.2. The country groupings

We have categorized the Member States into five groups according to the progress they are making towards liberalization, and the likelihood of them opening their markets by 1998. Considering countries in groups illustrates the common effects of variations in liberalization of the EU telecoms sector, and hence on the economy as a whole. The categorization of Member States also provides some indication of the varying priorities for different Member States, although it cannot completely capture the differences that exist between countries in the same group. Each group is analysed below: the current state of liberalization and market development in each country is discussed for a range of services, and the implications and impact of the *antimonde*, the unsynchronized and the rapid scenarios, are considered in turn.

Group 1: proactive liberalization (Finland, Sweden, UK)

These are the countries that have already liberalized their telecoms sector to a large extent. Because of their early adoption of liberalization measures, these countries will have largely open markets even in the *antimonde* scenario. However, even in this group there is a significant difference in the application of telecoms regulation in each of the three scenarios.

A high level of competition is already permitted in these countries in fixed telephony. Finland removed restrictions on the competitive provision of infrastructure in 1994; competition is now also permitted in the provision of public voice telephony. Telecom Finland is allowed to compete against the 46 local telephone companies in the provision of telecoms services in urban and suburban areas. Similarly, the local telephone companies are allowed to provide long-distance service in Finland, these activities being co-ordinated through companies such as Telivo and Kaukoverkko.

Sweden has permitted competition in most basic networks and services since 1975, although until the early 1990s competition was very limited in practice, primarily because potential operators had to agree interconnection with Televerket (now Telia), which was also responsible for regulatory matters. Responsibility for regulation was removed from Telia in 1993.

The UK began to liberalize its telecoms market in 1981, though again it was not until the early 1990s that the effects of competition began to take hold. No area of telecoms activity remains reserved to a single operator: there is full competition both in national infrastructure provision and in basic, as well as value added, services, including the provision of voice telephony by cable TV operators. There are currently more than 150 operators licensed to provide voice telephony, including Mercury Communications, Kingston Communications, AT&T, Energis, MFS, Norweb, Ionica and COLT. However, the provision of international infrastructure is limited to a duopoly, BT and Mercury Communications.

A large proportion of the telephone subscribers in these countries currently have access to more than one service provider. However, under the *antimonde*, the impetus required to provide further competition does not develop. Regulators find it almost impossible to prevent the incumbent TOs from continuing to dominate both residential and business markets. Barriers remain in the path of telecoms companies seeking to enter these markets. In addition, plans to open international telecoms infrastructure to further competition in the UK are shelved, and international simple resale is limited to those countries that are currently permitted.

Under the unsynchronized scenario, regulators are under strong pressure from domestic players to prevent 'unfair' competition from new network operators or existing TOs in other (non-liberalized) countries. The incumbent TOs argue that the NRA should not regulate them too strictly as this would disadvantage them *vis-à-vis* their counterparts in non-liberalized countries. The regulator can restrict the rate of tariff rebalancing, slowing down the ability of TOs to implement cost-based pricing. The impact would be to inhibit investment activity in the Swedish market, for example, which is currently growing rapidly: witness the number of competing operators, including Tele2, France Telecom Network Services, Fonetel and BT. Interest could be stifled as investors worry whether they will be able to make an adequate return.

In addition, this scenario reduces the development potential of the international telecoms market. In the UK, BT and Mercury are successful in getting a delay in the removal of their duopoly on the provision of international infrastructure. The lack of strong competition in international infrastructure provision has the effect of encouraging the growth of international resellers, as players take advantage of arbitrage opportunities. International simple resale, however, is only allowed with countries that provide reciprocal treatment.

In contrast, under the rapid scenario, the last remaining barriers to full competition are removed. Facilities-based international service providers are licensed in the UK and also flourish in Finland and Sweden. The national regulator in each country focuses on the task of introducing genuine competition into the marketplace: in the UK this means licensing at least three national players of adequate financial strength to compete for telecoms subscribers nationwide. These players compete for global, national and local services; however, a number of other niche players are also licensed to provide services in these markets.

The incumbent operators face clearly targeted asymmetric regulation (price controls, accounting separation, banning of cross-subsidies and below-cost pricing), from strong independent regulatory authorities which have the overall objective of making them become more efficient service providers and more effective competitors internationally. This results in the commercial, if not structural, separation of network provision from service delivery. As

this becomes the industry norm, regulators could leave the telecoms service provision business – which has lower barriers to market entry – subject to general competition rules, and then focus their attention exclusively on the network business.

An increasingly important feature of modern telecoms is the growth of local telephony operators. In addition to metropolitan area network (MAN) operators and cable TV operators, wireless in the local loop has also become a viable commercial technology. Under the *antimonde*, the potential of these competing technologies to provide genuine competition (in particular for residential customers) is not exploited. Under the unsynchronized scenario, competition in the local loop is slow to develop for residential customers, mainly because the incumbent TOs still provide services to many residential customers at below-cost prices, due to the slow rate of tariff rebalancing. Competition takes off gradually, however, as cable TV operators and local loop wireless operators find cheaper means of delivering service to residential customers. In both the unsynchronized and rapid scenarios, there is strong competition in urban centres for the corporate telecoms market by MAN operators.

The different scenarios would also have an effect on ownership and establishment rules. Currently, BT is the only incumbent European TO wholly in private ownership, and the incumbent operators in both Finland and Sweden are 100% state-owned. Foreign ownership in Finland is currently restricted to 20% (although permission can be sought to purchase 40%); in Sweden and the UK there are no foreign ownership restrictions. Under the *antimonde*, neither of the Scandinavian countries would privatize their incumbent TO. However, Telia and Telecom Finland are privatized under both the unsynchronized scenario (around 2000) and the rapid scenario (in 1998). Since Telia and Telecom Finland will face strong competition under both these scenarios, the privatization process will be given impetus by the need to provide them with the tools to respond to this competition, in the shape of greater management flexibility, freedom from bureaucratic constraints and access to private capital. The speed with which these companies are given the means to attract private capital is a function of the level of competition; thus, there will be greater pressure on Telia and Telecom Finland to privatize under the rapid scenario.

Competition in the mobile cellular telephony market is well developed in all three countries, with four operators in the UK, three in Sweden and two in Finland. These countries have among the highest penetration of cellular subscribers and are experiencing high rates of growth. The rules for interconnect agreements have largely been agreed. In addition, there is clear evidence of foreign direct investment in Sweden (Millicom has a 20% stake in Comvik, while NordicTel is majority-owned by AirTouch International) and the UK (Mercury one2one is 50% owned by US West and Orange is majority-owned by Hutchison Telecom). Even the *antimonde* scenario, therefore, involves a high degree of competition. Both the unsynchronized and rapid scenarios involve respectively higher levels of competition, however, as more operating licences are awarded in the high bandwidth frequencies for the provision of PCS services. With regard to international service provision, the *antimonde* scenario means a delay in the setting up of roaming agreements with other countries.

Under the *antimonde*, the development of value added and multimedia services is delayed, largely as a result of the continued high tariffs for relevant services and the limited range of competitors in the local loop, as discussed above. Video-based services remain relatively poor quality and expensive. Growth of the Internet is frustrated by low access speeds which reduce service quality and increase costs of access. Under the unsynchronized scenario, the growth in

demand for advanced services is sustained by falling prices for traditional, mobile and ISDN services, and the growth of competition in the local loop, which increases the speed of access and brings down access prices. In the case of the rapid scenario, the proliferation of service providers and the growth in network capacity at relatively low prices fuels the use of multimedia services, especially those using video technologies. The separation of services and network provision provides an additional boost to the accessibility and affordability of value added and multimedia services.

Group 2: rapid progress towards liberalization (Belgium, Denmark, Germany)

Countries in this group are considered to be making rapid progress towards liberalization. Current activities within each market suggest that they will either implement liberalization measures ahead of the EU deadlines, or at least in good time to meet the EU deadlines. Group 2 countries are politically enthusiastic about the process of reform, and able to overcome rapidly any internal political hurdles to TO privatization or the entry of new players. Moreover, national regulators are relatively independent and assertive. Belgium is included in this category on the basis of two recent developments – privatization of the TO and the establishment of a second mobile operator. The Belgian regulator has shown itself to be adept and independent, particularly in the context of mobile competition.

Although attitudes to liberalization have become more positive in the past few years, in the fixed telephony market each country still has monopoly providers of both public voice telephony and infrastructure. Germany is moving inexorably towards effective competition. Resale of data services is permitted; Frankfurt City Council has awarded operator licences to two local access operators (MFS and COLT) to provide competitive data services for the city's financial community. Full liberalization is planned for 1 January 1998, and the current indications are that there will be few restrictions on the number of licences. A number of companies (for example, VEBACOM, CNI, VIAG INTERKOM and Thyssen) are positioning themselves to apply for TO licences. Given that this includes some of Germany's largest organizations, there are significant industrial forces behind the process of change.

Denmark has been slower than its Nordic neighbours to embrace competition but the accession of Sweden and Finland to the EU has spurred Denmark into more rapid action. Cable TV and other operators are allowed to offer voice telephony and other services on a local basis, although Tele Danmark still has a monopoly in national and international public voice telephony. However, Denmark is aiming for total liberalization of voice services and infrastructure by January 1997, one year ahead of the 1998 deadline. There have been suggestions that the Danish government may sell its 51% stake in Tele Danmark once liberalization has been completed.

The inclusion of Belgium in Group 2 is not immediately obvious – on past performance it could be argued that Belgium would be more appropriately placed in Group 3. However, there have been developments in Belgium in recent years that indicate that liberalization will proceed more quickly in the future. While Belgacom still has a monopoly in the provision of basic telecoms services, Telenet Vlaanderen is on course to compete with Belgacom in 1998, in both voice telephony and infrastructure throughout Belgium. There are also changes in the Belgian mobile sector: Mobistar, the second mobile telephony operator, was licensed in late 1995, and 25% of Belgacom Mobile has been sold to Airtouch, causing a separation of the mobile operator from the incumbent fixed operator.

The *antimonde* has a considerable negative effect on this market: for example, current plans by the German government to set up an independent telecoms regulator (the *Regulierungsrat*, which would work in parallel with the *Bundesministerium*) are shelved. The planned partial privatization of 20–25% of Deutsche Telekom through a DM 15 billion share issue in November 1996 did not go ahead, and network operator licences have not been awarded to its potential competitors (Mannesmann, RWE, Thyssen, VEBACOM, VIAG INTERKOM, CNI). MFS's and COLT's operations are limited to provision of data services and corporate voice. The picture is very similar in Belgium and Denmark, where plans to set up alternative players to compete with the incumbent TOs fail.

Under the unsynchronized scenario, there is a significant increase in the number of telephone subscribers with access to more than one fixed telecoms service provider. However, liberalization only becomes a reality in the course of 1998, because of legal challenges to regulations and less-than-wholehearted political support for the liberalization process. Effective regulatory powers relating to interconnect and licence agreements are delayed until well into 1999. The fact that the regulators do not have strong powers significantly limits their ability to license new operators quickly and to adjudicate effectively on interconnect disagreements. In addition, national governments retain significant control over the incumbent TOs, reducing their ability to increase operational efficiency. There is significant public disagreement on major policy issues (such as employment) between the CEOs of the Deutsche Telekom and Belgacom and their respective governments, undermining investor confidence. The market reacts negatively to the prospects for incumbent operators and so the sale of shares in Deutsche Telekom is delayed until closer to the end of the decade.

Under the rapid scenario, liberalization of voice services and infrastructure effectively begins in advance of the 1998 deadline, even in Belgium and Germany. National regulators are quickly given the power to establish frameworks for negotiating interconnect agreements and a fair and reasonable licence agreement. Price controls are agreed before 1997 in Germany. Governments successfully distance themselves from their respective incumbent TOs, selling off a majority stake in the operator, and the incumbent operators deal effectively with the issue of a high staff ratio through expansion and natural wastage. The regulator uses its independent powers to award licences promptly – before the end of 1996. This permits new market entrants enough time to prepare for competition well in advance of 1998. There will be some jostling for position as alliance groupings seek to gain the financial and operational strength to compete with the incumbent TOs, but this will be complete by 1998, and there will be strong competition on price in both the residential and business markets in all three countries. For example, in Denmark, France Telecom Network Services and Sonofon (the GSM operator) position themselves as effective voice and data service providers.

The number of local telephony operators that are encouraged to set up will be key to the degree of choice (and therefore real competition) available to telecoms customers in these countries. Under the *antimonde*, there is virtually no competition: in Denmark, local cable TV operators are currently only permitted to carry voice telephony locally and, in any case, Tele Danmark dominates the cable TV market, with about 45% of homes passed through its interests in the regional phone companies. Cable TV operators are not permitted to carry voice telephony in Belgium and Germany. Existing MAN operators and other potential market entrants significantly scale down investment in new networks. Under the unsynchronized scenario, a number of MAN operators are licensed and possibly some wireless operators. However, due to the fact that the cable TV sector is dominated by a single player,

competition at local level does not begin in earnest before the end of the decade. In the rapid scenario, clear commercial separation (though not ownership) of cable TV interests from the incumbent TOs is required by regulators. Cable TV operators awarded a telephony licence are required to implement a telephony service by 1999.

The effect of the different scenarios on ownership and establishment rules are also significant for these three countries. Foreign ownership in Belgacom is currently limited to less than 50%; there are no explicit foreign ownership restrictions in Denmark and Germany. In December 1995, Belgium sold 50% (less one share) of Belgacom to a consortium composed of Ameritech, Tele Danmark and Singapore Telecom. The Danish government owns 51% of equity in Tele Danmark, the remainder being held by private and institutional investors, following the second stage of privatization in 1994. Deutsche Telekom is 100% state-owned. Under the *antimonde*, all three TOs remain state-controlled beyond 2005. In the unsynchronized scenario, state control of incumbent TOs remains until the end of decade. In the rapid scenario, however, a political decision to place the TOs firmly in the private sector would indicate the sale of remaining shares in Belgacom and Tele Danmark by the end of 1998 and in Deutsche Telekom by the end of 2000.

Considerable competition is emerging in the mobile cellular telephony sector. There are currently two operators in Belgium and Denmark and three in Germany. However, the markets in each of these countries are at a critical stage in development, and the *antimonde* effectively removes any hope of growth in the mass residential market. In addition, prices for business users remain relatively high. Under the unsynchronized scenario, there is strong growth as existing operators compete with one another on price in order to gain market share. However, new mobile operators are not licensed until 1998. Under the rapid scenario, new operators are licensed in 1996 and the tax regime is tailored to ensure that it encourages growth. The increased competition results in lower tariffs which, combined with handset subsidies and intensive marketing campaigns, bring about growth rates similar to those currently being experienced in Sweden and Norway.

The development of value added and multimedia services under the *antimonde* is dominated by the continued control of the local loop by the incumbent operators. This market domination and its inhibiting effect on demand for advanced services is reinforced by the control the incumbents have over the cable networks. No real competition emerges to generate demand for advanced services. Under the unsynchronized scenario, the growth of demand for new services is encouraged by new entrants, the establishment of an interconnect regime and the emergence of MAN operators in the major conurbations. Under the rapid scenario, restructuring of the market, especially the separation of the cable TV interests from the incumbent TOs, fosters the demand for advanced services. Internet access is fuelled by greater competition, and the combined effects of new entrants, services innovation and lower prices lead to strong growth in the demand for value added and multimedia services.

Group 3: progression towards liberalization, but more slowly and with less commitment (France, Luxembourg, Netherlands)

Countries in this group are making progress towards liberalization but at a slower pace and with significantly less commitment than those in Group 2. The reduced commitment arises from internal political concerns and debates that blunt the forces of reform. Thus, although Group 3 countries may agree to implement specific measures within the timescales proposed

by the EC, they almost certainly do not implement them as effectively as possible. France is included in this group because it has seen significant political unrest over the process of privatization and national budgetary reform, and this is likely to slow the liberalization process over the coming years.

In the fixed telephony market, there is a monopoly on the provision of basic telecoms services and infrastructure in all three countries. Although the operators in France and the Netherlands have shown themselves to be relatively efficient as monopoly operators, the *antimonde* leads to a deterioration in levels of service relative to Group 1 and 2 countries. Widespread concern over job losses in France leads to popular support to protect France Telecom from the effects of competition. In the Netherlands, the government – following the collapse of efforts by the EnerTel consortium to set itself up as a second national operator – decides not to introduce competition in basic services, and in addition fails to allow the widespread cable TV sector to provide voice telephony services. Luxembourg fails to introduce competition, even by 2000, the year its derogation expires.

In the unsynchronized scenario, liberalization measures, particularly in France, are stalled due to the political difficulties and administrative problems associated with transposing EU requirements into national law. Legal challenges are launched by the incumbent TOs, and trade union organizations cause further delays in market liberalization. The sale of a minority stake in France Telecom – much lower than the 49% which the government originally wanted to put up for sale – goes ahead towards the end of 1998 and is successful, despite strong opposition from trade unions. There are, however, no serious nationwide competitors to France Telecom. The Dutch Ministry of Transport recently announced proposals for a Telecoms Interim Act, to be adopted in 1996. Under the unsynchronized scenario, the implications of this act would be that a single national competitor enters the Dutch market in 1998. Luxembourg liberalizes its telecoms sector by 1998 rather than 2000.

Regulators are subject to government interference due to the political sensitivity of the liberalization process. Price caps are in place, but the regulators have difficulty in enforcing them because of a lack of co-operation from incumbent TOs and restrictions on their powers due to the inadequate transposition of directives into national law. Nevertheless, regulators adopt an increasingly robust line with the incumbent TOs in an effort to consolidate their authority, taking a lead from the recent decision by the French regulator, Direction Générale des Postes et Télécommunications (DGPT), favouring Bouygues Telecom in its interconnection dispute with France Telecom. Cable TV operators are not licensed to provide voice telephony until 1998 in the Netherlands and until early in the 21st century in France. In both countries, regulators also delay licensing other local loop operators until early next decade.

The rapid scenario assumes that the Member State governments in this group manage to overcome political difficulties and implement liberalization measures within the 1998 deadline. National regulators are effective, and impose price-cap regulations on incumbent TOs early in 1997, creating a stable environment for new operators. New telecoms laws laying down policy are adopted during 1996. In the Netherlands, even without the participation of Nederlandse Spoorwegen and BellSouth, EnerTel proves to be a serious force and is granted a national telecoms infrastructure licence; it begins to supply voice services in the local consumer market on 1 January 1998. In addition, the Telecom2 partnership (Nederlandse Spoorwegen and BT) is offered a national TO licence.

In order to encourage local telephony operators, in the rapid scenario, regulators in France and the Netherlands license wireless operators in a number of urban areas and competing MAN operators in the capital cities in 1996, and these begin commercial operations in 1997. In the French cable TV market, competitors to France Telecom, notably Compagnie Générale de Vidéocommunication and Lyonnaise Communications, are granted voice telephony licences. In the Netherlands, cable TV operators are permitted to provide public voice telephony from mid-1996.

The effect of the different scenarios on ownership and establishment are significant. PTT Telecom is 45% state-owned (through KPN), and the Dutch government is committed to holding 33% of KPN until 2004. P&T Luxembourg and France Telecom are 100% state-owned, and in France foreign ownership is not currently permitted. Under the unsynchronized scenario, political difficulties in France are not resolved until 1998 and a small shareholding of France Telecom is successfully sold off late that year. Handover of the Dutch TO to private control is not carried out until 1999. In the rapid scenario, however, PTT Telecom is transferred to private control during 1997. The political difficulties in France over the civil-servant status of France Telecom employees are resolved, and a large shareholding in France Telecom is sold to private investors in 1997.

As with Group 2 countries, the mobile cellular telephony markets are at a key stage of development. In France and the Netherlands, penetration levels are currently low and operators are mainly focused on the business, rather than the residential, sector. A third operator, Bouygues, was recently licensed in France; there are two operators in the Netherlands, but in both countries competition is nascent and the *antimonde* leads to very low growth rates. Under the unsynchronized scenario, the cellular market grows but at well below its potential. In both countries a new PCS operator is licensed in about 1998, but the gradual development of competition means that the residential market does not take off until approximately 1999, making it particularly difficult for the PCS operators. Under the rapid scenario, new PCS licences are awarded in early 1997 and operators aggressively target residential as well as business customers. Penetration rates start to climb steeply in early 1997 as existing operators implement market strategies to counter the threat of competition.

In the *antimonde*, the development of the market for value added and multimedia services is heavily constrained by the behaviour of the incumbent. The lack of effective price control and the constraints on new entrants leaves the prices of these services at prohibitive levels. Under the unsynchronized scenario, the liberalization policies designed to open up the market are biased towards greater competition in the mobile market and the enforcement of price caps. Relatively few liberalization measures are introduced which significantly increase demand for, and availability of, value added and multimedia services. In contrast, the rapid scenario sees the introduction, albeit around the turn of the century, of a wide range of reforms that foster the growth of new entrants, new service offerings and lower prices, and stimulate demand for advanced services. The most notable drivers are effective competition in the local loop, where cable TV companies are licensed to offer a full range of services competing with the incumbent TO, and the independence and authority of the regulatory agency.

Group 4: slow progression towards implementing liberalization measures (Austria, Italy, Spain)

Countries in this group are making only slow progress towards implementing liberalization measures. Internal political difficulties, the agendas of those with a vested interest in the existing structure, and a lack of political commitment to the liberalization process all combine to hinder progress. The Austrian TO, OPT, is still a government department, although there are plans to corporatize it under full government ownership in 1996. Operational and regulatory functions in Austria were separated in January 1993, and are adjacent sections under the Federal Ministry for Public Economy and Transport. Although Italy now appears to be making some progress, it could be argued that the government continues to act in a pro-incumbent manner, and it has failed to convince the EC of the independence of its NRA. Italy is still experiencing significant political difficulties and uncertainty. Until the recent elections, the Spanish government consistently sought to slow the pace of liberalization within the EU, and to oppose liberalization measures. It has secured a derogation from infrastructure and voice service liberalization until 2003, although more recent announcements from the government stated an intention to liberalize the Spanish market by the January 1998 deadline.

Under the *antimonde*, the incumbent TOs in all three countries would retain a firm monopoly on provision of public infrastructure and public voice telephony in the fixed telephony market.

Under the unsynchronized scenario, the intentions of the Spanish government to introduce liberalization in 1998 evaporate. As the 1998 deadline approaches, the government faces mounting opposition from Telefónica, trade unions and political opponents, and returns to its original intention of delaying the entry of competitors into the Spanish market until beyond the end of the decade. In Italy, continuing political instability makes it impossible to transpose liberalization measures into national law until well into 1999. Even then, the regulator is unable effectively to control anti-competitive practices in the market, and real liberalization is delayed until beyond 2000. Austria, having joined the EU in 1995, has some difficulty complying with liberalization directives, and the proposal to open voice services to competition initiates a national debate about the ownership and status of OPT, which takes a number of years to be resolved. Nevertheless, liberalization is firmly on the agenda and a strategic international partner is found for OPT, though not until after 2000.

The rapid scenario assumes that the difficulties currently being experienced are only short-term and are overcome quickly. Problems relating to the independence of the NRA in Italy are resolved, and the regulators in all three countries establish growing power over the market in 1998. All three markets are nominally liberalized in 1998, although effective liberalization does not occur until towards the end of 1998 or early 1999. Italy and Spain adopt legislation in 1996 or early 1997 that allows alternative infrastructure providers to offer already liberalized services. In 1998, Telecom Italia forms strategic alliances with two global telecoms companies and the Italian regulator awards new TO licences to at least two alliance groupings, which could include for example the following potential competitors: Ferrovie dello Stato, Olivetti, Autostrade, Albacom (BT/BNL), Cable & Wireless and Bell Atlantic. Similarly, in Spain, new TO licences are awarded to two alliance groupings, one of which involves significant foreign investment.

In Italy and Spain, under the *antimonde* and the unsynchronized scenario, there is no immediate growth in the number of local telephony operators, mainly because the cable TV industry is at the very early stages of development. Under the rapid scenario, however, MAN

and wireless operators in these countries begin to receive licences from 2000. In Austria, there is already significant cable TV coverage, particularly of Vienna and other urban areas. These local operators are licensed to offer voice telephony services under the unsynchronized scenario, though not before 2000. In the rapid scenario, they are licensed in 1998.

In relation to ownership and establishment rules, under the *antimonde* OPT remains 100% state-owned and plans to seek a strategic partner to take an equity stake are shelved; Telecom Italia remains 42% state-controlled (via STET and IRI); and Telefónica remains 20% state-owned. Currently in Austria, foreign ownership of the incumbent TO is not permitted, while in Italy and Spain, foreign ownership cannot exceed 50% and 25% respectively. The unsynchronized scenario involves a sale of a minority equity stake of OPT to a foreign strategic partner about 2000, and privatization of Telecom Italia through the sale of the government's stake in STET. Under the rapid scenario, the sale of the Italian government's stake in Telecom Italia takes place in 1996. In Austria, a strategic partner would be found for OPT in 1998, and the government would sell a further significant stake to private and institutional investors.

Competition is emerging in mobile cellular telephony in Austria, Italy and Spain. Each country has two operators, one of which is 100% owned by the incumbent TO and the other controlled by an alliance of domestic and foreign players. Italy's mobile market is at a somewhat later stage of development than those of Austria or Spain. Due to strong competition on price between Telecom Italia Mobile and Omnitel Pronto Italia, the market penetration in Italy's mobile market is the fourth highest in Western Europe (behind Sweden, Norway and the UK). There are plans to license a third operator in Italy this year.

The *antimonde* stifles prospects for growth in all three countries, as the threat of competition from a third operator is removed. In the unsynchronized scenario, the markets in Austria and Spain are slow to take off, due to the regulators' inability to resolve interconnect disputes. A third (PCS) operator is not licensed before 2000. In Italy, there is a fast rate of growth under the unsynchronized scenario, but it does not match the market potential; the single most important factor inhibiting growth is the lack of a strong regulator to prevent unfair protection of the incumbent operator's market share. Under the rapid scenario, the mobile market in all three countries grows sharply from the beginning of 1997. In Italy, a strong regulator removes constraints on the second operator's network roll-out plans, and leads to immediate all-out competition by the two existing operators to gain market share in advance of service launch by the third operator. Similarly, Ö-call in Austria and Airtel-ASR in Spain speed up their roll-out plans, because the regulator creates an environment of certainty through speedy, competition-oriented decisions, including the decision to license a third operator in 1997. Their actions prompt competitive responses from the incumbent-owned mobile operators.

In the *antimonde*, the strength of the monopoly held by the TOs over the fixed network, and their continued role as public policy instruments, inhibit the uptake of value added and multimedia services. Incentives to provide new services are minimal and demand for services is suppressed. In the unsynchronized scenario, there is little change from the *antimonde*. It is only under the rapid scenario that these countries begin to see a growth in the demand for value added and multimedia services. As described above, the rapid scenario sees these countries largely achieving the minimum conditions for the 1998 liberalization programme, and as a result, competition, interconnection and price control establish a set of conditions in which the demand for advanced services can begin to be satisfied.

Group 5: little progress in implementing liberalization measures (Greece, Ireland, Portugal)

Countries in this group are judged to have made the least progress towards implementing existing liberalization measures. All three countries currently face considerable internal political opposition to the proposed liberalization programme. Each country has secured derogations extending the deadline for liberalizing voice services from 1998 to 2003, although the Irish government recently announced proposals to liberalize its telecoms market in 2000, and the President of Portugal Telecom has said that it expects to be ready to face competition in basic services by 1999. The Greek government has stated an intention to open its telecoms sector in 1998, but it is expected that Greece will take up its full derogation to 2003; the continued postponement of selling part of OTE illustrates the political difficulties that the government faces. Greece has recently been taken to the European Court of Justice by the EC for failing to establish an NRA.

In the *antimonde*, the fixed telephony sectors in these countries retain their current structure. In Ireland, Telecom Eireann has a monopoly in the provision of basic services and infrastructure. While the responsibility for regulation was separated from the TO in 1993, it is currently controlled by the Department of Communications. However, the Irish government has stated its intention to set up an independent regulator, which will have full authority over telephone charges and services. Portugal Telecom has a monopoly on the provision of basic telecoms services and infrastructure in Portugal until at least 1999. Responsibility for regulation was separated from the TO in 1989 and is now in the charge of the Institute of Communications of Portugal (ICP). Similarly, in Greece, OTE has a telecoms monopoly on basic services and infrastructure. Unlike Ireland and Portugal, it does not face even the threat of competition before 2003.

In the unsynchronized scenario, countries in this group take advantage of their derogations. In Greece, it is well into the next decade before there is a truly independent regulator and no price-cap regulations are imposed. In Ireland, setting up an Oftel-like regulator is delayed until 1998 and barriers are placed in the path of competitors to Telecom Eireann, following the example of the decision by the Communications Minister in early 1996 to 'instruct' Telecom Eireann not to sell any more capacity to its competitors. Similarly in Portugal, new market entrants are discouraged by market entry barriers due to lack of strong regulation until 2000. However, in both Ireland and Portugal, new entrants are successful in taking a significant proportion of TO revenues in the long-distance and international telephone services (corporate business) market.

In the rapid scenario, countries in this group move more quickly than required by their derogations. By 2000, the markets in all three countries have been liberalized, and effective regulators impose price-cap regulations on the incumbent TOs. The incumbent TOs undergo significant restructuring to enable them to face competition in basic services from 2000. Strategic stakes are rapidly taken up by global operators as a result of decisive moves by governments to set up an independent regulator and to rebalance prices rapidly.

Within this group, it is only in the rapid scenario that some (few) local telephony operators would be awarded new licences. There is no extensive cable TV structure in Greece or Portugal at present, while in Ireland the cable TV sector is dominated by Telecom Eireann. Thus, it is only in Ireland that this medium could be used to develop competition with the incumbent operator. In the rapid scenario, the Irish government requires Telecom Eireann to divest itself of Cablelink in 1997. The purchaser of Cablelink is guaranteed a licence to

provide voice telephony from 2000 as part of the sale package. A MAN operator is set up in each capital city.

With regard to ownership and establishment rules, there is significant variation between each country. In Ireland, there are no foreign ownership restrictions and 35% of Telecom Eireann has been sold to a consortium consisting of PTT Netherlands and Telia. In Portugal, foreign ownership is restricted to 25%, while in Greece current rules suggest that foreign ownership is not permitted. The Portuguese government currently owns 71.1% of Portugal Telecom, but speculation exists as to the likelihood of an international offer of up to 24% in 1996. 8% of OTE was sold in March 1996.

In the *antimonde*, it is virtually impossible for the incumbent TOs to find a strategic global partner willing to take an equity stake. Even under the unsynchronized scenario, this remains a difficult task: investors are wary of putting money into a venture when they are uncertain as to whether the regulator has the authority and the ability to enforce a strong application of competition rules. Consequently, there is much lower than anticipated interest in the purchase of a stake in Telecom Eireann and, as a result, the sale of part of Telecom Eireann to a strategic partner is delayed until 1997. A further sale of Portugal Telecom shares goes ahead in 2000, reducing the government's holding to just under 50%. OTE remains in full government ownership until after 2005. Under the rapid scenario, a strategic partner is found for Telecom Eireann in 1996. The Portuguese government reduces its share in Portugal Telecom to about 47% in 1996 and sells a further share to a strategic global partner in 1998. 6% of OTE is floated in 1996 and a further 25% is purchased by a strategic partner in 2001.

In the mobile cellular telephony market, each country has licensed two operators, although competition is in its infancy in Ireland: the second operator (Esat Digiphone) was only licensed in October 1995 and expects to achieve 80% population coverage in the latter half of 1996. Although the mobile sector did not exist in Greece before 1993, operators there have achieved relatively high penetration (under 4%) in three years, partly because of long waiting lists for the fixed telephony service. Under the *antimonde*, growth is minimal as tariffs fall very slowly. Under the unsynchronized scenario, high growth rates are attained in each country as mobile operators begin to compete more strongly on price and target the residential market. Targeted tariff packages designed for residential customers hit the marketplace in 1998 under the unsynchronized scenario, while under the rapid scenario this is brought forward two years to 1996. In each case, the targeting by existing mobile operators of the mass consumer market occurs about the same time as the licensing of a third PCS operator.

In both the *antimonde* and the unsynchronized scenario, the growth in the demand and supply of value added and multimedia services is heavily constrained by the failure to introduce competition and initiate processes of liberalization. It is only under the rapid scenario, where these countries move more rapidly towards liberalization than negotiated under their derogations, that the demand and supply of value added and multimedia services grow. Competition in the local loop and more favourable interconnection terms create a set of minimum conditions for the development of a large market in these services.

3.2.3. Conclusions

These scenarios form the basis of our subsequent analysis of the liberalization of the telecoms sector, and of the impact of this liberalization on the wider EU economy. The value of these

scenarios is in creating alternative settings against which to evaluate the impacts of the creation of the single information market. These groupings and the associated scenarios are purely illustrative and do not imply that the regulatory outcomes described above will indeed represent the actual outcome in each individual country. If there is one thing that is certain about the regulatory environment in Europe, it is that it changes frequently and sometimes in a manner which is difficult to foresee.

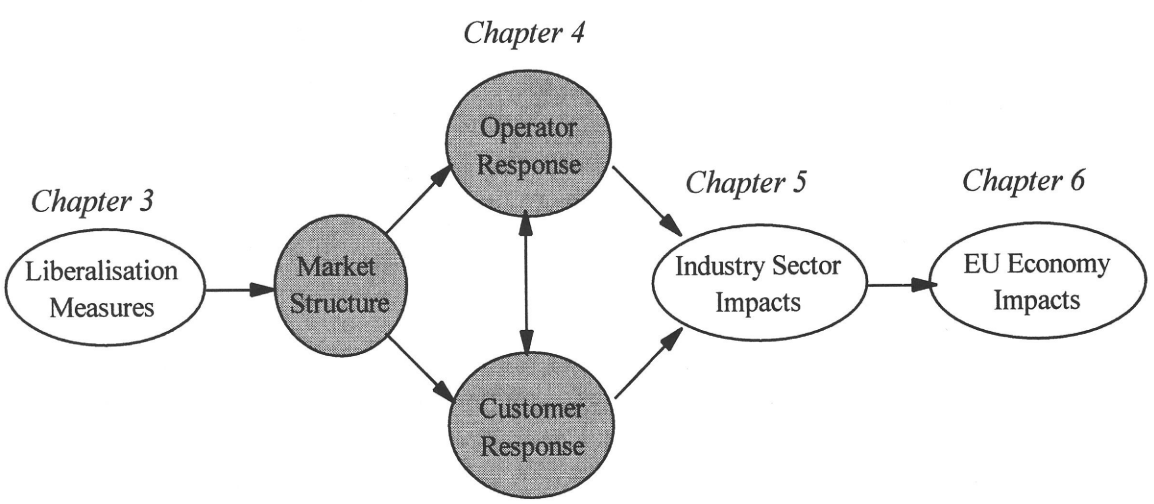
4. Development of the telecoms sector within the EU

4.1. Introduction

This chapter examines the impact of the proposed EU telecoms liberalization agenda on the market for telecoms services and infrastructure provision within the EU. The chapter takes the perspective of both operators (supply side) and telecoms users (demand side) by assessing how each of them is likely to be affected by, and respond to, the market structure changes that will be induced by liberalization. Analysis is performed at a disaggregated level on four major telecoms service sectors (traditional telecoms services, mobile bearer services, multimedia bearer services, and value added services, including mobile value added services) for each of the three regulatory scenarios developed in Chapter 3. The results for the four telecoms service sectors are then synthesized into a view of how the entire telecoms sector will develop under each of the three regulatory scenarios.

Figure 4.1 depicts the steps involved in our modelling approach. As described in Chapter 3, telecoms liberalization measures will affect the structure of the telecoms market by reducing barriers to entry, encouraging new players into the market and integrating national markets. These market structure changes will give users greater scope to affect market outcomes. This will elicit responses from operators and service providers, such as changes in strategy on price, innovation in product content, developments in customer service, investment in faster product delivery, or delivery over a wider geographical area. Changes in service affordability, availability, functionality and quality will lead to changes in service take-up and utilization.

Figure 4.1. A model of the impact of telecoms liberalization



The impact on telecoms operators has been assessed in terms of the effect on overall sectoral revenues, employment and capital expenditures. End users' benefits have been assessed in terms of the cost savings they are likely to reap as a result of:

(a) price reductions on telecoms services they currently use,
(b) using telecoms and information-based services to substitute for other inputs or activities,
(c) increased flexibility in the use of information due to enhanced functionality of telecoms services.

The chapter is structured in seven sections. The model is applied to the four major service categories: traditional telecoms services (Section 4.2), mobile bearer services (Section 4.3), multimedia bearer services (Section 4.4), and value added services, including mobile (Section 4.5). In each of these sections, we characterize likely changes in market structure under each scenario, the likely response of operators in terms of pricing and service offerings, and likely customer reaction to those changes. These effects are estimated on the basis of a bottom-up model which encapsulates our assessment of the emerging trends in each service category. The overall effect of these changes on the development of the sector is summarized in Section 4.6. In the same section we contrast the combined results derived from the bottom-up methodology with the results of a simple econometric model at the aggregate level. Conclusions are drawn on the impact of the proposed liberalization measures in Section 4.7.

4.2. Developments in the traditional services market

The traditional services category is defined as public switched telephony network (PSTN) services, leased line provision, X.25 services, frame relay, and SMDS/CBDS services. These services currently account for more than 80% of the total revenue of the telecoms sector. We focus discussion on those factors that are driving the development of basic PSTN services, which represent 95% of the total revenues of traditional services.

4.2.1. Market structure

Liberalization measures introduced at the EU and national levels are having a major impact on the structure of the market for PSTN and corporate network services. Constraints on the provision of public voice services over new infrastructure by competing operators should be lifted in most EU countries by 1 January 1998. Leading up to that date, we expect to see the structure of the market for the provision of traditional services change significantly, both nationally and at the pan-European level. Our assessment of the likely number of operators competing in each sector of the market under the three scenarios, and the proportion of the EU market having a choice of service provider in each case, is summarized in Table 4.1.

International services

The most immediate impact of liberalization will be on provision of international services:

(a) Existing and new International Simple Resale (ISR) operators will move rapidly to offer service in EU markets as they are opened to them, making competitive international service offerings available across almost the whole of the EU, in both the rapid and the unsynchronized scenarios.
(b) International alliances, such as Concert, Unisource, and Global One, have already been established, in order to take advantage of cross-border integration and lower the costs of service delivery to corporate users.
(c) Other cross-border operators will enter the market to deliver lower-cost international corporate network and PSTN services, either exclusively for their own use (as in the case of ISIS, an alliance between RWE and Générale des Eaux) or for the benefit of other national operators as a 'carriers' carrier' (e.g. Hermes).

Facilities-based carriers will be subject to stricter regulatory control than their ISR counterparts, and their development will depend on co-ordinated regulatory action by a

number of different national regulatory bodies. They will also require time to develop their infrastructure. As a result, we expect the number of such operators, and the proportion of the EU market that they serve, to be limited in the unsynchronized scenario. In contrast, under the rapid scenario, we expect significant growth in the number of international facilities-based carriers and in the proportion of the EU market that they serve; however, this will still take time to develop, only reaching the majority of the EU market early in the next century. This strong growth in facilities-based carriers in the rapid scenario will actually undermine the arbitrage position of ISR operators, leading to a significant decline in the number of such operators by the end of the period, although the remaining operators will continue to offer service throughout most of the EU.

Table 4.1. Traditional services market structure and coverage

	Number of operators			% of population with access to more than one operator		
	1997	2000	2005	1997	2000	2005
Local:						
Rapid	74	92	125	7	19	37
Unsynchronized	74	85	91	7	17	29
Antimonde	74	74	74	7	7	7
Long distance:						
Rapid	22	38	54	17	44	77
Unsynchronized	22	37	45	17	36	59
Antimonde	22	22	22	17	17	17
International:						
Rapid	5	8	12	7	47	84
Unsynchronized	4	4	5	7	31	61
Antimonde	4	4	4	7	7	7
International resale:						
Rapid	12	16	8	38	88	98
Unsynchronized	12	18	22	38	75	92
Antimonde	12	12	12	38	38	38
Service providers:						
Rapid	5	8	12	6	31	55
Unsynchronized	3	5	7	5	20	45
Antimonde	3	3	3	5	5	5

Source: Analysys.

New national network operators

The lifting of restrictions on the provision of public voice services will also give rise to an increase in the number of national operators for the provision of basic services in long-distance national markets. Because national network operators do not depend on co-ordinated regulatory action by a number of national regulatory bodies, the structure of each national market can develop largely independently of other national markets, and need not be constrained to move at the pace of the slowest.

Since 1995, a number of organizations have taken advantage of the liberalization of non-reserved service provision to establish themselves as telecoms operators. The primary goal of these operators is to establish significant revenue streams from the delivery of public voice services. The expectation that they will be permitted to offer public voice telephony in 1998

has encouraged the formation of operators such as Telecom Flanders, Thyssen Telecom, VEBACOM and Lyonnaise Telecom.

The rate at which other organizations enter the market depends on the manner in which regulatory reform develops. In an environment where competition is encouraged through the breaking down of barriers to entry and the suppression of monopoly power, the number of new entrants will rise significantly. Where the licensing of new operators takes an extended period of time or carries onerous conditions, or where fair and reasonable interconnection with the incumbent remains difficult to obtain, organizations will perceive the business risk to be high and will be discouraged from entering the market.

We expect the number of organizations entering the market for long-distance service provision between 1997 and 2000 to be broadly the same under the unsynchronized and rapid scenarios. However, between 2000 and 2005 we expect to see some divergence between the scenarios, with the number of operators growing more quickly in the rapid scenario, under which markets continue to develop after the year 2000.

Because of the significant investments necessary to develop national networks, competitive services are not expected to be available to the majority of the EU population until some time after the year 2000 (in both scenarios). However, the proportion of the population with competitive service offerings will have increased to over 75% by the year 2005 in the rapid scenario; we estimate that it will be less than 60% by this date in the unsynchronized scenario.

New local network operators

Liberalization will also have an impact on the provision of local services (both access and call delivery). However, the provision of these services is only becoming financially viable as a result of other changes in the telecoms sector:

(a) tariff rebalancing, leading to an increase in the revenues earned from local services;
(b) convergence with broadcast entertainment services, leading to economies of scope in the provision of local services;
(c) the introduction of new technologies, in particular wireless local loop, with different cost characteristics to those of traditional copper-based access networks.

Even with these changes, new local access network development will only be financially viable in some parts of each national market.

Because of these prerequisites for the development of local access competition, we expect to see some significant differences between scenarios. Under the rapid scenario, we expect a steady increase in the number of local access network operators and in the proportion of the EU market having access to a choice of local access provider. However, even in this scenario, coverage by new local network operators will be limited to under 40% of the EU market in 2005. In the unsynchronized scenario, development will be even slower, in terms of both the number of local network operators and the proportion of the EU population with competitive access. Under the unsynchronized scenario, less than 30% of the market is expected to have access to an alternative local service provider by 2005.

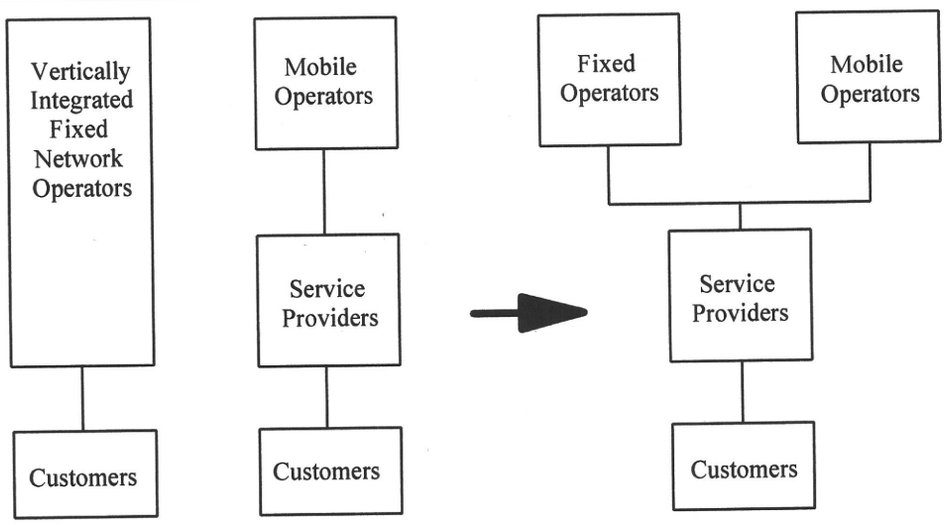
Separation of network operation and service provision businesses

As prices fall and competition increases in all elements of the industry, two factors will become increasingly important in attracting and retaining customers:

(a) improved customer-facing activities,
(b) improved management and operation of network infrastructure to minimize costs.

The focus of an organization undertaking customer-facing activity differs greatly from that of a commodity bit transportation business: the former must concentrate on service quality and product differentiation, while the latter must place more emphasis on minimizing cost. This difference is sufficiently fundamental for TOs maybe to see advantages to splitting into two organizations (see Figure 4.2). Rochester Telecom in the USA has already completed such a separation, the Telecom Corporation of New Zealand followed suit with a similar re-organization in early 1996, and other major operators such as BT are considering such voluntary separation. The rapid growth of the Internet will accelerate the commoditization of transmission and focus users' attention on service quality and differentiation. This may constitute a strong driver for the restructuring of TOs along these lines.

Figure 4.2. Evolving TO organizational structure



Source: Analysys.

While we expect incumbent operators throughout the EU to follow this path more or less rapidly, we do not see a significant role for other non-facilities-based basic service providers in most EU markets. The exception is Germany, where we expect that the separation of networks and services will become an integral part of the regulatory strategy for the market. We therefore expect a relatively smaller number of national and local network providers to emerge in Germany than in other markets, but posit a significant role for national service providers in Germany: we envisage them serving about 80%, and nearly 100%, of the German market by 2005, in the unsynchronized and rapid scenarios respectively.

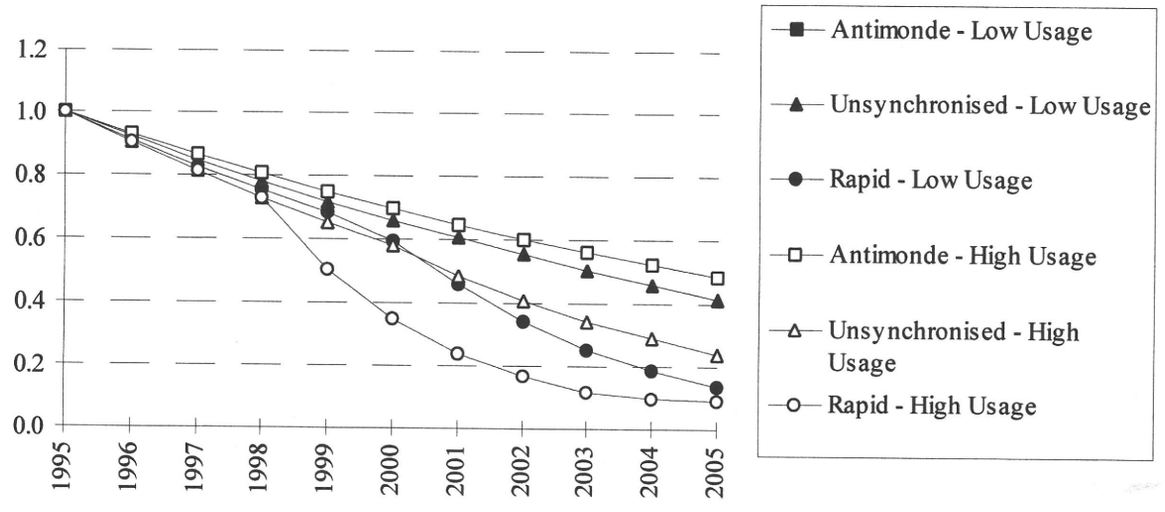
4.2.2. Overall reduction in prices

Significant international price cuts

Significantly increased competition in the international services market will prompt operators to cut prices for these services. Liberalization of intra-EU international services, in particular, will allow operators to bypass the current bilateral international accounting rate mechanisms within the EU and reduce the apparent cost of intra-EU international calls. (In fact, the reduction in outpayments will be matched by a similar reduction in receipts, assuming traffic on the route is in balance; thus the net effect on an operator in these circumstances will be negligible.)

In the rapid scenario, price cuts will initially be targeted at high-volume customers, but the extent of competition assumed in this scenario will force operators to focus on all segments of the market, and hence to cut prices for low volume customers too, albeit at a slower rate (illustrated in Figure 4.3). The fall in prices for intra-EU calls will be greater than for national calls, reflecting the greater scope for cost cutting because of the high margins currently enjoyed by TOs on international calls. As the margins for international calls are eroded, prices for both national and intra-EU calls will converge. This is particularly true for the rapid scenario, under which the cost of intra-EU calls falls to roughly 10% of current levels and the price of national calls falls to just over one-third of current levels.[24]

Figure 4.3. Indexed average price per minute of intra-EU calls (1995 = 1)



Source: Analysys.

Other price changes

Competition in the market for long-distance national services will be less developed than that for international services, and hence the pressure to reduce prices will be less intense, particularly in the unsynchronized scenario. Once again, these price cuts will be targeted at

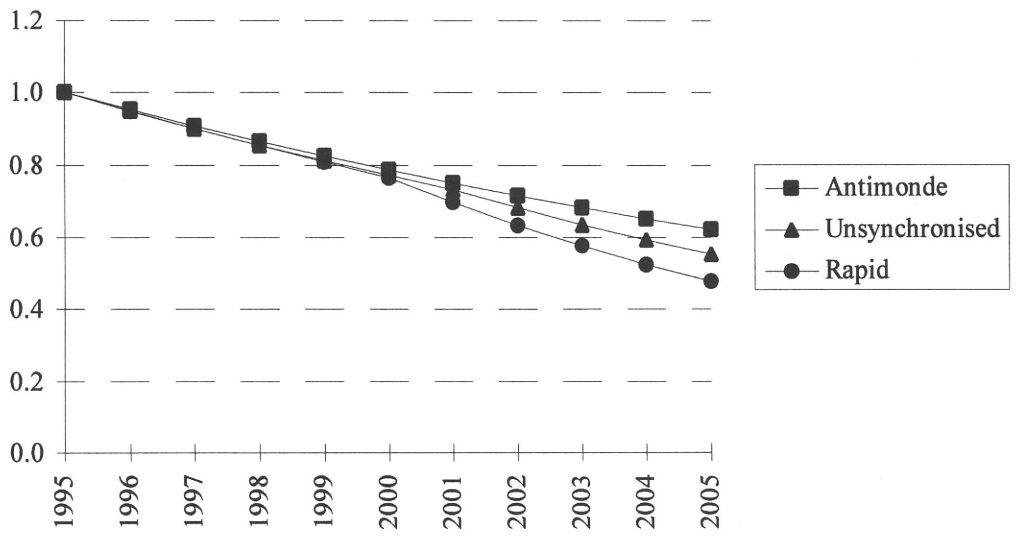
[24] These trends are averaged for the EU as a whole.

high-volume customers in the first instance, but will flow down to low-volume customers later on under the rapid scenario.

Because of the significant price cuts made in national and international service prices, particularly in the rapid scenario, operators will be able to increase fixed charges gradually while still meeting price caps aimed at reducing the overall price of service to users. High-volume users in the rapid scenario will be subject to the greatest increases in fixed charges, since they will enjoy the greatest cuts in national and international prices. The threat of competition from new local network operators is unlikely to constrain existing operators, given the relatively limited number and coverage that such operators will have by 2005.

Overall, the cost of PSTN services to users is falling.[25] The single biggest factor influencing falling call charges is the imposition at a national level of price caps that require operators to cut prices across a range of services. As discussed in Chapter 3, eight EU Member States currently manage prices of PSTN services through price caps. The effectiveness of price-cap and other tariff regulation schemes in reducing prices depends on how demanding they are to meet and how adequately they are monitored and enforced. In the unsynchronized scenario, we expect that price caps in general will be more lax. We therefore project that, under the unsynchronized scenario, prices will fall less quickly than in the rapid scenario. Figures 4.4 and 4.5 illustrate the impact of these differences on high and low volume users, comparing the total cost of basic telephone service per call minute, between the different scenarios.

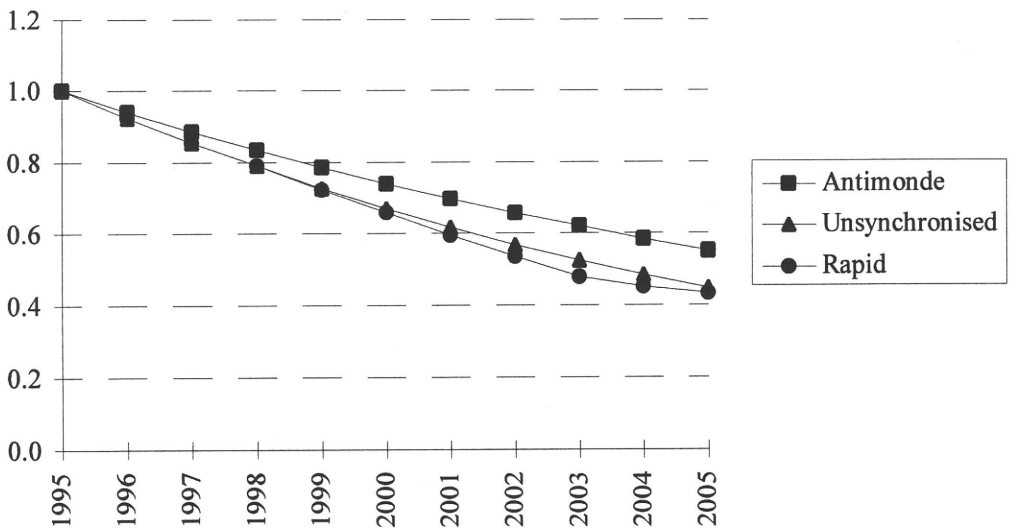
Figure 4.4. Average price per minute for basic telephone service, low-usage customers (indexed, 1995 = 1)



Source: Analysys.

[25] In *Cutting the cost: the falling price of telephony in Europe* (Analysys [1995b]) the costs of telephony services for a number of different categories of user (from residential to business customers with 100 lines) were examined. The costs of a three-line business were chosen as representing the 'average cost' of telephony in the countries surveyed.

Figure 4.5. Average price per minute for basic telephone service, high-usage customers (indexed, 1995 = 1)

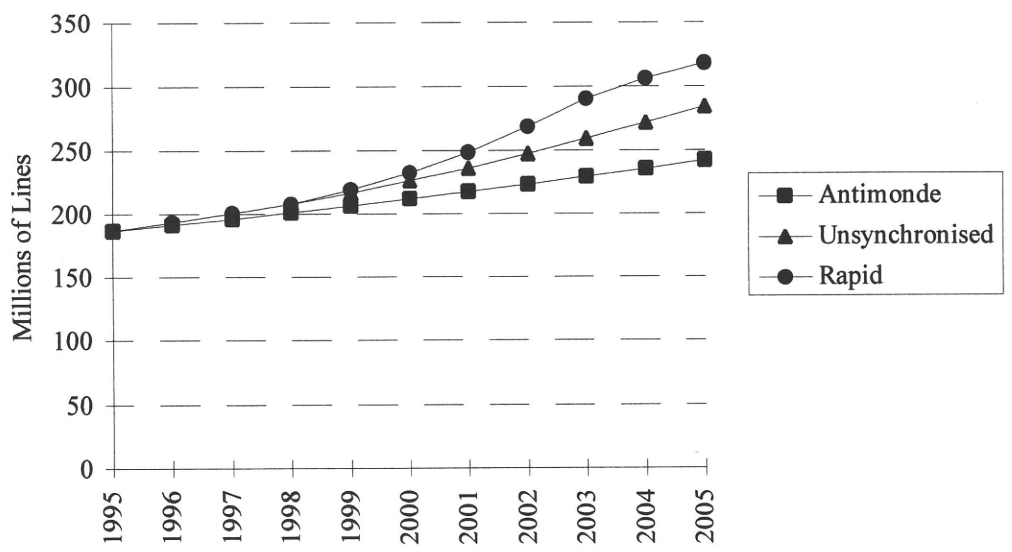


Source: Analysys.

4.2.3. Traffic volume

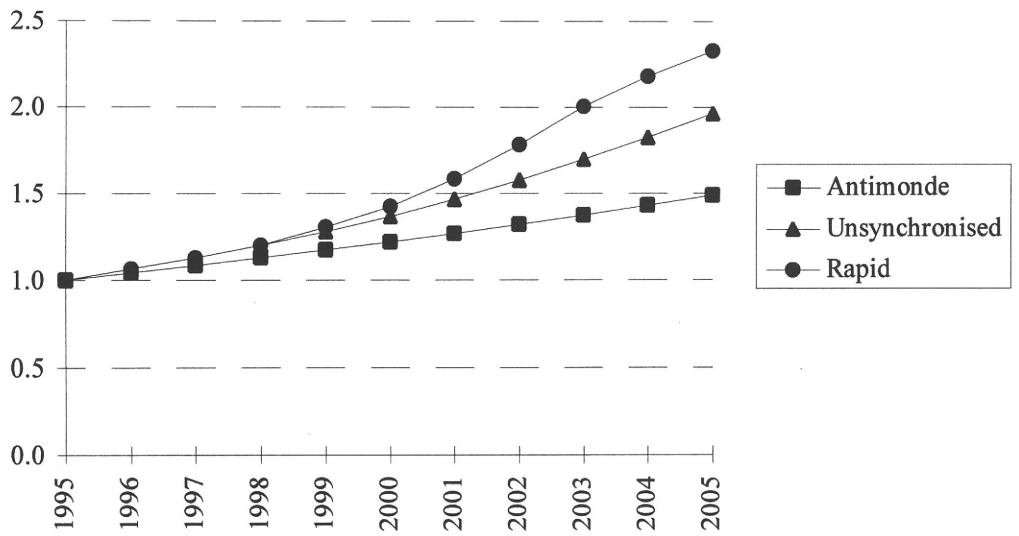
With price declines of between 30% and 60% over the next ten years under the two liberalization scenarios, basic telephony services users will increase both the utilization of their existing lines and the number of lines they take (Figure 4.6) to accommodate the extra traffic generated by second phones, fax machines and dial-up computer services. The combined effect on the volume of traffic is shown in Figure 4.7.

Figure 4.6. Number of PSTN lines in the EU



Source: Analysys.

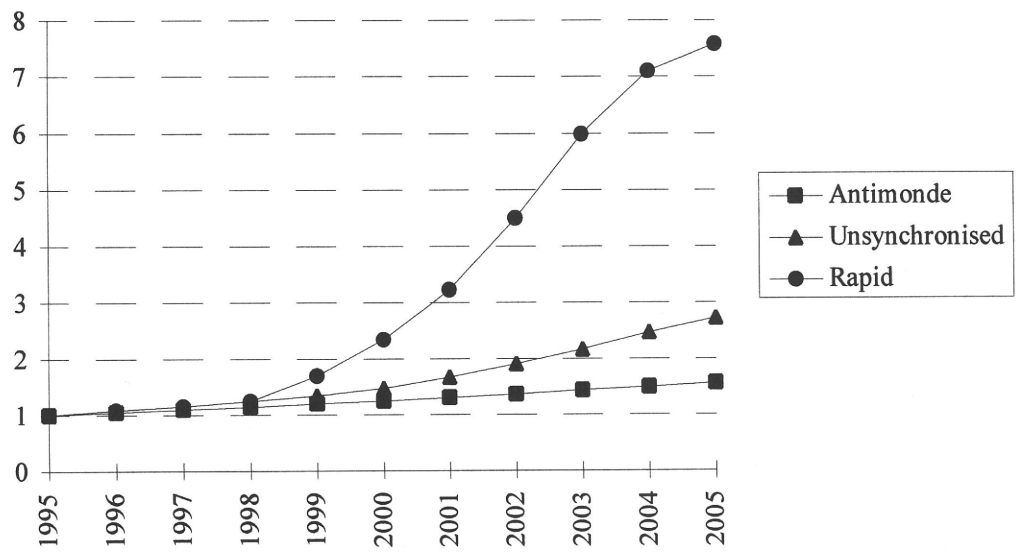
Figure 4.7. Indexed total call minutes in the EU (1995 = 1)



Source: Analysys.

Customers will respond particularly strongly to the radical price cuts for intra-EU services forecast for the rapid scenario, leading to significant increases in the volume of intra-EU traffic, as illustrated in Figure 4.8.

Figure 4.8. Indexed intra-EU traffic volume (1995 = 1)



Source: Analysys.

Increased marketing of services by operators under the rapid scenario will make customers more aware of the real price of services, and the options available to them. As a result, customers will become significantly more responsive to cuts in service prices, and increase their level of usage accordingly. The impact of the greater awareness caused by the more active marketing of telecoms services was modelled by increasing the elasticity of demand by 15% in the rapid scenario.

4.2.4. Improved level of service

As competition between operators and service providers increases, organizations will differentiate themselves not simply on price but also on the basis of the quality of service provided to their customers. Customer-facing elements of operators and service providers will increasingly focus on:

(a) improving the perceived value of service offerings through bundling and development of service interfaces;
(b) improving the speed of service delivery;
(c) implementing efficient and responsive customer support systems, customer help desks, and online services;
(d) providing on-site assistance in service configuration and management.

Only those organizations that perform well in these areas will retain or gain market share. Additionally, as increasing numbers of operators enter the market, the incentive for operators to identify new geographical areas for operation will increase. As a result, the benefits of competition – lower prices, greater choice, and improved quality of service – will be more widely felt.

4.2.5. Investment in new technologies

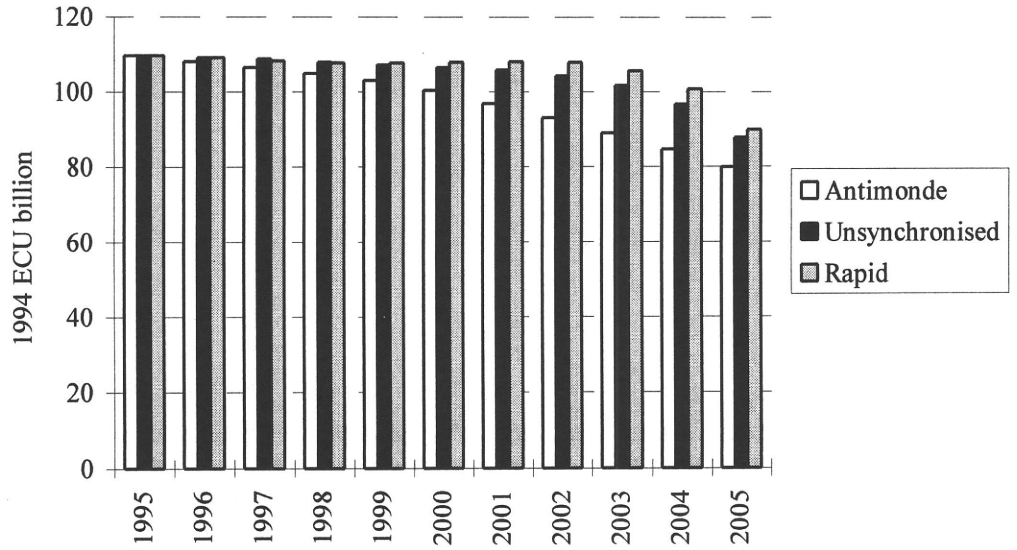
Operators have acted to reduce costs and increase the flexibility of service offerings simultaneously by introducing new technologies. Significant new investment is being made by operators in completing the digitization of networks with the introduction of optical fibre line transmission systems and digital exchanges. Flexibility in service provision is also being enhanced by the introduction of Synchronous Digital Hierarchy transmission systems and Intelligent Network technology. Similarly, wireless access technology is also being considered as a means of reducing the cost of maintaining local access networks.

4.2.6. Operator revenues

In 1995, revenues from traditional services in the EU amounted to ECU 110 billion (1994 ECU), accounting for approximately 82% of total sector revenues. In the period 1992 to 1994 they grew only slowly, at around 1% per annum.

Under the rapid scenario, price reductions dominate the increased take-up in service over the short term, so that over the next five years we expect overall revenues from traditional services to decline moderately, eventually falling below traditional service revenues for the unsynchronized scenario (illustrated in Figure 4.9). In the early part of the next decade, however, the increased affordability and availability of both mobile and ISDN services will result in the traffic and lines of traditional network bearers being gradually substituted by these new services. As a result, revenues from traditional services will at that point fall more markedly. By 2005, we project that traditional service revenues will decline to ECU 90 billion (1994 ECU).

Figure 4.9. Revenue from traditional services, all scenarios



Source: Analysys.

In the unsynchronized scenario, the lower level of competition between players will lead to a slower reduction in prices and reduced marketing expenditure, but with a significant slow-down in take-up relative to the rapid scenario. As a result, revenues from traditional services will continue to fall slowly until 1998. From 1998, new entrants into long-distance markets will stimulate growth in traditional PSTN traffic, which will tend to moderate the decline in revenues induced by falling prices. However, we project that the downward trend will accelerate around 2001 as ISDN and mobile become significant substitutes for traditional services. Traditional service revenues will fall to ECU 88 billion by 2005 (1994 ECU).

Under the *antimonde*, the decline in the revenues of traditional services reflects an assumption that supply will stagnate, rather than an assumption that traditional services will be substituted by new services. The decline in revenues occurs earlier than under the two liberalization scenarios, reflecting the probably unenthusiastic customer response to the limited and poorly targeted price cuts predicted under this scenario.

By 2005 traditional services account for 43% of telecoms revenues in the *antimonde*, 41% in the unsynchronized scenario and 39% in the rapid scenario.

4.3. Developments in the mobile services market

The mobile services category is defined as basic cellular and cordless (DECT) public mobile network services, together with paging and public mobile radio (PMR) services. These services currently account for 11.5% of the total revenue of the telecoms sector.

In this section, we focus discussion on those factors that are driving the development of cellular services delivered at 900MHz and 1,800MHz. These represent over 95% of the total category value at present, and will represent the majority of the category for the period under study. Hence, over the short term, liberalization measures that influence their development will have the greatest impact on the evolution of the sector.

4.3.1. Market structure

Competition in mobile infrastructure and service provision

As with the traditional services market, the major difference between the unsynchronized and rapid scenarios will be how quickly each Member State modifies its supply conditions by introducing multiple operators. This, in turn, will determine how rapidly mobile services will become affordable to the majority of the population within a specific market.

Currently, every EU Member State has licensed at least two operators to deliver mobile services using the GSM digital mobile standard at 900MHz. In certain Member States, the second operator has yet to start trading. The recently adopted EU Directive on Mobile Services and Infrastructure[26] calls on Member States to license at least one additional DCS1800 operator over the next two years. At present, DCS1800 networks are available in only three countries. Over the next five years we expect this number to increase, with the licensing of up to 20 new DCS1800 operators across the EU. However, unlike the situation in the late 1980s when GSM was adopted, there is no mandatory requirement to clear frequency spectrum to accommodate this service. Without binding agreements to do so, increased competition could be delayed. We therefore expect that the introduction of DCS1800 operators will progress at different rates across country groupings under the two liberalization scenarios.

Our projections on the number of mobile operators are summarized in Table 4.2, and discussed below:

(a) Group 1 countries already have strong competitive cellular telephony markets. In the unsynchronized scenario, we expect the number of operators to remain more or less unchanged, with industry discussions on the licensing of new DCS1800 operators failing to make ground. In the rapid scenario, however, we assume that further liberalization will result in more DCS1800 licences being granted in each country. For example, in Sweden discussion is underway with a view to issuing four DCS1800 licences in 1996. For Sweden, under the rapid scenario, we therefore assume that two DCS operators are operational by 1997, and another two DCS1800 networks come into service by 2000.

(b) Group 2 countries have been treated in a similar way to Group 1 countries. Under the unsynchronized scenario, the number of licensed mobile operators remains largely unchanged until 2005. In the rapid scenario, two or three new operators are licensed in each country by 2005.

(c) In the unsynchronized scenario for the Group 3 countries, the Bouygues mobile service becomes operational in France in 1996, but no further mobile operators are licensed in Luxembourg, Belgium or France. In the rapid scenario, we assume that France and Luxembourg each gain one additional DCS1800 operator (beyond the Bouygues service in the case of France), and Belgium gains two.

(d) Groups 4 and 5 countries are assumed to meet their obligations under EU law to have competing mobile operators by 1997, in the unsynchronized scenario. In the rapid scenario, we assume that another DCS1800 operator is added in each country.

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[26] Commission Directive 96/2/EC of 16 January 1996 amending Directive 90/388/EEC with regard to mobile and personal communications (OJ L 20, 26.1.1996, p. 59).

There are currently few relationships between mobile operators across borders, but in the last three years some mobile operators have invested in other mobile operators in the EU: Vodafone and France Telecom Mobile invested in Panafon in Greece; France Telecom Mobile invested in Mobistar in Belgium and Tele-Mobil (the mobile division of Telenor) in Esat in Ireland. Strategic international alliances such as Unisource have also been active in bidding for mobile licences. We expect that, as competition spreads and DCS1800 licences proliferate, more cross-border relationships will develop; leading to a consolidation of the mobile telecoms industry at a European level. However, the number of operators shown for each Member State in Table 4.2 reflects the number of operators active in each State; thus operators with investments in more than one country are counted more than once.

Table 4.2. Number of cellular telephony providers operating in each EU Member State

Country	1995	1997		2005 (predicted)	
	Antimonde	Unsynchronized	Rapid	Unsynchronized	Rapid
Group 1:					
Finland	2	3	4	3	5
Sweden	3	3	5	3	7
UK	4	4	4	4	5
Group 2:					
Belgium	2	2	3	2	5
Denmark	3	3	4	3	5
Germany	1*	2	3	2	4
Group 3:					
France	1*	2	2	2	4
Luxembourg	2	3	3	3	4
Netherlands	1*	1	1	1	2
Group 4:					
Austria	1*	2	2	2	3
Italy	1*	2	2	2	3
Spain	1*	2	2	2	3
Group 5:					
Greece	2	2	2	2	3
Ireland	1*	2	2	2	3
Portugal	2	2	3	2	3

Source: Analysys.
* Second operator licensed but not yet trading.

4.3.2. Extent of network coverage and service take-up

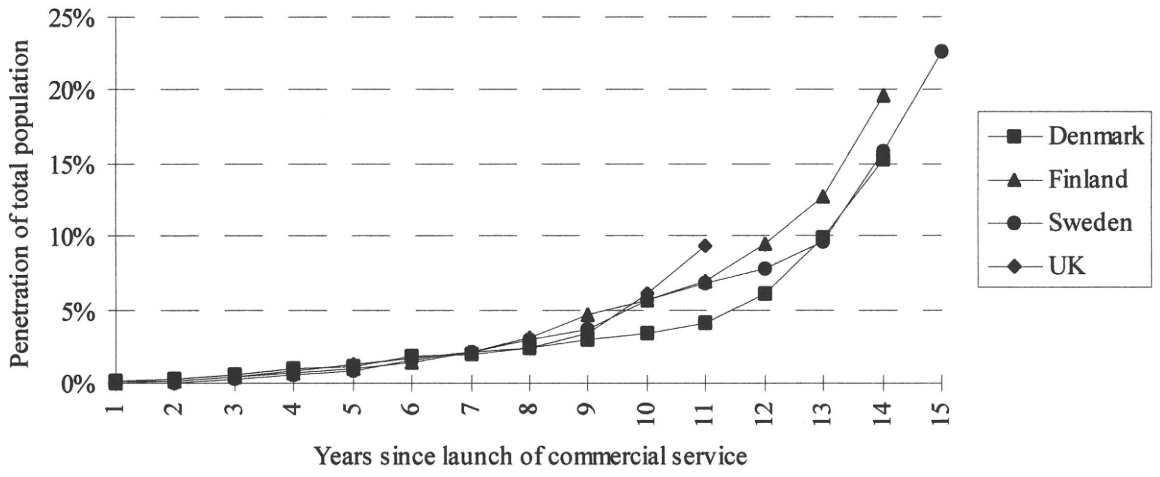
The majority of mobile operators in the EU cover over 95% of the population, although in the UK and France, for example, this equates to around 75% of the geographical area of the country. With this degree of population coverage, service availability is not a significant issue for consumers. Expectations have now been set by incumbent operators of near 100% coverage in urban areas. New entrants now have to match this level of availability in order to compete effectively. They may do this either through investment in their own network infrastructure, or through roaming agreements with other operators.

The importance of coverage has been demonstrated by the different fortunes of the two UK DCS1800 operators, Orange and Mercury one2one. Orange now leads Mercury one2one in the total number of subscribers, despite being launched nine months after Mercury. Most commentators agree that, alongside an excellent marketing campaign, Orange benefited significantly from being able to offer near complete UK coverage early on in its existence. Orange now covers over 90% of the UK population, while Mercury one2one has reached 75%.

In Germany, E-Plus has also recognized the importance of coverage in its service proposition, and plans to increase its network coverage from 30% in 1994 to 98% by 1998.

Since 1990, the introduction of GSM and a basic level of competition between operators has prompted subscriber growth within the EU of 53% per annum. With the introduction of consumer tariffs and the adoption of per-second billing by many operators, the cost of owning a mobile phone is reducing. As this becomes apparent to the market, service take-up increases. Consumer tariffs are usually introduced coincidentally with a third operator entering the market. Two years after the duopoly in a country has been broken, there is a significant increase in subscriber growth, as illustrated in Figure 4.10: Sweden, Denmark, Finland and the UK introduced third operators 11, 10, 9 and 8 years after launch respectively.

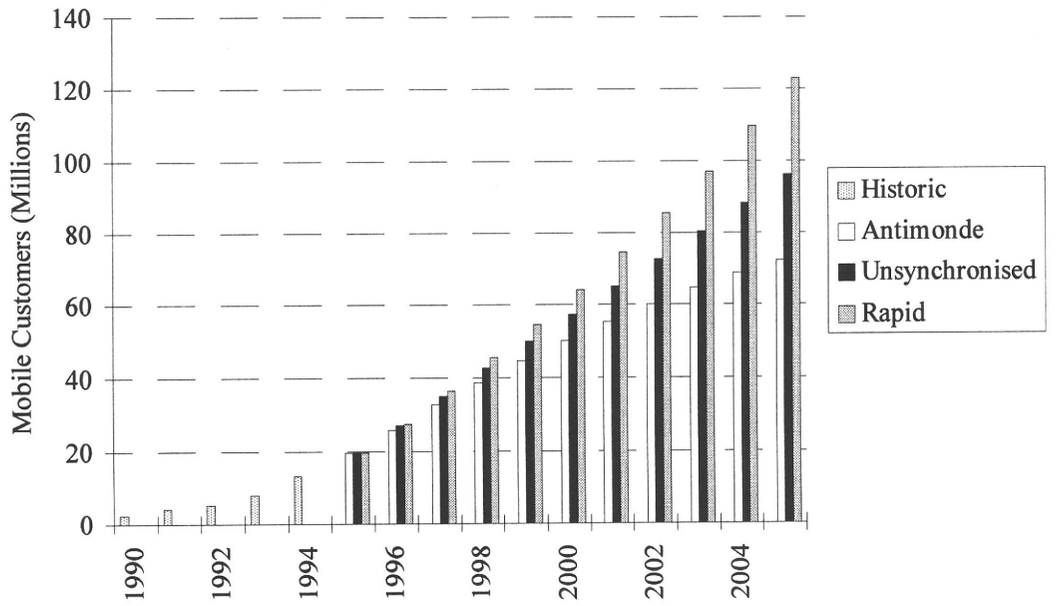
Figure 4.10. Mobile telephony penetration in Scandinavia and the UK since launch



Source: Analysys.

Under the rapid scenario, we expect that approximately 87% of the EU population will be able to choose between at least three mobile operators by 2005. With the increased affordability that this choice offers, subscriber growth under this scenario will slow only gradually over the next ten years, averaging 27% per annum between 1995 and 2000, and 14% between 2001 and 2005 (Figure 4.11). It should be noted that this is a very conservative forecast, and less than half the growth rate experienced by Norway and Sweden over the last five years. Under this assumption, a total of 122 million people, approximately 30% of the population of the EU, will be subscribing to mobile telephony by 2005. It is worth noting that the Scandanavian countries are already approaching these levels of mobile market penetration. Under the unsynchronized scenario, subscriber growth will average 24% per annum between 1995 and 2000, and 11% per annum between 2001 and 2005. EU subscribers under this assumption will reach 96 million (around 25% of the population) by 2005. By 2005, the rapid scenario represents an increase of 25 million cellular subscribers, or around 28% over the unsynchronized case. Other industry commentators forecast that the penetration in 2000 will be higher than even in the rapid scenario. The *European Information Technology Observatory 1996 Yearbook* forecasts that the total number of mobile customers in Western Europe in 2000 will be in excess of 70 million (EITO [1996]). Ovum, in its recent report *PCS: the mass market for mobile communications,* forecasts that mobile customers in Western Europe will number in excess of 100 million by 2000 (Ovum [1996]).

Figure 4.11. Projected number of mobile subscribers, all scenarios



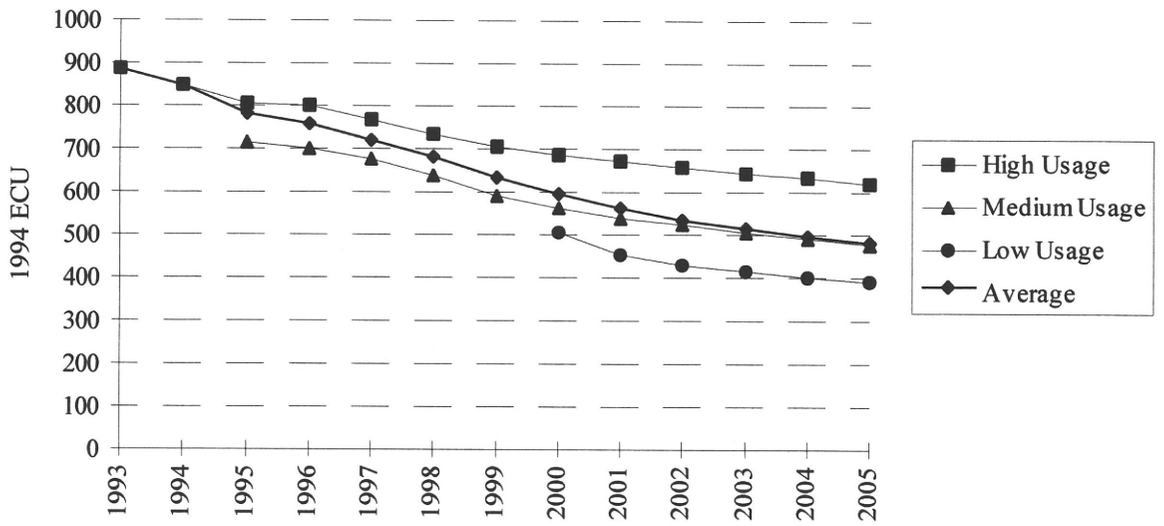
Source: Analysys.

4.3.3. Price reductions and increased range of tariffs

As discussed above, recent evidence suggests that the entry of a third and fourth operator into the market for mobile services within a country has a significant impact on the cost of mobile services to the user. Consumer (low user) tariffs were introduced by incumbent operators in both the UK and Germany, in advance of any perceptible maturing of the business market. Other competitive response measures by incumbents have included the launching of location-based discounted tariffs.

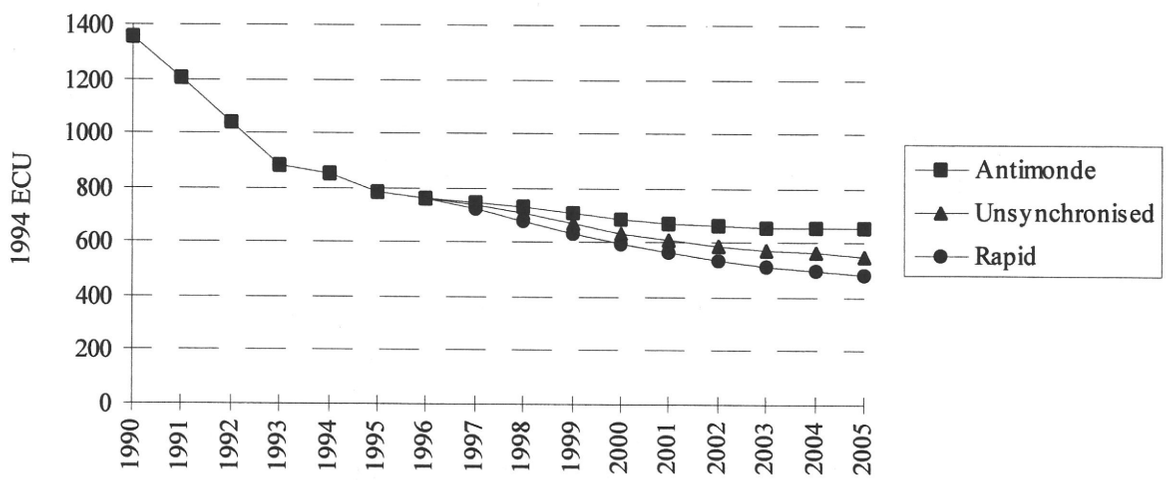
The effect of introducing new tariff packages, targeted at lower-spending customers, on the average revenue per subscriber, is illustrated in Figure 4.12 (overleaf). This figure shows how we expect the total cost of mobile service will fall for three types of customer under the rapid scenario. However, the more important effect overall is the increasing number of subscribers attracted by lower-priced packages, reducing the average revenue per subscriber across all customer types more rapidly than the cost of service to any individual customer. As a result, we predict that the average revenue per subscriber will fall more gradually under the unsynchronized scenario, since there will be less pressure on operators to offer tariff packages targeted at lower-spending customers. As illustrated in Figure 4.13, the average revenue per subscriber in the EU has fallen by 42% from 1990 to 1995, with further drops of 17% projected in the *antimonde* and 39% in the rapid scenario, over the next 10 years.

Figure 4.12. Comparison of average revenue per subscriber with the total cost of service for three customer types, rapid scenario



Source: Analysys.

Figure 4.13. Comparison of average revenue per subscriber, all scenarios



Source: Analysys.

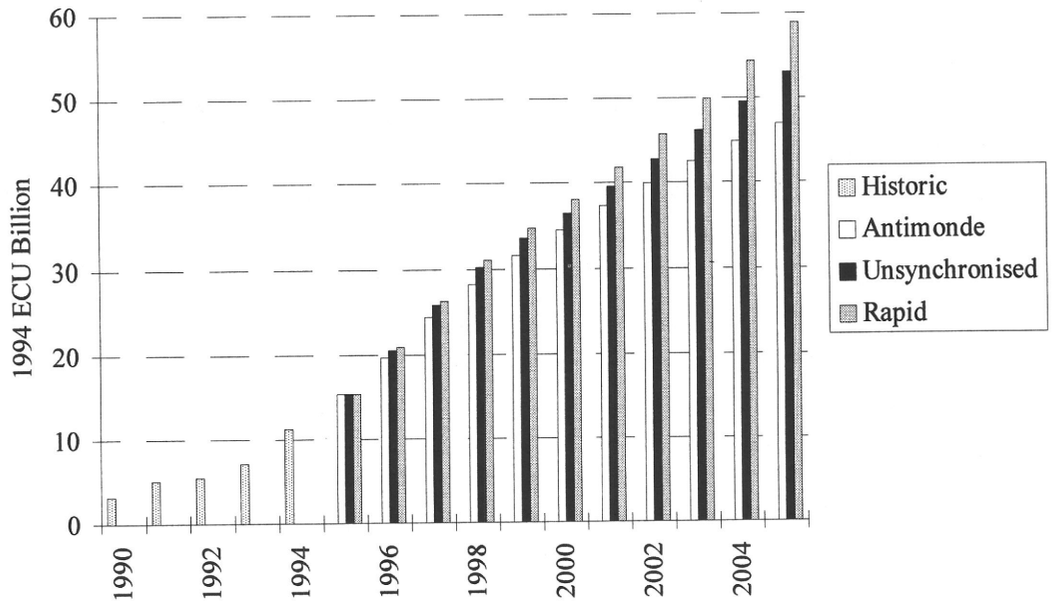
4.3.4. Impact on operator revenues

Under the rapid scenario, given the increasingly competitive tariffs offered by mobile operators and the level of service utilization, we expect growth in total operators' revenues to slow gradually from the current rate of 37% per annum (1990 to 1995) to 20% (1995 to 2000) and then to 9% (2001 to 2005). We estimate that total mobile revenues within the EU will amount to just under ECU 59 billion (1994 ECU) by 2005, as illustrated in Figure 4.14.

Under the unsynchronized scenario, with a smaller proportion of the population benefiting from a third mobile operator and lower levels of investment in advertising and promotion, service prices will remain high and subscriber growth will slow significantly. With less

pressure on prices, revenue per subscriber will decline less rapidly. Revenue growth will average 19% per annum in 1995–2000 and 8% per annum in 2000–2005. Total revenues will reach ECU 53 billion by 2005 (1994 ECU).

Figure 4.14. Projected mobile telephony revenues, all scenarios



Source: Analysys.

Mobile revenues in the rapid scenario by 2005 represent an 11% increase over the unsynchronized scenario. The total difference in revenues over the ten-year period between the two scenarios is estimated at around ECU 24 billion (1994 ECU). These figures indicate that the liberalization measures promoted by the EU will have a significant impact on the development of the mobile sector.

4.4. Developments in the multimedia bearer services market

The multimedia services category consists of those bearer services that are designed specifically for the carriage of multimedia services. The primary bearers considered in this category are ISDN and ATM. These services currently account for about 3% of the total value of the telecoms sector. We expect ISDN to be the dominant multimedia bearer service for residential and business customers over the period to 2005. Multimedia service providers are addressed in the next section, under the heading of value added services.

4.4.1. ISDN

ISDN is delivered to customers in two forms: basic rate ISDN (BR-ISDN) provides a customer with two 64kbit/s digital channels (known as 'B channels'); primary rate ISDN (PR-ISDN) is typically used for PBX connection and offers 30 B channels. At time of writing (mid-1996), ISDN is available to about 90% of the population, although outside the major population centres basic rate ISDN may be 'available' only at a prohibitive price.

Market structure

At present, the provision of ISDN services in Europe is virtually a monopoly. In most European countries ISDN is included in statutory monopolies covering voice services, and hence will not be liberalized until 1998. Even in the UK, a national basic rate access service is currently only available from BT (although there is no statutory monopoly). The current situation simply reflects a lack of desire on the part of competing network operators to offer basic rate ISDN access, because the market for ISDN has, until very recently, been subject to a high degree of uncertainty.

There are indications that this situation is changing in the UK market, driven by changes in demand conditions mentioned above. Three operators, Mercury Communications Ltd, Ionica/ScottishTelecom, and National Transcommunications Ltd, have recently been awarded 10GHz Wireless Access Licences by the UK Department of Trade and Industry to enable them to deliver ISDN services nationwide. Some regional operators (e.g. Norweb Communications and Cambridge Cable) have indicated that they also intend to offer basic rate ISDN services in the near future.

As the importance of ISDN in the marketplace grows, so new operators will increasingly look to offer this service as part of their portfolio. However, it is unlikely that any operator will provide this service as its first offering or on its own. The number of operators offering ISDN will instead be a subset of the total number of traditional service operators, discussed in Section 4.2 above, and will therefore vary between the scenarios. Overall, we predict that significantly more operators will offer an ISDN service under the rapid scenario than under the unsynchronized scenario, and that the proportion of the EU market having access to such services will also be wider, as detailed in Table 4.3.

Operators will look to increase the size of the addressable market for ISDN through investment in ISDN network provisioning to the Euro-ISDN standard, and by making the service available at an affordable price to a greater percentage of the EU. A major competitive factor is the percentage of the population that will have a choice of ISDN provider. Our assessment of the percentage of the population with a choice of service provider is based on our estimates of the rate at which new entrants come into the market and the likely roll-out of their service coverage.

Table 4.3. Comparison of ISDN operators and population coverage

	Number of providers operating nationally			% of population with access to more than one operator		
	1997	2000	2005	1997	2000	2005
Rapid	42	65	103	3	13	32
Unsynchronized	42	61	83	3	11	25
Antimonde	42	42	42	3	3	3

Source: Analysys.

Service take-up and coverage

ISDN has been on the verge of success for many years, without actually making a significant impact on the market. However, with the deployment of Euro-ISDN making cross-border ISDN services viable in the last 18 months, the ISDN market has begun to develop rapidly. In several countries, the rate of ISDN growth is now outstripping growth in cellular telephony.

In Germany, there were more than 700,000 BR-ISDN connections at the end of 1994, up 150% on the previous year. In Ireland, the growth in ISDN connections is currently running at 10% per calendar month. Belgium and the Netherlands are also seeing dramatic rates of growth in connections. In the UK, BT's basic rate ISDN connections increased by 124% in 1994. International ISDN traffic to and from the UK increased by 230% in the same year, and ISDN now accounts for 20% of all new business line connections. This performance is being achieved despite a high connection charge (more than ECU 500 for its basic rate ISDN service), and rental charges running at twice the rate charged for a PSTN line.

The recent rapid take-up of ISDN services has been driven by three main factors:

(a) *The availability of an international standard for ISDN.* With the adoption of Euro-ISDN, market-leading companies now have the confidence to develop network infrastructures on an international scale. This improved availability of service is reflected in the growth in international ISDN traffic experienced by BT and other operators.

(b) *Applications development.* EFTPOS applications and LAN interconnect are currently the major application drivers in this market. For example, a European wines and spirits retailer has recently installed BR-ISDN in 1,500 outlets to increase the efficiency of credit card verification and data collection. In the future, Internet access and PC-based videoconferencing applications will fuel rapid growth in ISDN. Internet and other online service providers such as CompuServe are in the process of increasing the numbers of available ISDN accesses to their networks. Software suppliers such as PictureTel have seen dramatic growth in the uptake of PC-based videoconferencing applications, with major corporations such as BP ordering more than 100 ISDN-based units for use in offices worldwide.

(c) *Falling hardware and software costs.* Increased take-up of ISDN services is reducing manufacturing and provisioning costs through economies of scale. These cost reductions are being reflected in falling prices for ISDN modems, bridges, and applications software, and are therefore lowering the cost of service to users.

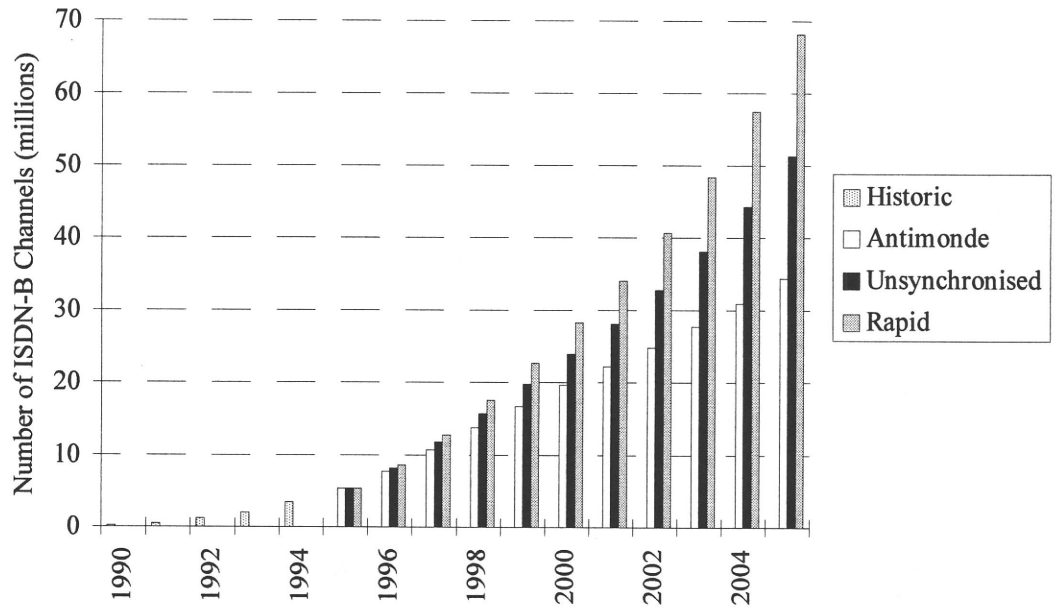
In order to ascertain how ISDN growth will vary between the two scenarios, we have considered both the timing of market entry by new players, and the scope of their service coverage. We have also taken into consideration the downward pressure on prices that will result from increased competition in both the ISDN and traditional services markets.

For both scenarios, we assume that ISDN market growth over the next five years arises primarily because of demand from business consumers. Growth in the business market begins to slow in the early part of the next decade, as ISDN achieves high penetration rates in the business market and viable ATM services become available as an alternative bearer. However, take-up of applications such as Internet access and PC-based video telephony among residential subscribers is assumed to accelerate from 1998 onwards, leading to continued growth in revenues and customers for ISDN.

Overall, we expect the number of BR-ISDN connections to reach between 9 and 11 million by 2000 (resulting in 18 million to 22 million B channels), and then to increase to 28 million (56 million B channels) by 2005 in the rapid scenario, and 21 million (42 million B channels) in the unsynchronized scenario. In addition, we expect PR-ISDN demand to reach between 6 million and 8 million B channels by 2000, and between 10 million and 13 million B channels by 2005. Our forecasts for the total demand for ISDN capacity in B channels are illustrated in

Figure 4.15. This forecast matches well with the EITO's estimate of 23 million B channels in Western Europe in 2000 (EITO [1996]).

Figure 4.15. Projection of ISDN capacity in B channels, all scenarios



Source: Analysys.

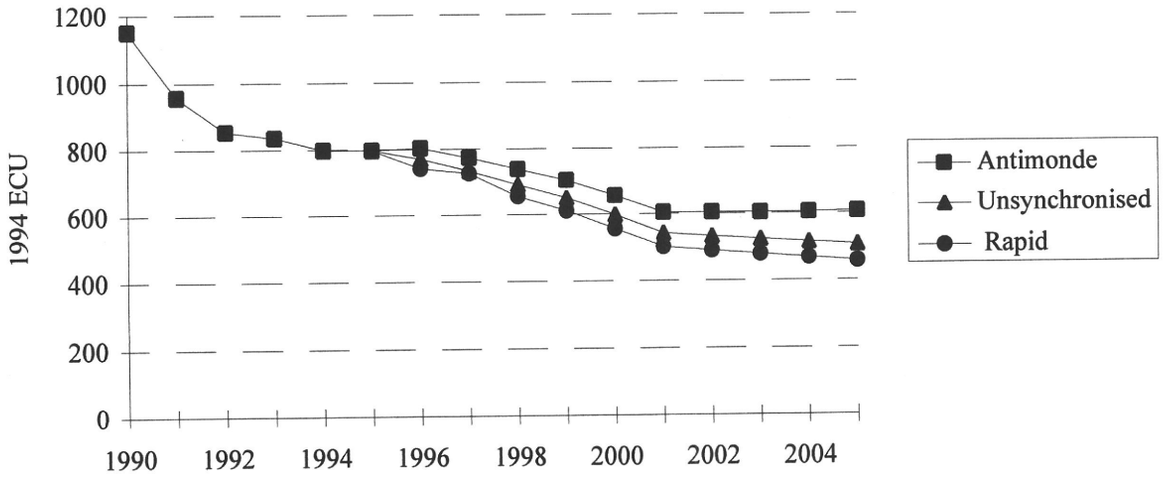
Price reductions

One of the major barriers to growth of the ISDN market in at least some Member States has been the differential between ISDN and PSTN service prices. As existing operators face increasing competition from new operators in the traditional services market as well as the ISDN market, they are likely to respond by reducing this differential so as to encourage take-up of ISDN services. We expect to see this convergence happening more gradually in the *antimonde* and unsynchronized scenarios than in the rapid scenario (illustrated in Figure 4.16), as a result of the different levels of competition predicted under the scenarios.

Operator revenues

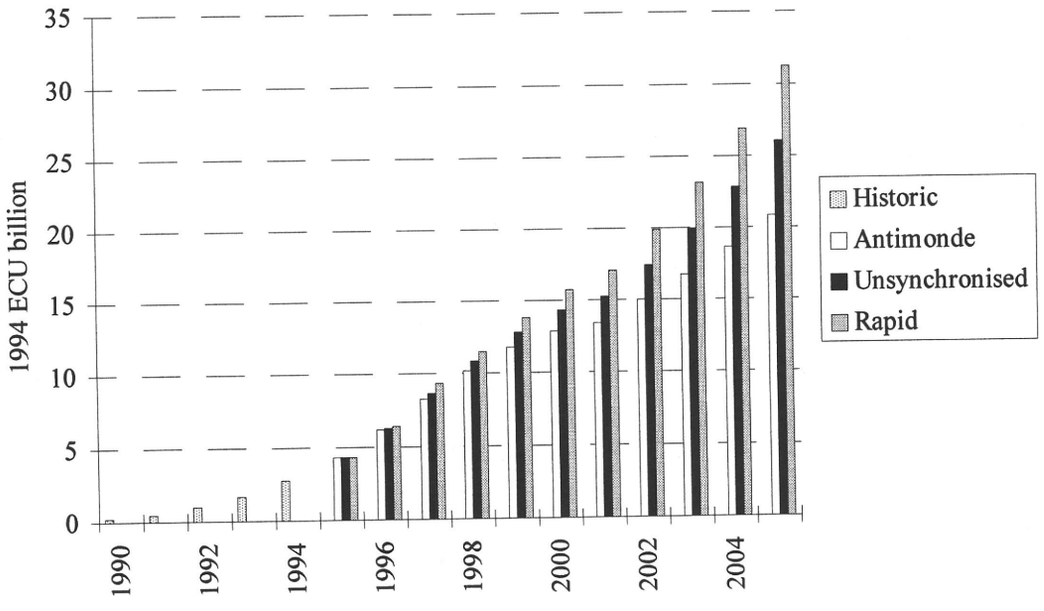
In the rapid scenario, we expect the market to continue to grow quickly in response to significant numbers of new market entrants. The widespread availability of ISDN at affordable prices results in the early adoption of ISDN by residential users and SMEs for services such as fast Internet access and LAN interconnection. This, in turn, results in ISDN revenues achieving a CAGR of 27% over the period 1995 to 2000. As new operators establish themselves in the market, price pressures will increase. Under this pressure, revenue growth will slow to around 15% per annum beyond 2000, to reach ECU 31 billion (1994 ECU) by 2005 (Figure 4.17).

Figure 4.16. Comparison of average revenue per ISDN channel, all scenarios



Source: Analysys.

Figure 4.17. Projection of EU ISDN revenues, all scenarios



Source: Analysys.

Under the unsynchronized scenario, we still expect to see significant revenue and connection growth, since the applications requirements of users will not change. However, lower availability of the service, coupled with high connection and rental charges, will deter adoption, particularly in the residential sector. As a result, we forecast a CAGR for ISDN revenues of 27% over the period to 2000, falling off gradually to average 13% between 2001 and 2005, and to reach ECU 26 billion (1994 ECU) by 2005. Total BR-ISDN lines will reach 21 million by 2005, 7% of total fixed lines.

4.4.2. ATM

ATM is still in the early stages of development. Only a few incumbents (e.g. Telecom Finland) are currently offering public network ATM services. Operators will look to roll out BR-ISDN in preference to ATM, for two reasons:

(a) It is likely that ISDN will meet the needs of SMEs and residential customers for the foreseeable future. They will take up ISDN services in significant numbers in order to gain faster access to online services, in particular the Internet, and to allow small businesses to exchange data rapidly. However, take-up will be dependent on the installation costs being reduced to an acceptable level (i.e. similar to the cost of installing a second PSTN line).
(b) As yet the applications that might command sufficient value to justify investment in ATM services do not exist, and indeed, are not even appearing on the horizon. This, then, restricts the market for ATM services to a small number of large corporations that generate data in sufficient quantity to justify this type of service.

However, despite ATM's limited short-term promise, ATM services have been included in the following discussion for three reasons:

(a) the degree of interest and discussion within the industry of the future of ATM services, although some commentators have suggested that the combination of fast Ethernet and the Internet may reduce the role available for ATM (McQuillan [1996]);
(b) the level of use of ATM technology in the medium term, as operators seek to maximize network flexibility to respond to demand from increasing levels of data and video traffic;
(c) the potential for ATM to deliver a significant proportion of end-user bearer services beyond 2005.

ATM is an important element of the long-term evolution of the information society in Europe. Having been adopted as the standard for broadband ISDN, it is the bearer service to which existing ISDN users will eventually migrate. The most important question to be addressed in relation to ATM is the timing and rate of this migration. Published work indicates that user demand for ATM is, and will be, limited for the period of this study (McQuillan Consulting [1993]). A recent study undertaken by Analysys for the ATM Forum indicated that one-third of large corporate users either have not heard of the service or do not understand what it can offer (Analysys [1995a]). At the same time, anecdotal evidence suggests that competitive pressures to deploy the service are limited, since new operators do not wish to undermine existing tariff structures and destroy value within the market. We therefore do not expect public network ATM services to be offered in significant numbers under either regulatory scenario until after the year 2000.

Once significant service volume starts to develop beyond 2000, the rate of deployment will depend primarily on the intensity of competitive forces in the market. ATM offers operators the ability to minimize costs in the trunk network by maximizing traffic aggregation efficiency across the full range of services it delivers. However, in doing this it passes control of switching and routing to the corporate customer. The ability for the operator to charge differential tariffs for different types of traffic is therefore lost. Charges for customers taking broadband services will fall to the lowest common denominator, and revenues (particularly from voice services) will fall substantially. Thus, in an environment of limited competition, operators will tend to delay the roll-out of ATM for as long as possible, in order to retain

existing revenue structures. However, in a highly competitive environment, they may be forced to move quickly to minimize costs, and introduce end-user ATM services in order to maintain market share.

Market structure

Widespread adoption of ATM by new operators will only occur once there is an indication that there is likely to be sufficiently high demand for the services in the marketplace, and we do not expect this to happen much before the year 2005. Accordingly, we predict little difference between the rapid and unsynchronized scenarios in the number of operators offering an ATM service and the coverage that they offer up to the year 2000. Thereafter, we expect a slight divergence of the scenarios, with the increased competitive pressure in the rapid scenario encouraging a greater number of operators to offer an ATM service over a wider area (Table 4.4).

Table 4.4. Comparison of number of ATM-based carriers

	Number of providers operating nationally			% population with access to more than one carrier		
	1997	2000	2005	1997	2000	2005
Rapid	18	24	53	1	5	29
Unsynchronized	18	24	43	1	5	21
Antimonde	18	18	18	1	1	1

Source: Analysys.

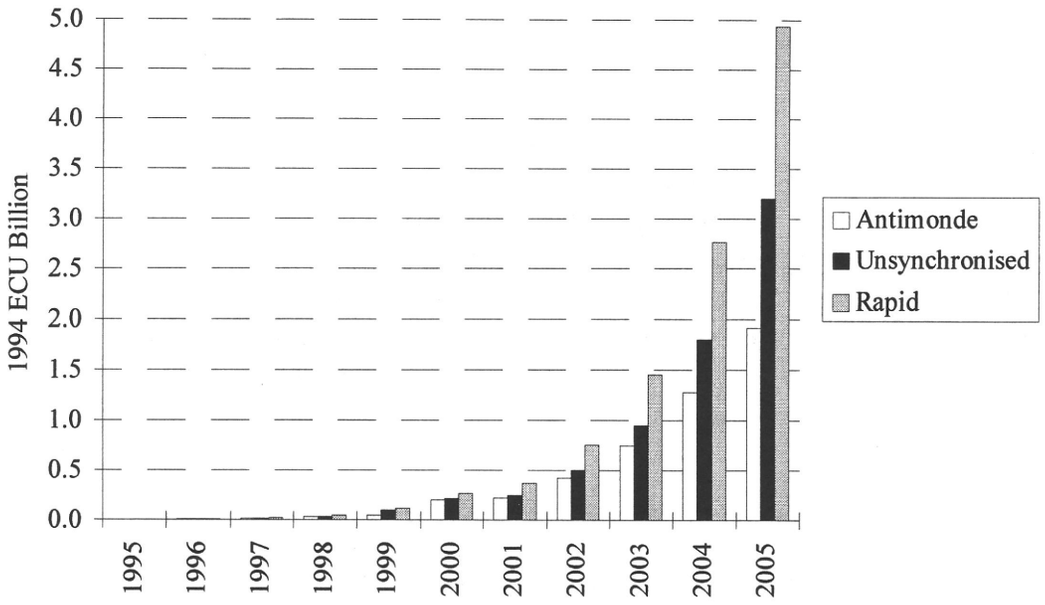
Service take-up and coverage

We do not expect the roll-out of ATM to happen much before 2000, and therefore predict that less than 5% of the EU population will have access to ATM services before that time. Thereafter, we expect a more accelerated roll-out, leading to 29% of the EU population having access to ATM services in the rapid scenario, and 21% in the unsynchronized scenario.

Operator revenues

Given our predictions of the limited availability of ATM services, we do not expect ATM revenues to form a significant part of telecom sector revenues before 2005. Figure 4.18 shows how the larger numbers of operators covering a higher percentage of the population predicted for the rapid scenario result in higher levels of revenue from ATM by the end of the period than in the unsynchronized scenario. However, even under the rapid scenario, revenues from ATM services still only account for 3% of total sector revenues.

Figure 4.18. Projection of ATM revenues, all scenarios



Source: Analysys.

4.5. Developments in the value added services market

This section discusses the development in value added services (VAS) markets in three major areas: voice services (offered over both fixed and mobile networks), Internet services and multimedia services. At present, these services together account for approximately 4% of the total value of the telecoms sector.

4.5.1. Market structure

Third-party provision of value added services (VAS) was liberalized in the EU in 1990. However, because service provision has until recently been closely intertwined with the operation of the basic network, competition in VAS has only developed within the data service area. This obstacle is slowly being removed, with the adoption of Intelligent Networks and the deployment of SS7 to support distributed service functionality in the fixed network arena, and GSM in the mobile network arena. As a result of these developments, competitive and independent value added voice service provision over both fixed and mobile networks is becoming a feasible commercial proposition.

At present, every facilities-based player in both the fixed and mobile markets is offering a range of value added voice services. Value added voice services are an important means of differentiating service offerings, providing an alternative to price competition. Similarly, new entrants in the market for basic services will offer value added voice services as a way of differentiating their service portfolio from that of the incumbents. New operators will not be constrained by the legacy of older installed equipment in parts of their network, which hampers delivery of sophisticated services. This implies that the value added voice services market will develop more rapidly in an environment that encourages significant numbers of new operators.

Following liberalization in the UK, a number of new independent players have entered the market, primarily in the mobile arena, e.g. Flextel, TPS, The Personal Numbering Company. However, interconnection still hampers development of independent service providers, particularly in fixed network VAS provision. The multiplicity of standards and regulatory conditions across countries has hindered the development of pan-European VAS. Even among established national operators, the range of service functionality that is available outside the home network is extremely limited. As these constraints are proving difficult to address, we expect only a small difference between the number of value added voice service providers in the two scenarios, as illustrated in Table 4.5.

Table 4.5. Comparison of value added service providers and population coverage

	Number of providers operating nationally			% of population with access to more than one provider		
	1997	2000	2005	1997	2000	2005
Rapid	19	54	92	6	37	77
Unsynchronized	19	36	80	6	27	64
Antimonde	19	19	19	6	6	6

Source: Analysys.

4.5.2. Expansion of the range of services

As the number of VAS operators grows, so the range of services on offer from both fixed and mobile operators is increasing significantly. On fixed networks, simple freephone and premium-rate services, calling card services, virtual private network services, and a variety of data services (e.g. EDI and e-mail) have been introduced by most TOs within the EU. Services such as automatic call distribution, personal numbering, voice mail and, recently, Internet access, are also being developed by a number of TOs.

The development of many value added services is based on the principle that network intelligence should be separated from network switching functions, i.e. the programs or 'scripts' that are executed when a service is invoked, and the subscriber data required as input to that script, are held in a different platform from the switches that execute the call connection functions. By centralizing service intelligence in this manner, services can be brought to market more quickly, maintained more easily, and upgraded with new features more rapidly. Moreover, it becomes possible to allow customers to change service data remotely and modify the way the service operates.

This process of market development is most advanced within the mobile community. Mobile operators have offered VAS such as call diversion, voice mail and SMS services for some time. Most mobile operators are now working with business partners to develop the range of possible VAS that can be offered. For example:

(a) Mannesmann Mobilfunk in Germany is working with five partners in the provision of value added information services over its D2 network. These services are accessed through short codes which the customer dials into his handset.

(b) Flextel, an independent UK service provider, uses its own service control facilities, plus switching capacity leased from Mercury one2one, to offer a personal numbering service over fixed and mobile networks in the UK.

(c) Aamulehti, a Finnish newspaper and electronic information group, is offering a news service via Telecom Finland's GSM network. Headlines are provided to subscribers via SMS together with a premium rate number which subscribers can dial to obtain more detailed information on a story.

In addition to information services, which can be considered 'remote' to the functioning of the network itself, network-centric services such as personal numbering and voice mail are routinely being supplied in liberalized markets, for example the UK and Finland, by companies other than the network operator.

As the penetration of mobile increases, there is likely to be growing demand for value added services such as cellular VPN, and 'Mobile Extension'[27] services, in which the mobile user is fully integrated with the rest of the organization's corporate network. Other mobile value added services under development include personal numbering, a range of information services and, with GSM phase II, 64kbit/s data services and videoconferencing. The combination of these service offerings from fixed and mobile operators is set to represent a major part of the telecoms market in the next decade. As other markets liberalize, there will be strong incentives for operators to adopt similar strategies in order to maximize the volume of traffic flowing over their network and the perceived value of their services to users.

4.5.3. Operator revenues

As basic bearer services have become widespread and users' familiarity with telecoms has grown, business users have started to look for services which offer greater functionality and greater utility, in an effort to establish and maintain competitive advantage in their respective businesses. Demand for value added services was first illustrated by the introduction of freephone and premium-rate (e.g. travel, weather and sports information) services in the USA. Around 50% of inter-state traffic carried by US inter-exchange carriers is freephone and premium rate traffic: the freephone market in the USA generates $8 to $9 billion per annum.

In Europe, demand for basic value added services is significant. Freephone, premium-rate and calling-card services are now available in most countries, and value added service revenues now account for around 4% of total TO revenues across the EU. In Germany, revenues from recently introduced freephone services rose by 450% in 1994. Demand for value added services in Europe will continue to grow over the next ten years, in response to the increasing range of services on offer from operators. This demand will be driven by three factors:

(a) organizations that are driven by increasing competitive intensity will try to establish a 'competitive edge' by making innovative use of new telecoms features;
(b) increasing competitive intensity will push organizations to adopt highly functional value added services that improve internal processes and enhance efficiency;
(c) customers' attitudes and perceptions will change as they come to expect free access to companies when they want buy a product or use customer support services.

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[27] Mobile Extension is a Cellnet brand name. This service enables a mobile phone to be utilized within a corporate network as another PBX extension. Standard extension numbers are used to dial between the mobile and fixed phones within the corporate network. Special rates apply to all on-net calls.

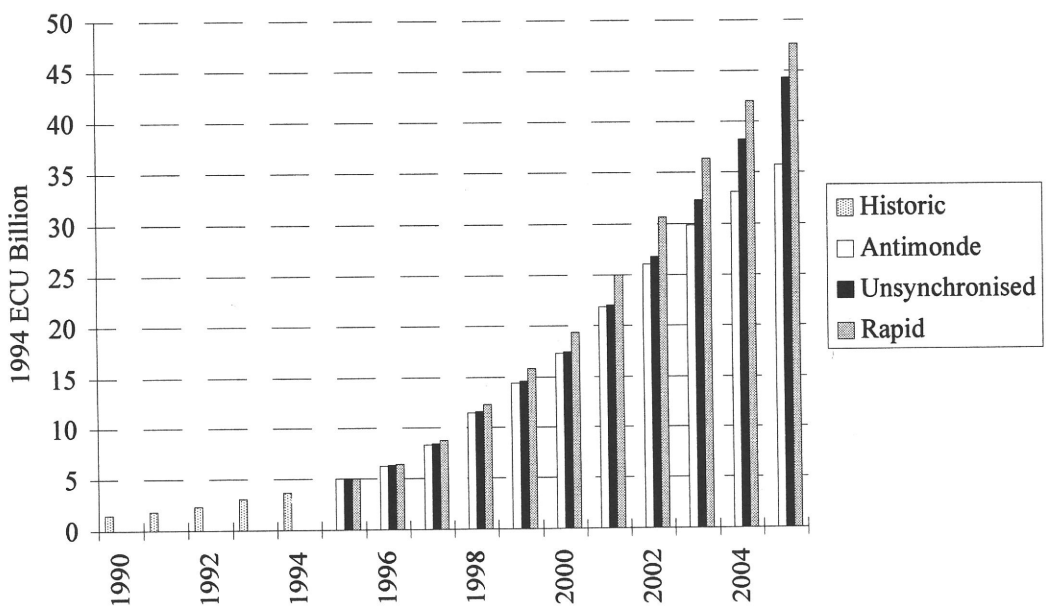
As Figure 4.19 shows, we expect that revenues accruing from value added service provision will grow faster under the rapid scenario than under the unsynchronized scenario. This is a result of the development of the greater range of services discussed above, coupled with the price declines projected for basic services. Total VAS revenues will rize from ECU 5 billion in 1995 to ECU 48 billion (1994 ECU) in 2005 under the rapid scenario. Under the unsynchronized scenario, with fewer players offering a more limited range of services, total VAS revenues are projected to rise to ECU 44 billion (1994 ECU). VAS represent approximately 20% of total sector revenues by the year 2005 under both scenarios.

4.6. Developments in the telecoms sector as a whole

The liberalization processes that will lead to the changes described above have already been put in place. What remains to be determined is the rate of evolution of the sector as a whole under these forces, and the magnitude of the benefits which residential and business users will reap from a wider range of more affordable and more readily available services.

Section 4.6.1 reviews the implications of the three scenarios for total telecoms sector revenues and their sources, by aggregating the bottom-up forecasts for each of the four telecoms sector segments considered above. In Section 4.6.2, these overall operator revenue estimates are then compared to those derived from a top-down econometric analysis based on the historical relationship between telecoms sector performance, macroeconomic conditions, and regulatory and market structure conditions. These assessments of telecoms sector performance then form the basis of our estimates of the impact of liberalization on employment in the EU telecoms sector (Section 4.6.3) and capital expenditures (Section 4.6.4).

Figure 4.19. Projection of VAS revenues, all scenarios



Source: Analysys.

4.6.1. Total sector revenues

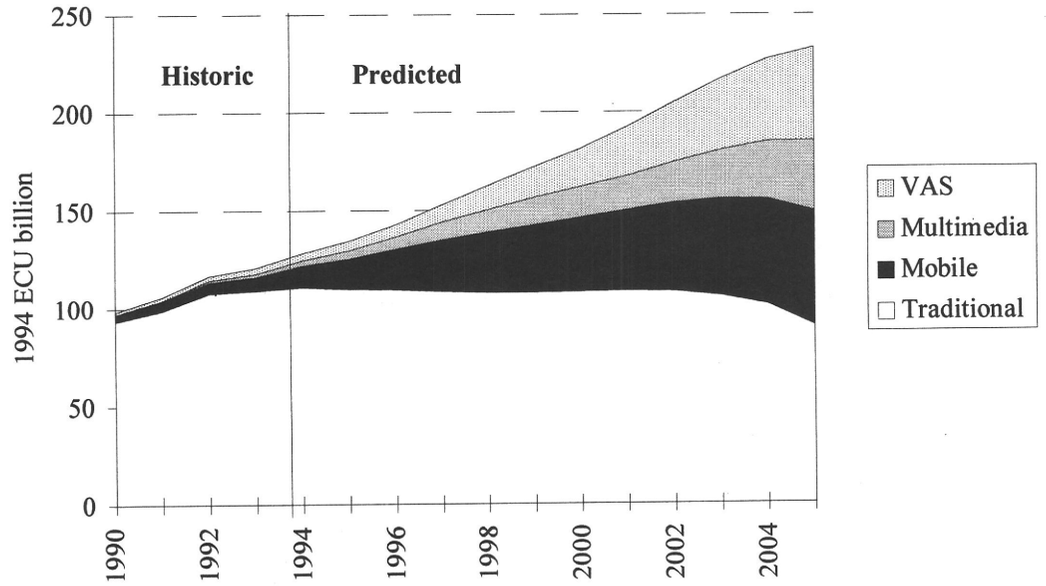
Projections for all four service categories suggest that the structure of the telecoms market and the sources of revenue will change dramatically over the next ten years under both the rapid and the unsynchronized scenarios. The key conclusions in relation to the likely sources of future revenues for the telecoms sector are:

(a) Revenue from traditional services will decline significantly in real terms. Its share in total telecoms sector revenue will fall from the current level of over 80% to 40% of sector revenues by the year 2005 under both the rapid and the unsynchronized scenarios.
(b) Mobile cellular services will become the primary communications device for a significant percentage of EU citizens, with approximately 25% of sector revenues being generated from this source in 2005 under all liberalization scenarios, and between 20% (*antimonde*) and 35% (rapid scenario) of the population subscribing to mobile services.
(c) ISDN will make significant inroads into the business market due to its ability to deliver multimedia services, particularly among SMEs. ISDN will also play an important role in delivering fast and affordable access to the services and applications that constitute the information age for residential consumers.
(d) ATM will not play a significant role within the sector until after the turn of the decade, with only major corporations being significant beneficiaries of this service.
(e) Multimedia-capable services (mainly ISDN) will be used to provide fast and affordable LAN interconnect services between large numbers of small sites, as well as rapid access to the Internet and other online services. PC-based videoconferencing will also become more widespread, and will have a significant impact on processes in businesses of all sizes. As a result, multimedia bearer services, and in particular ISDN, will account for between 12% and 16% of total sector revenues.

Under the rapid scenario, many new players will enter the market. This will result in increased pressure on both service prices and service availability, giving rise in turn to increased take-up and service utilization. Total revenues under this scenario are expected to exceed ECU 232 billion (1994 ECU) in 2005, with non-traditional services accounting for 61% of the total (Figure 4.20). This represents an 8.5% increase in total sector size in the rapid scenario in comparison to the unsynchronized scenario; additional revenues total ECU 89 billion (1994 ECU) more than under the unsynchronized scenario over the ten-year period.

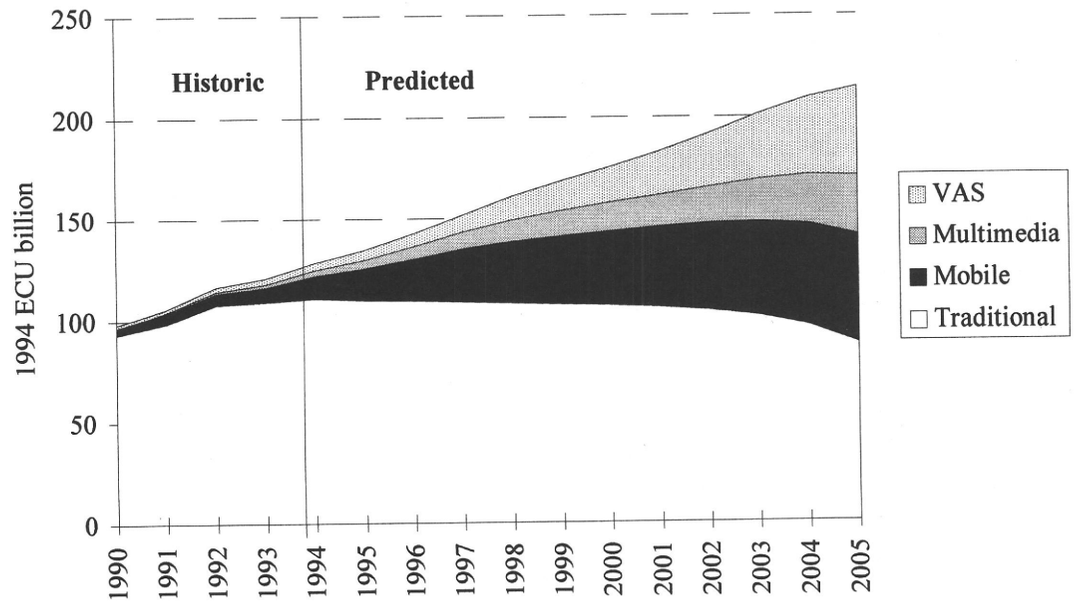
In the unsynchronized scenario, the process underpinning these changes will happen relatively slowly. New entrants will enter the market in each area, but will be limited in number and in the scope of their operations, and will have relatively little impact on cross-border service development. As a result, total telecoms revenues will grow at only 4.8% per annum over the next ten years to reach a value of ECU 214 billion (1994 ECU) by 2005 (Figure 4.21). Over this period, mobile, multimedia, and value added services will constitute around 59% of total revenues. Results for the *antimonde* are shown in Figure 4.22.

Figure 4.20. Breakdown of European telecoms revenues, rapid scenario



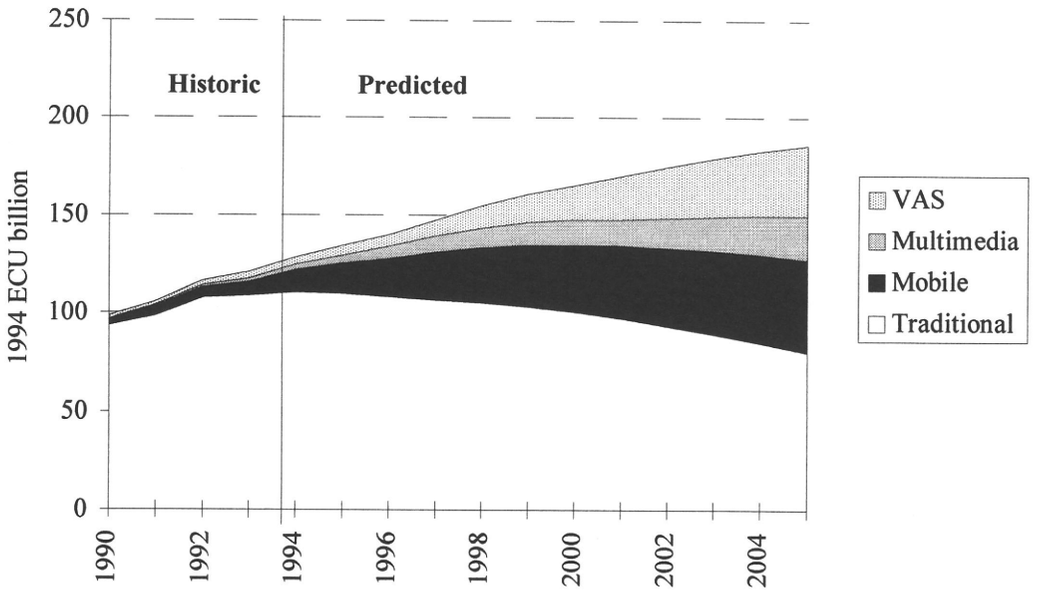
Source: Analysys.

Figure 4.21. Breakdown of European telecoms revenues, unsynchronized scenario



Source: Analysys.

Figure 4.22. Breakdown of European telecoms revenues, *antimonde*



Source: Analysys.

4.6.2. Comparison with results of econometric (top-down) model

The results of the bottom-up forecast methodology described above have been compared with the results of an econometric model relating telecoms sector revenues to indicators of macroeconomic, regulatory and market structure conditions within the telecoms sector. The methodology and the results of this model are explained in more detail in Appendix A.

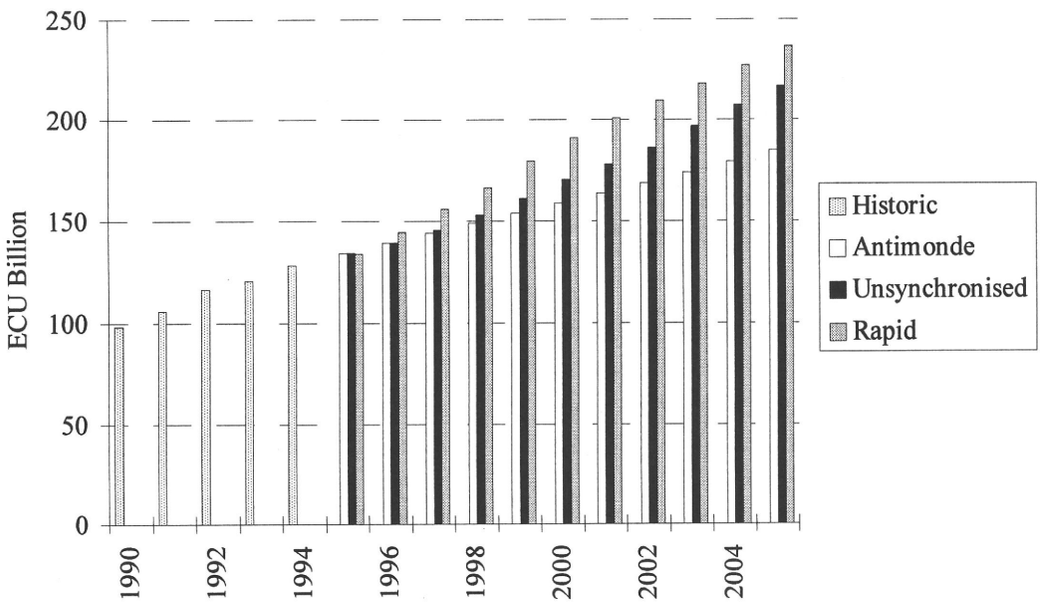
The EU is at the onset of an unprecedented liberalization in its telecoms market. The fundamental changes that will ensue, and the consequent economic impacts, will mark a significant break with the effects observed to date. Thus, statistical analysis based on historical data might provide a misleading view of the economic consequences of liberalization. Nevertheless, we use the results of this analysis to validate the overall trends and magnitudes being forecast under the bottom-up approach.

The analysis is based on a disaggregated set of indicators on regulatory conditions and market structure for the telecoms sectors of 23 major OECD countries (including all 15 EU Member States), dating back to 1973. These diverse indicators were subjected to factor analysis to capture the spirit of their trend with a reduced number of indicators. The two resulting principal factors (which we refer to as the liberalization indices) can be interpreted as broadly representing the degree of independence of the TO from government, and the extent of competition permitted in the market.

The impact of these two liberalization indices on telecoms sector growth was estimated econometrically, with GDP per capita used as a control variable to capture changing economy-wide conditions. Separate equations were estimated for telecoms lines per capita and telecoms revenues per capita in step-wise fashion, on the basis of an annual data set for the 23 OECD countries for the period covering the period since 1973.

Our view of future regulatory and market structure developments under each of the regulatory scenarios discussed in Chapter 3 was then mapped onto the two liberalization indices on a country-group basis, using the results of the factor analysis. These were combined with GDP per capita forecasts for EU Member States, to forecast future telecoms revenue growth and line penetration under the three regulatory scenarios for each country, on the basis of the regression results. The resulting projections of telecoms revenues over the period 1995 to 2005 at the aggregate EU level are shown in Figure 4.23.

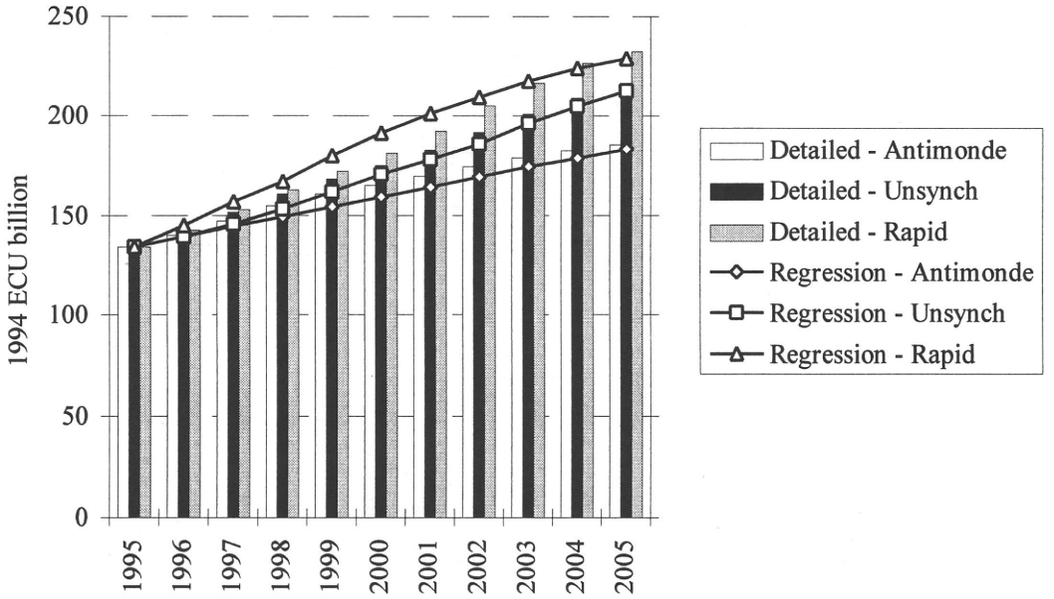
Figure 4.23. Projection of EU telecoms revenues from statistical analysis, all scenarios



Source: Analysys.

Comparing these results with those from our more detailed analysis of the four telecoms service sectors, we find that the predicted revenues in 2005 are very similar, with differences of less than 2% for all scenarios (see Figure 4.24). The major difference is that our detailed bottom-up projections for the four telecoms service sectors indicate that, in the rapid scenario, revenue growth will occur earlier than predicted by the more simplistic econometric analysis, and that, conversely, revenue growth will be later in the unsynchronized scenario than the simplistic econometric analysis would indicate.

Figure 4.24. Comparison of forecast telecoms sector revenues



Source: Analysys.

4.6.3. The impact on telecoms employment

Operator responses to changes in market structure will have a significant effect on both the level and nature of employment within the sector. Downward pressure on prices, resulting from increased competition, will place downward pressures on employment in the sector as operators seek to lower their cost base and increase efficiency. On the other hand, increasing telecoms revenues will have a positive impact on employment in the telecoms sector.

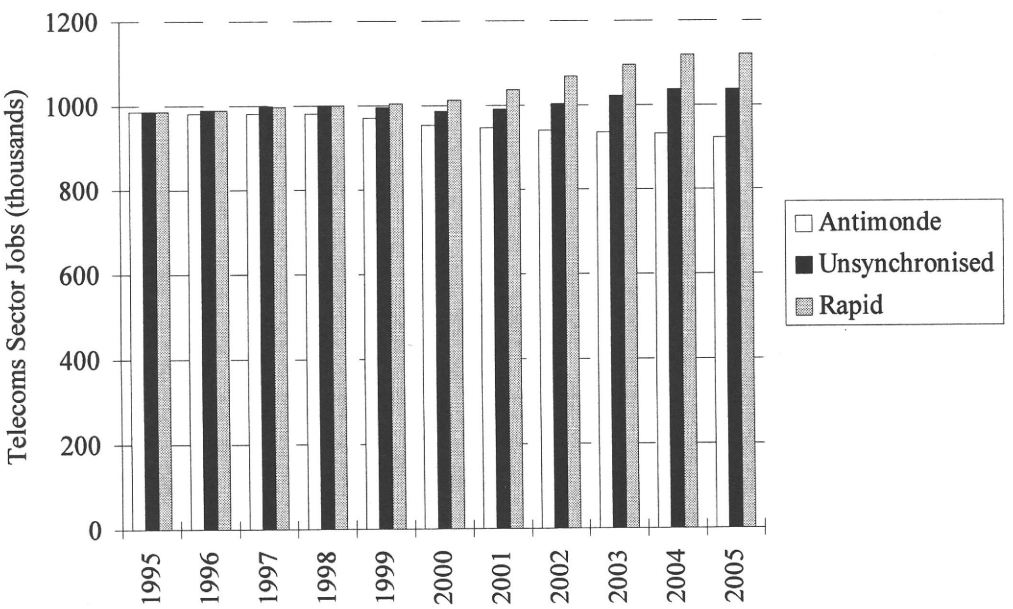
Employment in the telecoms sector has historically been maintained or increased by incumbent TOs expanding their networks, and changes in the overall level of employment in an incumbent TO over the period of this study will depend on its current level of efficiency. TOs with lower efficiency (Telecom Eireann and OTE, among others) are generally continuing to expand their networks and are likely to take advantage of derogations negotiated by their national governments, which will give them more time to resolve their overstaffing problems. However, with telephone penetration in the EU standing at more than one telephone for every two people, the rate of growth of the network is falling, and many of the lines now being installed are additional lines for existing customers, which require less work than lines for new customers. Moreover, increasing intelligence in the network will make network operations possible with fewer employees. Employment in the European telecoms sector has consequently fallen from 1.13 million in 1989 to 0.98 million in 1995. This fall is largely a reflection of a decline in the numbers employed by incumbent operators.

These factors are counterbalanced by developments that will increase employment. Major work is currently being carried out in upgrading existing lines to digital lines. These digitization programmes will be coming to an end in the next few years, but work on installing ISDN lines will accelerate. In addition, TOs are increasing the number of staff they employ in service activities, to reflect their increasing emphasis on the quality of service available to customers (OECD [1995]). Effective liberalization will also create telecoms-related

employment in organizations other than the incumbent TOs. New entrants will construct new networks, create new customer support organizations, and employ additional marketing, sales and financial support staff.

In recent years employment in European telecoms has been in gentle decline. The underlying European trend was exaggerated in 1993 and 1994 due to heavy job losses in BT, which addressed significant overstaffing in a short period in those years. The *antimonde* thus reflects a continuation of the gentle decline of employment according to the existing trend, as illustrated in Figure 4.25. Efficiencies brought about by improvements in technology are matched in incumbent operators by natural wastage, as employees retire or resign of their own volition. Job creation by other operators does not become a significant factor outside the already liberalized markets of Finland, Sweden and the UK. Factors such as privatization do not create incentives for cost savings in incumbent operators because they remain sheltered from competition under this scenario. In summary, the gentle decline in employment in the telecoms sector continues as improvements in technology allow services to be provided with fewer employees.

Figure 4.25. Projection of EU telecoms sector employment, both scenarios



Source: Analysys.

The unsynchronized scenario sees many incumbent operators subject to pressure to cut costs following privatization. However, this trend is compensated by increases in telecoms employment in new entrants. The result is a slight increase in telecoms employment in the short term. From 2001 employment begins to rise more quickly as penetration of new services grows and more customer service personnel are required.

Employment under the rapid scenario follows a largely similar trend to that in the unsynchronized scenario. However, the rise in employment from 2000 is more rapid, resulting in the higher employment levels seen in this scenario. This faster rise is a result of a wider

range of services being made available, and more intense competition to provide personalized services for telecoms customers.

To generate the employment forecast, we established a two-step methodology. The first step is to generate a trend forecast for the period; this is derived from the bottom-up revenue forecasts for each scenario and forecasts in the trend in revenue per employee. Under the *antimonde*, the growth in revenue per employee is assumed to remain within historical standards until the end of the decade, and then trails off to 2.5% per year in the subsequent period. Under the two liberalization scenarios, this trend accelerates faster in the earlier years on account of higher productivity gains induced by competitive pressures.

The second step is to 'shock' incumbent employment numbers downwards in the first few years of liberalization to reflect induced short-term structural discontinuities and adjustments associated with TO corporatization and privatization processes – several major privatizations are expected before 1998 including Deutsche Telekom, France Telecom, Telecom Italia and KPN Netherlands. This is performed for the two liberalization scenarios, where the main differences relate to the expected timing of sectoral reform programmes within each country. The adjusted employment figures are achieved by increasing the rate of change in revenue per employee so that it rises beyond the *antimonde* around the time of liberalization. The increase is greater and earlier for the rapid scenario than for the unsynchronized scenario, reflecting the more concentrated response of incumbent TOs to the liberalization of the telecoms market. The assumed growth rates in revenue per employee are shown in Table 4.6.

Table 4.6. Assumed percentage growth in labour productivity (as measured by revenue per employee) for the three scenarios

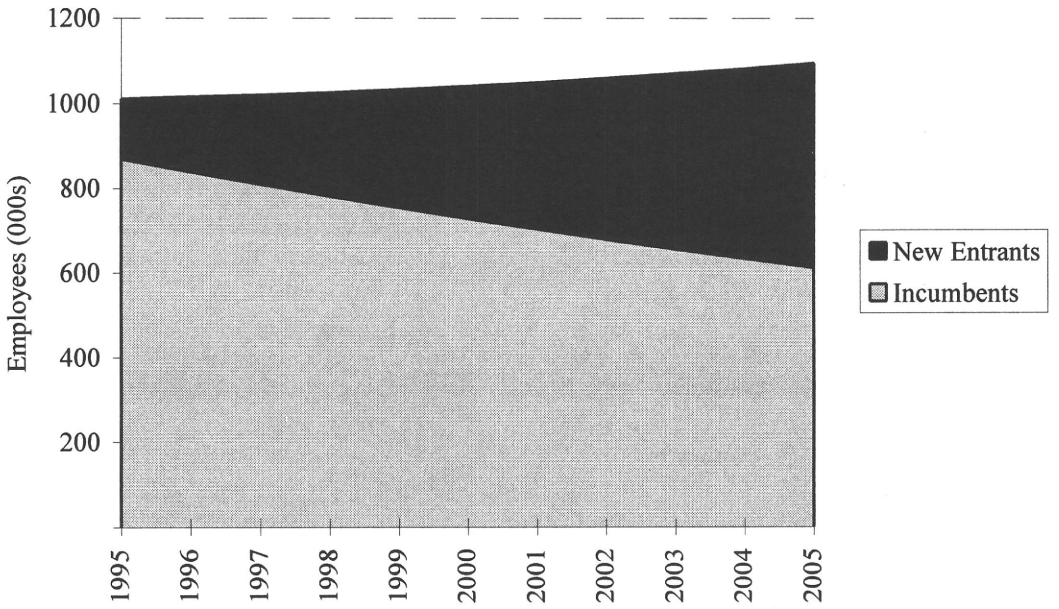
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Rapid	5.0	6	6	6.0	5.5	4.5	3.5	3.5	3.0	2.5	2.5
Unsynchronized	5.0	5.5	5.5	6.0	5.0	5.0	4.0	3.5	3.0	2.5	2.5
Antimonde	5.0	5.0	5.0	5.0	5.0	4.5	3.5	3.5	3.0	2.5	2.5

Source: Analysys.

In all scenarios described above there is a significant decline in the employment among incumbent TOs. This reflects increasing efficiency and falling market share as new entrants enter the market. An extension of the above analysis allows a forecast to be made of the split between incumbent operators and new entrants, as illustrated in Figure 4.26. This shows how the steady decline in employment in incumbent telecoms operators continues over the period modelled. However, the growth in employment by new entrants more than compensates for this decline, causing employment in the sector to rise over the period.[28]

[28] 'New entrants' comprises mobile operators not associated with the incumbent in the country in which they operate, service providers (mobile service providers, value added service providers, and Internet service providers), systems integrators and all the growth in employment in the cable TV sector which will largely be enabled through combining entertainment and telecoms services.

Figure 4.26. Telecoms sector employment: employees of incumbent operators and new entrants



Source: Analysys.

4.6.4. The impact on telecoms capital expenditure

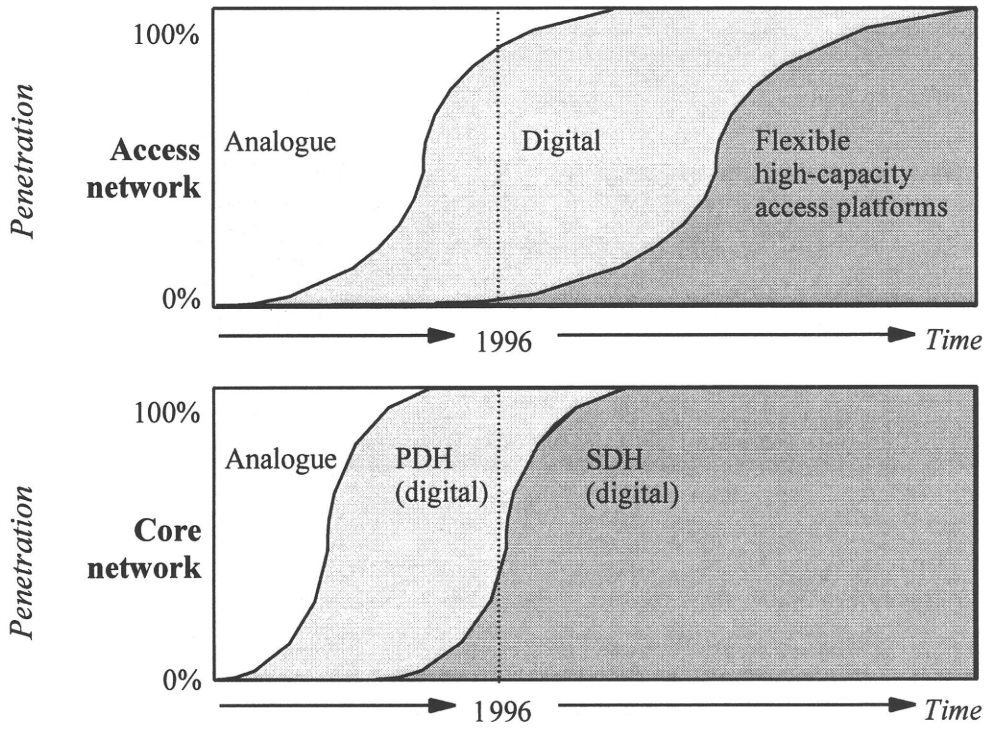
Telecoms networks can be divided into two major sections: the core (or trunk) network and the access network. These networks are the subject of investment cycles, which increase the capacity/reliability of these networks. We have recently seen the completion of the investment cycle which upgraded the core network in Europe, making it completely digital (based on PDH) and capable of carrying high bandwidth communications. Another investment cycle is now well under way with the older PDH technology being upgraded to SDH (Figure 4.27).

The access network has been upgraded more slowly and digital lines to the customer are still being rolled out. However, evidence is emerging of the start of a new investment cycle in the access network, providing flexible high-performance access platforms for some customers in major population centres, and particularly in leading financial centres such as the City of London, where new operators such as MFS are providing high bandwidth ATM access. These platforms will become more prevalent as more customers require higher bandwidth access. However, it is also likely that other technological advances, such as using ADSL, to allow high capacity transmission over standard telephone lines, will become widespread.

The situation that exists now is that virtually all telecommunications networks are capable of carrying high bandwidth communications even if they are not actually used for this. Therefore all current and future network investment will provide high capacity networks. Future telecoms capital expenditure can be seen as relating to two activities:

(a) recurring investment by operators to maintain and replace infrastructure,
(b) roll-out investment by operators to provide new networks or services.

Figure 4.27. Core and access network stylized investment cycles

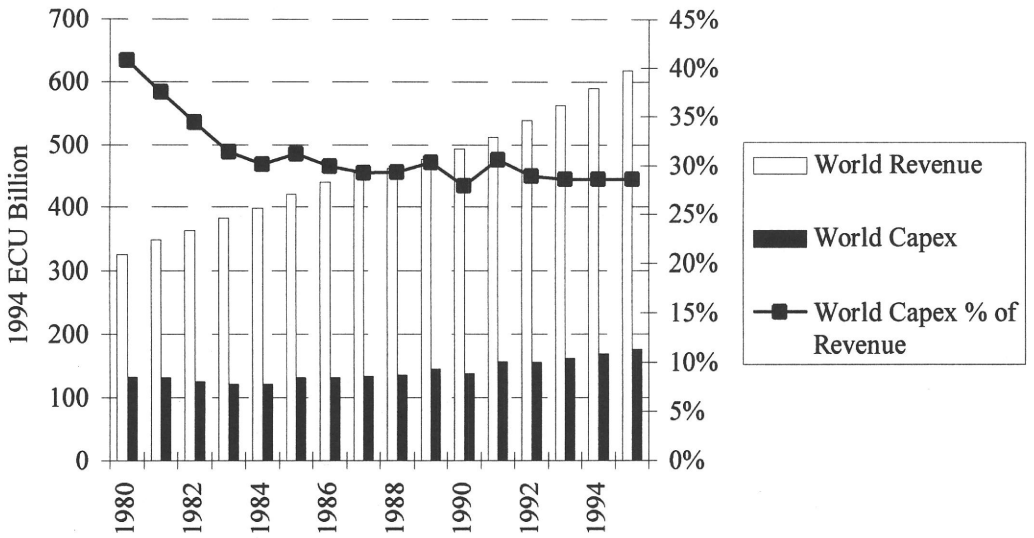


Source: Analysys.

Work undertaken recently by Analysys (Cleevely [1995]), illustrated in Figure 4.28, shows that telecoms capital expenditure world-wide fell as a percentage of telecoms revenues in the early 1980s, but has since stabilized at around 28%. This pattern contrasts with the evolution of capital expenditures by European TOs over the same period, which does not show a discernible trend. This is because the predominantly state-owned European TOs have had to compete with other demands on public funds: telecoms capital expenditure has depended more on governmental spending priorities than on the industry's requirements. However, Europe has a highly developed telecoms infrastructure by world standards, so we would expect European levels of capital expenditure to be lower than the world average. Recent work undertaken by Analysys indicates that recurring telecoms capital expenditure is likely to stabilize at 25% of telecoms revenues in EU countries (Cleevely [1995]).

The major factor influencing future roll-out capital expenditure will clearly be the number and type of new operators entering the market, and the scope of their activities. For instance, fixed-wire operators operating PSTN services (e.g. cable TV companies) will, by necessity, invest significantly more than regional wireless operators offering the same service; similarly, operators offering national coverage to residential markets will be required to invest significantly greater amounts than niche market local loop players.

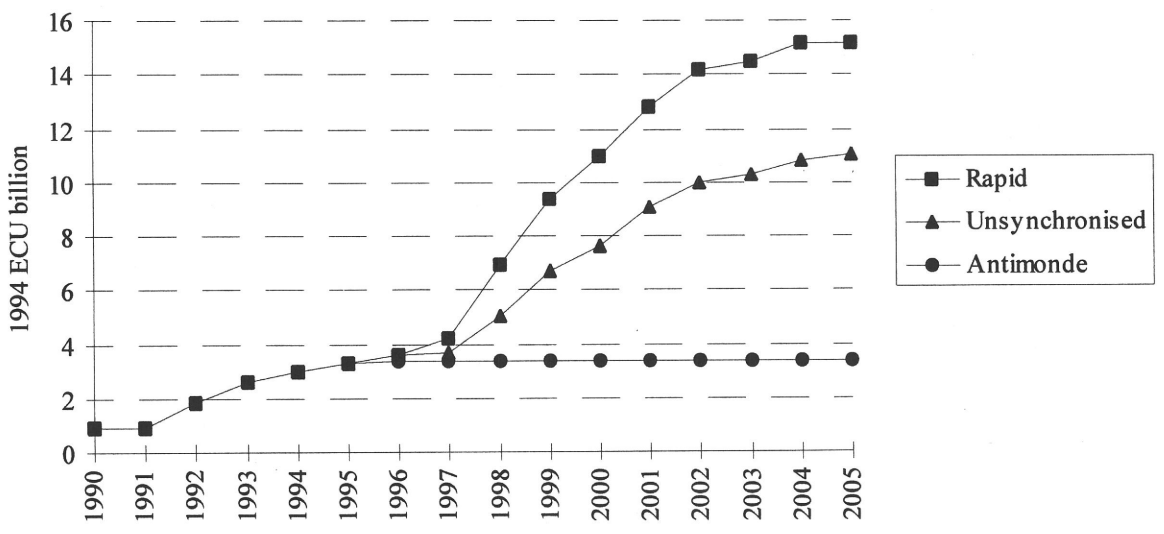
Figure 4.28. World-wide capital expenditure by TOs as a proportion of world-wide telecoms revenues



Source: Analysys.

Roll-out capital expenditures have been estimated on the basis of the number and type of new entrants forecast under each scenario for each segment of the telecoms market. The investment profile for entrants' roll-out is estimated on the basis of trends observed in the UK since 1990, scaled by the assumed size of the operator and the market. Appendix B reviews the capital expenditure patterns of recent entrants in the UK and details the corresponding assumptions used in this analysis. Figure 4.29 shows estimated capital expenditures by new entrants under each scenario. The introduction of new operators is estimated to generate new investments of ECU 11 billion to ECU 15 billion (1994 ECU), depending on the speed of liberalization.

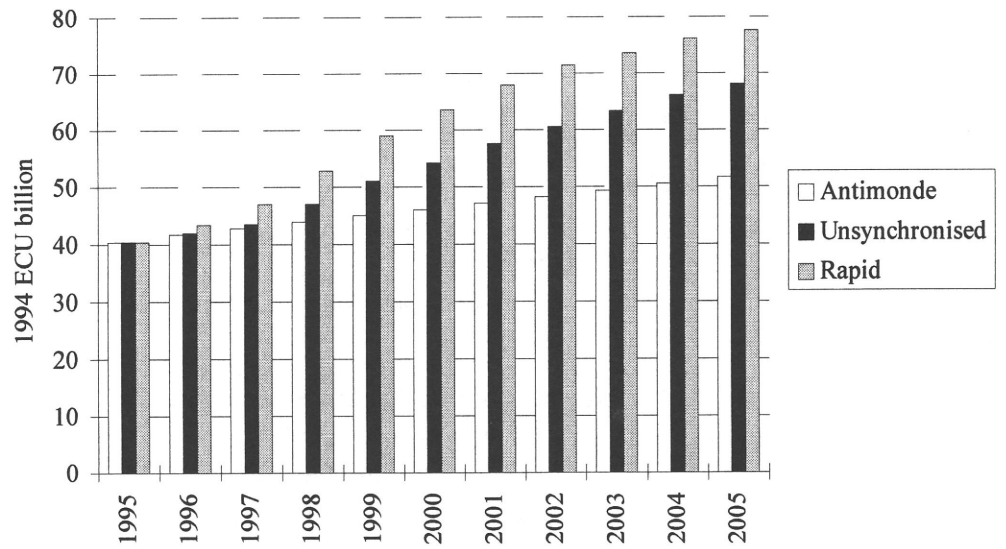
Figure 4.29. Forecast of capital expenditure by new TOs, all scenarios



Source: Analysys.

Overall, capital expenditure among European operators will rise at 5.3% per annum under the unsynchronized scenario, and 6.7% per annum under the rapid scenario as 1998 approaches and significant numbers of new players enter the market (see Figure 4.29). By 2005, new operator investment will have risen to between ECU 11 billion and ECU 15 billion per annum under the unsynchronized and rapid scenarios respectively, while incumbent investment will have risen from ECU 37 billion to between ECU 57 billion and ECU 62 billion per annum (1994 ECU).

Figure 4.30. Forecast of telecoms capital expenditure by all operators, all scenarios



Source: Analysys.

4.7. Summary of the impact of liberalization on the telecoms sector

This chapter has detailed the mechanisms through which telecoms liberalization will lead to increased affordability, accessibility, and functionality of telecoms services, and the extent to which these changes are affected by the degree of liberalization. Greater liberalization will be marked by increased revenues for all services, and particularly rapid growth in non-traditional areas such as mobile communications, multimedia and value added services. The telecoms sector across the EU will be 5% larger in 2001 under the rapid scenario than under the unsynchronized scenario, and by 2005 the difference will have grown to 9%. These differences represent substantial amounts of money: the corresponding additional revenues over the ten-year period to 2005 will amount to ECU 89 billion. Moreover, employment within the sector will also increase significantly – the difference is an extra 80,000 jobs by 2005.

The economy will benefit not only directly, from increased expenditure and increased value added in the sector, but also indirectly, from the impact of telecoms on organizations. Advances in telecoms services can lead to significant benefits for organizations, as they use telecoms to improve many aspects of their operations. The increase in revenues which result from liberalization are substantial because, despite the more rapid reductions in tariffs induced by liberalization, demand grows very rapidly, as users take advantage of not just lower prices but also greater accessibility and functionality. Why and how users take advantage of telecoms, and the implications for different sectors in the economy, are the subjects of the next chapter.

5. Impact on the EU economy: sector studies and location

5.1. Introduction

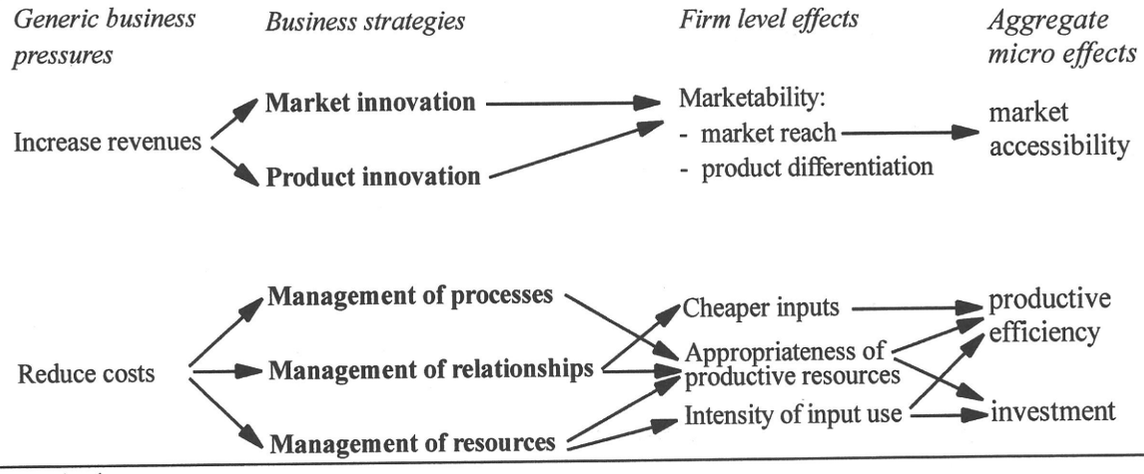
This chapter discusses the ways in which the creation of a liberalized single information market is bringing about changes in the behaviour of firms and organizations, including changes to the locations of their operations. It also discusses the ways in which the spread of advanced communications can support the process of European economic integration through the fulfilment of the single market.

The primary focus of this chapter is on the generic business pressures that are confronting firms in ten key sectors of the European economy, and on the strategies that businesses employ in response to these pressures. These strategies are categorized according to their impact on the sources of revenue available to firms and mechanisms to control and reduce costs. The chapter then considers the ways in which the adoption and use of telecoms services (fostered by changes in affordability, functionality and accessibility brought about by telecoms liberalization measures) interact with the strategies used. This allows the analysis to identify those opportunities where there is a synergy between the business strategies on the one hand and the use of telecoms services on the other.

The business strategies map onto the firm-level effects which emerge from the liberalization of the telecoms sector, and onto aggregate micro effects, as discussed in Section 2.3.4. This establishes the context for the interpretation of the macroeconomic impacts of a single liberalized information market which is contained in Chapter 6. Discussion of the impact of the use of telecoms in various sectors will inform the debate over the nature and magnitude of the multipliers used to assess the macroeconomic results.

The translation of the generic business pressures through to business strategies and firm-level effects is shown in Figure 5.1.

Figure 5.1. Business strategy implications of telecoms liberalization



Source: Analysys.

This chapter summarizes the results of data collection through primary and secondary sources, in relation to ten major sectors of the economy. The choice of sectors was defined by the

relative importance in terms of expenditure on telecoms services: the ten sectors chosen account for approximately 70% of business telecoms services revenues in the EU. The sectors are aerospace, automotive and engineering manufacturing; healthcare; travel and transport; finance; electrical and electronic manufacturing; retail and distribution; entertainment, printing and publishing; chemical, pharmaceutical and oil; education; and other government. A fuller discussion of the methodology of the survey and a detailed review of each sector are contained in Appendix C.

5.2. Business strategies

This section describes in general terms the five business strategies that firms are using to respond to generic business pressures and which are driving organizational change. The generic pressures confronted by an organization can be divided into those that deliver 'revenue' benefits and those that deliver 'cost' benefits.

In terms of revenue-orientated strategies two distinct courses can be identified:

(a) *Product innovation*, i.e. innovation that increases the functionality of products and services in order to capture additional value from existing customers or to attract new customers.
(b) *Market innovation*, i.e. innovation that enables a company to enter new geographical markets or increase its share of existing markets by use of new delivery mechanisms.

In terms of cost-orientated strategies, three distinct courses can be identified:

(a) *Managing internal processes*, i.e. redesigning internal processes in order to do things more efficiently (e.g. accelerating business processes) or effectively (e.g. creating new flows of information between business units, thereby enabling better decision making). As a result of changing a firm's internal processes, new organizational forms may come into existence: for example, the emphasis of the firm may move away from functional-based activities and towards more customer-focused business processes.
(b) *Managing relationships*, i.e. management of external relationships with suppliers and customers in order to achieve better co-ordination between consumption and production. Relationships with suppliers are particularly important, as companies seek to achieve higher quality inputs delivered as and when required, thus eliminating the need to hold expensive stock. Better co-ordination of activities between firms can also result in collaborative relationships capable of supporting new product design and research and development.
(c) *Managing resources*, i.e. making better use of existing resources by improving skills and decision-making processes, and in allocating capital and other resources. Unused productive capacity carries a significant cost penalty on firms: the objective is to increase the intensity with which resources are used and improve the co-ordination of activities within a firm, enabling significant cost reductions without lowering quality.

5.3. Business pressures and sector dynamics

The purpose of this section is twofold:

(a) to assess the relative importance of the five business strategies described above to the ten sectors;

(b) to consider the relative importance of telecoms services to the implementation of each of the business strategies.

The source material for this section is in Appendix C, which contains a sector-by-sector description of the change processes occurring in each sector, together with an assessment of the impact of telecoms services on each sector.

5.3.1. Sector importance of business strategies

Product innovation

In terms of revenue-orientated strategies, product innovation is of greater importance than market innovation (largely because many of the markets are relatively mature). In our assessment, in seven of the ten sectors reviewed product innovation is of importance, and in two sectors (electrical and electronic manufacturing, and chemical, oil and pharmaceutical) it is critically important. The individual sector commentaries in Appendix C confirm that the opportunities for developing new sources of income from product and service innovation are essential in an increasingly competitive market. Market instability is increasing as a result of customer demand for customized products, and the processes of technical change which foster new product development. In response to this market volatility, manufacturers and service providers need to focus on rapid product development strategies. A company which is able to react faster than its competitors in terms of identifying new products and bringing them to the market recovers its return on investment more rapidly. This gives the firm the flexibility to manage its portfolio of products more aggressively, i.e. to launch new products when the market requires them, rather than persisting with existing products which have not yet recovered their costs.

Market innovation

Market innovation is of relatively low importance in a number of sectors, reflecting in some cases the well-established international nature of business (e.g. aerospace) and in others the national focus of the sector and its relatively stable delivery mechanisms (e.g. healthcare). However, in certain sectors the opening up of new markets is dependent on the ability to develop new distribution channels. Such profound changes are best illustrated within the finance sector where new products have been created and new geographical markets have been exploited following radical redesign of distribution channels. This process has in turn been driven by the need to improve customer service and the perception of value added which is provided by financial institutions.

Managing internal processes

In terms of cost-orientated strategies, changes in the management of processes are most important across the sectors. A theme that emerges consistently from Appendix C is the importance attached to the redesign of business processes and to a shift towards cross-functional processes focused on the needs of consumers. In embracing cross-functional teams, firms are more able to ensure the 'appropriateness of productive resources' (e.g. ensuring that production capacities are well balanced with demand) and thereby help to contain costs. Management of processes is having the greatest impact in the aerospace, healthcare, and finance sectors, which share a recent history of adopting management concepts such as business process re-engineering.

Managing relationships

The second most important strategy is managing relationships. The aerospace, finance, electrical and electronic manufacturing, and retail and distribution sectors recognize the potential of inter-organizational activity and the need for co-ordination in order to enhance their competitive positions. The introduction of new manufacturing strategies, such as lean production and just-in-time systems, necessitates close inter-working between organizations, and thus the careful management of relationships. Companies are beginning to move to a position where they wish to exploit collaborative advantage rather than the more narrowly-defined competitive advantage, i.e. basing a competitive position on access to and use of resources, rather than ownership of those resources. This allows a company to be more flexible and responsive to customer demand, which is critical in unstable markets.

Managing resources

Changes in the management of resources appears to be a major strategy in relatively few sectors, with the exceptions of finance and healthcare. In each of these sectors, the motivation is different. In the finance sector, the management of resources is an important element in overcoming issues of skills shortage which have arisen as liberalization has broken down the boundaries between traditionally separate markets. In the healthcare sector, changes in management philosophy are bringing into question the nature of resource allocation procedures and the allocation of staff between a wide array of functions. As detailed in Appendix C, these changes are bringing about a greater intensity in the use of resources.

Table 5.1 summarizes the use of these five business strategies across the ten industry sectors.

Table 5.1. Sector importance of business drivers

	Revenue benefits		Cost benefits		
	Product innovation	**Market innovation**	**Management of process**	**Management of relationships**	**Management of resources**
Aerospace, automotive and engineering	◑	○	●	●	◑
Healthcare	◑	○	●	◑	●
Travel and transport	◑	◑	◔	●	◑
Finance	◕	●	●	●	●
Electrical and electronic	●	◔	●	●	◑
Retail and distribution	◔	◑	●	●	○
Chemical, pharmaceutical and oil	●	○	●	◕	◕
Entertainment, printing and publishing	◕	◕	◔	●	◔
Education	○	◑	◑	○	◑
Other government	○	○	●	◑	◑

Source: Analysys.

5.3.2. Impact of telecoms services on business strategies

The purpose of this section is to describe briefly the relative importance of the adoption and use of telecoms services to the business strategies outlined above: further detail is provided in Appendix C.

Revenue-orientated strategies

In terms of revenue-orientated strategies, the adoption and use of telecoms services is making, or is set to make, a substantial contribution in three sectors: travel and transport, finance, and entertainment, printing and publishing. In each of these sectors telecoms has a major impact on both product and market innovation.

In the travel and transport sector, the adoption of telecoms services is creating new opportunities for both product and market innovation. For example, in terms of product innovation, the use of telecoms services is central to the ability of tour operators to create holidays and travel plans tailored to the individual needs of customers, while still maintaining the advantages of a volume buyer in terms of lower prices. Furthermore, the use of telecoms technologies, such as interactive multimedia systems, permits the novel packaging of travel products allowing potential consumers to gain a much better understanding of the 'products' they buy. In terms of market innovation, telecoms technologies are creating new distribution mechanisms, which are in turn allowing new geographical market opportunities to be exploited. Individual suppliers of travel services are able to market their services directly to a wide range of consumers in diverse geographical markets, bypassing the dominant tour operators in each market.

In the entertainment sector, market innovation focuses on new delivery mechanisms, such as the Internet, and there is considerable debate as to the effects these will have on the industry and on relationships with consumers. There are strong possibilities for music to be downloaded from the Internet rather than purchased on physical media such as tapes or compact discs. In the Netherlands, a record company is already experimenting with the local printing of compact discs – it has been argued that local printing (i.e. in the retail outlet) makes it possible to overcome many of the problems associated with aligning stock to consumer needs (Boumann [1995]). Similarly, developments in local loop technology will allow customers to download films on demand over telephone lines or broadband cable networks.

In terms of product innovation, many newspapers and periodicals have already established a presence on the Internet, allowing access to their publications, and some papers are using 'intelligent agents' to learn the reading behaviour of individual consumers, so allowing the development of personalized newspapers. The development of a set of generic 'intelligent agents' would allow the creation of individualized newspapers from a variety of sources, thereby adding value to the existing products and services.

In the financial services sector, the use of new technologies has led both to the creation of new products and highly sophisticated variants on existing products (such as options trading and derivatives) and to the reshaping of services offered to the general public. The most notable product innovations relate to the introduction of telephone-based financial services. In recent years, financial institutions which deal with the public have recognized that maintaining a presence in town centres is less cost effective than dealing with customers by telephone.

Organizations such as the First Direct bank and Direct Line Insurance in the UK are now offering banking and insurance services entirely by telephone. The revenue and cost benefits of doing business this way are considerable. Organizations providing these services are able to cover the costs of the telephone calls made to them by their customers and are still in a position to undercut financial institutions operating in a more traditional manner.

The financial services sector in Europe is considerably more liberal than those in the USA or Japan and different types of financial services companies are moving into one another's markets: for example, in Europe, it is becoming common for banks to offer insurance cover. The management of complicated packages of financial services for customers, covering banking, insurance and other requirements, is predicated on the use of new communications technologies.

Cost-orientated strategies

With regard to cost-based strategies, telecoms services are having the most significant contribution in terms of managing relationships. As firms adopt new forms of behaviour predicated on the co-ordination of activity between different organizations, the importance of telecoms increases: widespread adoption of lean production and just-in-time techniques, and the closer relationships with suppliers that these require, lead to increased use of telecoms services. Similarly, telecoms services are rapidly becoming a necessary condition for the deployment of geographically dispersed teams, which are a central feature of inter-organizational activity.[29]

In the travel and transport sector, the benefits of telecoms services largely flow from the ability to co-ordinate activities more closely between different agencies. The co-ordination of mode shifts in a journey is of critical importance in sustaining the competitiveness of a product. Retailers and consumers are equally concerned that goods be delivered within a guaranteed period, and in freight transport, goods need to be monitored at all stages of a journey through 'track and trace' systems. The need for this is particularly acute because the transport sector is having to respond to changes brought about in other sectors, for example, the adoption of lean manufacturing. In effect, there is a growing need to establish 'common knowledge' between all the organizations involved in the manufacture, distribution and consumption of a product or service (Cremer [1990]; Borman et al. [1992]).

The control of costs is an issue which haunts the healthcare sector throughout the EU. In part, the pressure on healthcare costs has been created by improvements in medical technologies and clinical practices leading to an ever increasing number of cases in which medical intervention is possible and desirable. Advances include organ transplants, joint replacements, laser and keyhole surgery, and the successful treatment of major illnesses (heart disease, cancer, diabetes, etc.). The undoubted benefits of such advances do, however, cause healthcare costs to spiral. For example, in 1991, healthcare expenditure in the EU increased by 14% (Eurostat [1994a]).

Telecoms can help to control this increase in costs by improving the management of resources and processes. There is scope for the sharing of expensive equipment between several

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29 For example, Ford has established product teams which cut across country boundaries and organizational structures.

hospitals using communication over public or private networks. As mentioned above, telecoms can provide hospitals with access to the specialist services available from centres of excellence through online information systems, videoconferencing, and interactive diagnostic services. Consultations with medical specialists using videoconferencing systems will lead to more efficient throughput of patients, and minimize significant travel, disruption and costs. Storage and transmission of medical records (including X-rays and other detailed information) is resource-intensive. New storage technologies not only decrease the cost of holding machine readable records but allow such records to be accessed quickly and accurately by medical staff.

In the automotive sector, processes of automation are now being superseded by the introduction of lean production techniques. Such techniques are designed with the aim of minimizing stockholding costs and facilitating the closer integration of consumption and production, and therefore require the closer management of relationships and processes. The design and production of components and finished products is more closely related to demand as expressed in 'real time'. For example, many motor vehicle manufacturers now only manufacture cars that have been already sold. This reduces costs and allows customization of vehicles for individual customers at a great level of detail. BMW currently offers more than 30,000 variants of its cars and each car sold is tailored to the individual customer's requirements.

Lean production necessitates greater co-ordination between component suppliers, buyers and the manufacturer which can only be achieved cost effectively by using communications services such as EDI. EDI is used in the automotive sector to:

(a) integrate the design process between numerous suppliers and the main manufacturers;
(b) communicate frequent small batch orders to suppliers;
(c) take orders from dealers, communicating specifications for vehicles which have been sold and which need to be manufactured.

In the aerospace industry, this trend is even more pronounced. In recent years, new civil and military aircraft in Europe have been produced by multinational partnerships. Those companies that have failed to join international alliances have lost market share and in some cases have closed, e.g. Fokker in the Netherlands. This need for businesses to form international alliances is well illustrated by the current discussions over the future of Dasa and its Dornier Luftfahrt turbo-prop aircraft business. Such alliances focus attention on the need for the close management of relationships.

A summary of the contribution that telecoms can make to the business strategies being developed in response to an increasingly competitive and uncertain business environment is set out below in Table 5.2.

Table 5.2. Assessment of the impact of telecoms services on the sectors via the business strategies

	Revenue benefits		Cost benefits		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Aerospace, automotive and engineering	◑	◔	◑	●	●
Healthcare	◔	◑	◕	◕	◔
Travel and transport	◑	●	◑	●	◑
Finance	●	●	●	●	●
Electrical and electronic	◑	◑	◑	●	◔
Retail and distribution	○	◕	◕	●	◔
Chemical, pharmaceutical and oil	◑	○	◑	●	◑
Entertainment, printing and publishing	●	●	◕	◑	◔
Education	○	◕	◑	◕	◕
Other government	○	◑	◕	◕	◑

Source: Analysys.

5.4. Overall impact of telecoms liberalization measures

The impact of telecoms on the ten sectors reviewed is uneven, both in terms of the overall impact of telecoms on the sectors themselves and, within each sector, the degree to which telecoms influences revenue streams or cost structures. The finance sector and the entertainment, printing and publishing sector appear to be the major beneficiaries of the adoption of telecoms services. This reflects the fact that telecoms is capable of being well integrated into the products and processes of these sectors and thus acts as a catalyst for major change within the sector. The majority of sectors appear to benefit from the use of telecoms services through their ability to change cost structures through enhanced co-ordination of resources or through lower input costs.

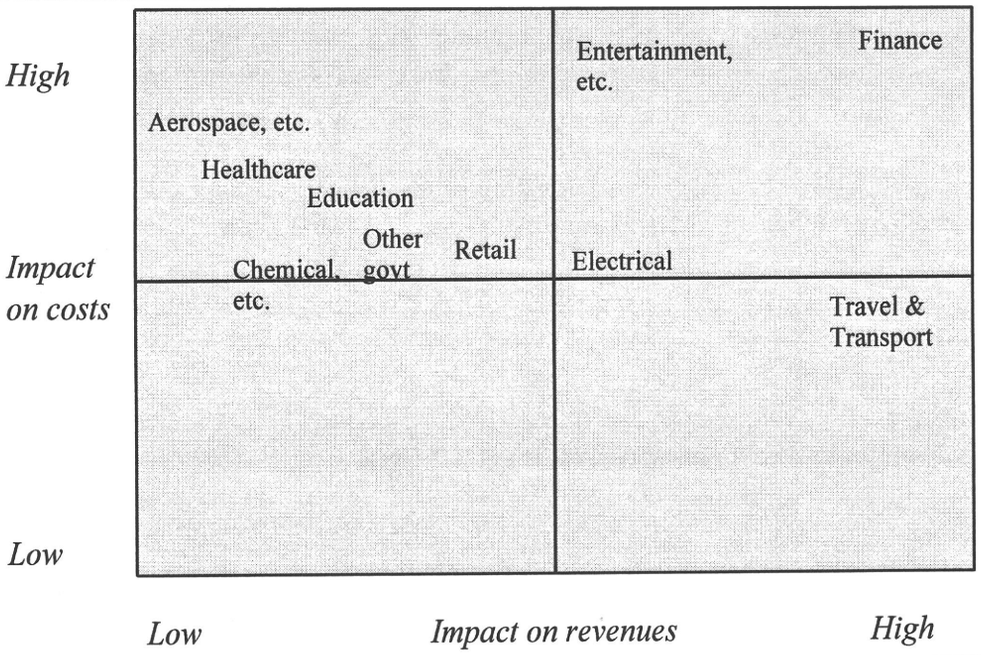
However, there are some gaps between the business needs of the sectors and the role that telecoms can play in facilitating an effective strategic response:

(a) Revenue-orientated strategies: the sectors studied typically emphasized a focus on product innovations when developing business strategies but the major contribution of telecoms is biased towards market-based innovations. For example, the use of telecoms is critical to developing market innovations in the travel and transport sector but overall such innovative activity is of modest importance in the sector.

(b) Cost-orientated strategies: while the management of processes has been identified as the most important element of cost control strategies, the greatest benefit from the use of telecoms services is derived from strategies designed to manage relationships.

These observations (summarized in Figure 5.2) suggest that the predominant effect of liberalization in the telecoms sector will manifest itself in enhanced competitive positions through lower costs rather than in the direct creation of new revenue streams.

Figure 5.2. Telecoms impact on the ten sectors (illustrative)



Source: Analysys.

5.5. Impact on the location of economic activity

This chapter closes with an assessment of the geographical concentration and dispersion of economic activity that may occur as a result of the increased affordability, availability and accessibility (and functionality) of telecoms services. The uptake and use of telecoms services by firms is a significant influence on the location of economic activity and thus on patterns of regional economic development. It is therefore important to examine possible implications of telecoms liberalization for how companies and people locate, and the impact this might have on processes of European integration.

5.5.1. Telecoms networks and their relationship to spatial organization

The widespread adoption and use of information and telecoms technology will transform the products, services and business processes of well established industries and redefine their competitive advantage. It has already created new industrial sectors, such as software, microelectronics, multimedia and information. The 'creative gales' of destruction (Schumpeter [1934]) are redefining the bases on which firms build their competitive strengths, and on which regional comparative advantage is secured, and have a number of immediate and important implications:

(a) The *ability to separate physically employment and investment*. Firms can now exploit differences in geographical markets for capital and labour both within the EU and globally.

(b) *Simultaneous access to capital resources*. The technical structure of information capital, especially computers and some software, begins to bring into question the basic idea that capital is indivisible, and enables greater exploitation of a given resource.

(c) *Increased flexibility.* By being able to bring appropriate resources to bear without having to have them present and available at a specific location, significant improvements in efficiency of use of resources may be possible.

(d) The *rapid transfer of productivity gains from one location to another.* Corporate networks allow organizations to learn and replicate behavioural patterns as a result of computer- and communication-based transactions. In an integrated and increasingly international economy, the rapid transfer of productivity gains can deliver significant advantages to multi-site firms operating in more than one distinct labour market.

(e) The *routinization and codification of decision-making processes.* The way in which processes are codified and operated has a major bearing on the quality and timeliness of the output. Telecoms and IT enable processes to be implemented more easily and to be changed in response to developing circumstances. They can also affect the routines of the organization (Nelson and Winters [1982]) leading to fundamental changes in the culture and values of an organization.

(f) *Redefining the relationship with the market.* The way in which distribution channels are structured and the way in which goods and services are delivered to the consumer can be completely changed using communications networks, and can lead to very significant competitive advantages for the organizations concerned.

These effects support the development of new forms of corporate networking and thereby bring about new spatial divisions of labour and capital (Hepworth [1989]; Capello and Williams [1992]).[30] The creation of 'corporate' networks is facilitating new geographical patterns of economic activity within and between organizations, especially as multi-location working is becoming widely adopted, at least among larger corporations. The impacts of networks are also observable in the innovative ways in which telecoms is used to augment or supplant sales and distribution. Finally, there are cost and efficiency savings to be made through locational concentration, by using 'customer' networks to support market and sales links with final consumers, as discussed below.

There are a number of organizational issues which emerge as a consequence of the extensive use of corporate networks to mediate internal processes and economic activity between firms (Malone and Rockart [1992]). Corporate networks enable firms to shift the emphasis of the organizational structure away from 'control' and towards 'co-ordination', particularly with regard to asynchronous working or the linking of teams dispersed across different cultures and countries, and promoting flexible and specialized production.

Inter-firm co-ordination is becoming crucial as firms trade in increasingly volatile markets where short product cycles and high development costs militate against the development of a broad range of in-house competencies. In this context, asynchronous working is becoming increasingly significant: not only does it facilitate the co-ordination of specific activities, but it also allows firms to increase the range of activities that can be incorporated into their own processes at relatively low prices and risk.

Similarly, flexible and specialized production is another response to increasing competition and volatility in markets, and the need to do more than exploit finite economies of scale. Central to this new production structure is the notion of flexible specialization (Aglietta

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30 For a discussion of the technical, economic and social characteristics of these networks see Barrett and Konsynksi [1982].

[1987]; Piore and Sabel [1987]). Here the focus is on the ways in which firms can better co-ordinate their own production activities in the light of changing consumer behaviour and technologies. The use of new technologies (which are inherently capable of being reconfigured), and the implementation of decision-making and co-ordination techniques and associated communications are fundamental to achieving flexible specialization (Gillespie and Williams [1988]; Capello and Williams [1992]).

5.5.2. Sectoral impacts

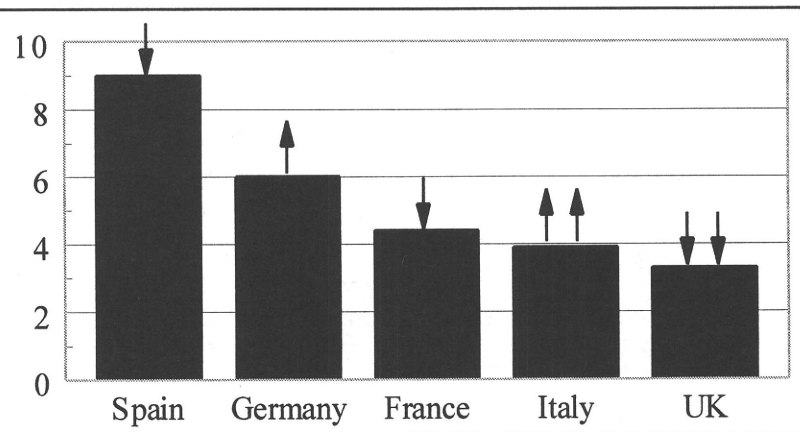
The regulatory environment has a direct bearing on the development of diffusion and use of corporate networks. In a liberalized environment, where processes of competition and customer choice result in the proliferation of services (availability), improved quality of services (functionality), and lower costs (affordability), corporate networks tend to be more intensively used and thus better integrated into the processes and structures of an organization, in supporting both internal processes and relationships with the market.

However, the impacts of telecommunications on different sectors are diverse and may or may not result in further concentration, depending on the nature of the operations in questions. Below we give two examples to illustrate this point.

Retail banking

Intense pressure to cut costs has resulted in the UK having the lowest number of retail bank branches per head in Europe, and this number is still falling rapidly as illustrated in Figure 5.3. Many of the functions previously carried out at retail branches have been concentrated in regional clearing centres, supported by telecoms and computer networks, and this process has enabled staff, and thus cost, reductions. The arrows on the figure show the rate of change in total employment in the industry.

Figure 5.3. Number of banks per 10,000 population, 1994



Source: Analysys.

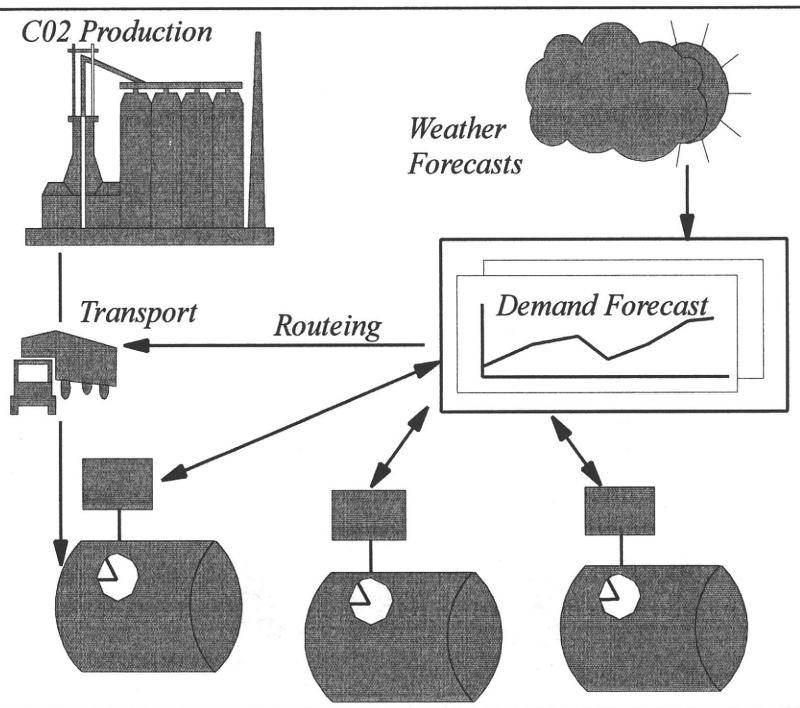
At the same time, there has been a change in the way in which banking services (and other financial services) are offered to the consumer. First Direct launched a telephone-based banking service in 1989 in the UK and this was shortly followed by Direct Line telephone

insurance service.[31] First Direct now has 500,000 customers and is opening 10,000 new accounts per month. Every major banking group in Scotland and most in England now offer some form of telephone-based banking service and a similar trend may be seen in insurance (for example, General Accident Direct and Cornhill Direct). The rapid growth of telecoms-based sales and customer support has been a major factor in accelerating the drive to reduce costs in the retail banking and insurance business. The availability, functionality and affordability of telecoms has resulted in a significant concentration of the sector in fewer locations.

Production co-ordination: soft drinks manufacture

There are a number of examples in the literature of the impact of telecoms on the co-ordination of production (Williams and Taylor [1989]). In this case, a soft drinks manufacturer has a long-term contract with its CO_2 gas supplier. As illustrated in Figure 5.4, the CO_2 supplier calculates when the manufacturer needs a delivery, based on weather forecasts and telemetry readings of current tank levels. Transport of the CO_2 is scheduled to minimize routeing costs and number of deliveries. The manufacturer is able to maintain viability at a lower level of production because some of the advantages of scale economies are passed on through the system set up by the CO_2 provider. The overall effect is to overcome diseconomies of distance and maintain the spatial distribution of production.

Figure 5.4. Production co-ordination: soft drinks manufacture



Source: Analysys.

31 These services have been made possible through the introduction of 'call centres' in which telecoms and computers are integrated to provide immediate customer and product or service information to the operator, who can process orders or queries. Call centres have strong economies of scale and it is interesting to note that many in the UK now act as contact points for several companies operating in different EU national markets, providing local language support without the caller being aware that they are talking to someone in a different EU Member State.

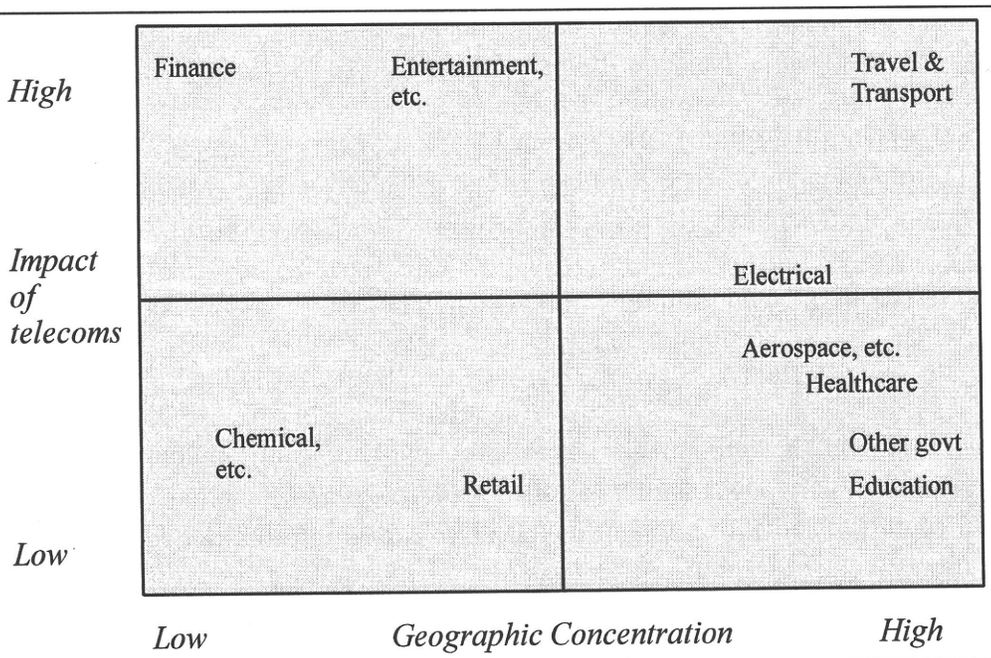
These two examples highlight conflicting forces shaping the location of economic activities:

(a) telecoms and IT enabling economies of scale or market access which then lead to concentration of activity (such as in retail banking);
(b) telecoms and IT overcoming the costs associated with distance, which then lead to maintained or even increased dispersion of activity.

The potential effect of these conflicting forces on the sectors is illustrated in Figure 5.5 and summarized below.

(a) The 'public' sectors of education, healthcare and other government are largely service based and have relatively strong economies of physical concentration. There are significant potential economies to be gained from using telecoms and IT as substitutes for physical presence in order to create greater accessibility, for example, access to specialist medical advice without having to maintain the resources locally. The impact of telecoms on location in these sectors can be expected to be high and to promote dispersion, although the rate of adoption by government itself may be low.
(b) The retail, finance and entertainment sectors currently have a moderate degree of concentration (with some very high levels of concentration in specific parts of each of these sectors). The impact of telecoms is likely to be very high, because of substantial concentration economies that could be realized.
(c) Transport, manufacturing, and industrial-related sectors such as chemicals, electrical, and aerospace may be able to use telecoms to overcome costs related to distance and to realize some benefits from being able to match or bring together resources in different locations flexibly. Telecoms can be expected to assist in slowing or even reversing concentration in these areas.

Figure 5.5. Impact of telecoms on spatial distribution of sectors (illustrative)



Source: Analysys.

There are two conclusions that we draw from this analysis. First, different spatial impacts on the sectors will emerge. Second, and perhaps most importantly for regional policy, although different impacts can be expected in different sectors, the overall impact is neutral with respect to the current rate of concentration.

5.5.3. Regional impacts

Undoubtedly, the diffusion of computer networks can be seen to reduce the 'friction of space' (Gillespie and Williams [1988]). However, it is not necessarily the case that the less favoured regions are the beneficiaries: as observed by Melody [1987], computer networks

> *'provide easier access to the regions, and a competitive advantage over local and regional interests. It may provide an efficient system for sucking out the economic benefits and opportunities that would otherwise be generated in the regions'.*

For example, in the case of the financial sector, increased use of telecoms and IT is leading to greater concentration and the ability to provide services in regions without being physically present. This level of remote operation does not yield the same levels of value added in the region as a system based on branches rather than networks. Furthermore, the impact of networks varies depending on both the function adopting the services and the existing spatial division of activity within the sectors. For example, the adoption of telecoms services into the functions of head offices has a different spatial impact to the adoption of the same services in branch plants (Gillespie et al. [1995]).

It is clear that the diffusion and use of networks does not necessarily result in a more even distribution of economic activity across the economy and thereby in itself provide a panacea for problems of uneven regional development. Issues of even distribution of development are as relevant within regions as between regions: an important aspect of policy is ensuring that economic development is *of* the area and not merely *in* the area. How do networks affect spatial processes associated with economic development in a specific locality? More specifically, how are agglomeration economies disturbed by the growth of computer networking?

Agglomeration economies, as positive externalities, reduce the relative cost of operating in any one location. The nature of agglomeration economies is critical in shaping the development of economic activity (Camagni et al. [1993]) and the evolution of these economies depends in turn on interaction between the economic behaviour of individual firms and several local factors, including institutional structure, support services to individual firms and access to resources. Of these, access to labour that is appropriately educated, trained and skilled for the needs of local industries is probably the most critical.

The development of various forms of networks – corporate, intra-corporate, and public (including, most importantly, the Internet) is creating new information flows that can be seen as substitutes for agglomeration economies. For example, for telework to be effective the resources provided by the agglomeration of individuals in one location must be replicated and delivered using a network – this is becoming easier with the evolution of computer networking and interface technologies such as World Wide Web browsers. In a similar way, an organization which is dependent on scarce technological resources can supplement these by the delivery of services over telecoms networks. If agglomeration economies can be delivered

over the telecoms infrastructure, then this greatly extends the organization's ability to exploit such economies. However, it then becomes increasingly difficult to implement regional policy initiatives which are designed to create distinctive agglomeration economies and underpin the development of particular patterns of economic activity.

If agglomeration economies become commodities capable of being exchanged over a telecommunciations network, existing geographical patterns of economic behaviour become reinforced, and further concentration may take place, such as in retail banking. For example, the incentives to relocate to relatively cheaper regions are reduced as teleworking opens up hitherto distant labour markets, and the development of electronic markets offers the option of reaching new sources of income without needing to be physically present. In effect, the growth of corporate networks brings about the ability of firms to articulate a virtual presence, which can result in new sources of income or new methods of reducing costs.

The sectoral analysis in Section 5.5.2 indicated that different impacts could be expected in different sectors but that there would be no overall increase or decrease in the rate of concentration. This sectoral analysis did not look in detail at the effect of teleworking on concentration economies but this effect is likely to be relatively small in the medium term compared to the current drivers of sector development. However, different regions have different sectoral compositions; a region weak in finance will find itself becoming increasingly weaker as other regions concentrate such activities. Telecoms will change the composition of economic activities within regions even if it does not affect the current rate of overall concentration above the regional level.

5.6. Impact on EU integration and the promotion of the single market

The processes of liberalization which bring about greater availability, functionality and affordability of telecoms services are central to the widespread diffusion and use of corporate networks across the economy. In turn, increased use of telecoms networks is likely to have a significant impact on the wider process of European integration. It is clear from the preceding section that for a number of sectors – especially finance, retail and entertainment – telecoms provides a way to realize both lower costs and new means of delivering products and services. In such cases there will be significant advantages in concentration and, as has already been described, this gives rise to operations in one location directly serving customers in other Member States. For other sectors, such as healthcare and education, telecoms enables the current trends in concentration to be overcome, and easier and better quality access to services to be achieved, including across national borders. At the regional level, the processes set in train will not all be beneficial: some regions will gain further cumulative advantages while others may find their economies further eroded. Nevertheless, the overall effect will be to accelerate the integration of the European economy.

Advanced communications is highly relevant to the key issues facing large and small organizations today, particularly with regard to the opportunities and threats posed by economic integration within Europe. These issues centre on the need for flexibility to cope with increasing uncertainty and volatility in the business environment, arising from an expansion of the range of their activities and those of their competitors, and the acceleration of the rates of societal, economic and technological change. Commercial organizations within Europe face both intensifying competition and pressure on costs, and strategic pressures to embark on risky and complex initiatives to 'globalize'. All organizations are now finding that

they need to improve the flexibility and effectiveness of their processes and review their cost structures on a continuous and intensive basis. Many of these trends increase the emphasis on communications within and between organizations:

(a) Organizations are becoming more geographically dispersed as they take advantage of European economic integration to exploit new markets. Face-to-face contact between employees within an organization is becoming less frequent, more difficult and costly.
(b) Organizations are increasing their level of integration with suppliers, customers and collaborators, and this is increasing the volume and complexity of information flows across organizational boundaries. The resultant 'extended enterprise' emerging within Europe is increasingly dispersed on a transnational basis, and cannot rely on face-to-face communications.
(c) Competitive pressures that have emerged from the fulfillment of the single market are forcing organizations to break down internal functional boundaries in order to organize around key business processes. This tends to increase the volume of information flow within an organization, and in many cases creates new information flows which cannot easily be supported by face-to-face contact (for example, the information flows between a dispersed mobile sales force and an order-processing department).
(d) The enhanced market opportunities and competitive threats posed by the single market have expanded the requirement for information relating to an organization's own activities and to suppliers, distributors, customers, competitors, technologies, standards, regulations and markets. Advances in IT and a greater understanding of the potential importance of information are both key drivers of this growth.
(e) The growing scale and complexity of information flows must be handled by ever smaller teams of managers and employees. The 'span of control' of many managers has been enlarged, there has been a growth in the volume of project work, and 'soft' targets, such as cultural development goals, have been added to their financial and operational targets. This places heavy demands on the communications media which exist to supply information to ensure that individuals have easy and timely access to all that is necessary for them to operate effectively.

For large international firms, the creation of a single information market is likely to reinforce or accelerate existing trends, such as the growth of truly European companies, and the rate at which a liberalized single information market develops will act as the regulator of the speed of transformation in these larger firms. Firms with footloose investment will seek to adjust their investment strategies in such a way as to maximize the returns open to them, using telecoms networks to support novel spatial structures. However, in environments of limited liberalization, only the larger users will be capable of securing the telecoms networks required.

For smaller firms, the creation of a liberalized information market has a much more dramatic effect, as liberalization brings about greater availability, functionality and affordability which in turn result in the greater use of telecoms services. Given that the use of telecoms services can substitute for other resources and capital investments, then changes in consumption could manifest themselves in dramatic changes in the nature and scope of activities within a firm. A liberalized environment will not only bring about changes within a small firm in a way that would not be achieved in a more restrictive environment, but also changes in patterns of activity between small firms, opening up the prospect of small and locally focused firms combining in novel ways across the European economy. The interlinking of small firms through the uptake of open networks carrying advanced services creates the opportunity for

small firms to mimic the behaviour of larger firms without the attendant risks associated with higher capital commitments, managing more complex organizations, etc.

In essence, there is evidence throughout Europe that large organizations are attempting to emulate the behaviour seen in the best small organizations (which are flexible, entrepreneurial, well-focused, lean, and project-oriented), while smaller organizations are under pressure to act like large organizations (aiming for global presence, global sourcing, strong systems, etc.).

Advanced communications enables both of these objectives to be met, by allowing an organization operating within an enlarged single market to design and implement its information flows according to its fundamental requirements, relaxing many of the constraints imposed by geography, mobility, etc. This allows organizations to develop organizational structures and processes that were previously infeasible: control can be maintained even where frequent face-to-face contact is not possible; collaborative work can be carried out by teams at dispersed sites, and access to experts and to senior management can be arranged at short notice when necessary. Advanced communications contributes to these changes by:

(a) making global narrowband communications so easily affordable that they can be used by organizations without concern over cost. The costs of transmission and switching are falling faster than the cost of computer power did in the 1980s and, in time, these cost savings will be passed on to end-users;
(b) offering affordable 'telepresence' through video and multimedia communications. The technologies which support virtual meetings are not yet able to match all aspects of face-to-face contact, but they do offer at least an acceptable substitute for traditional meetings;
(c) facilitating communications with peripatetic employees, through affordable mobile communications, personal numbering, and store-and-forward systems;
(d) offering affordable high-capacity data links that allow wide area networks to operate with the same speed and flexibility as local area networks. When combined with client-server architectures and open systems, this overcomes geographical constraints on information systems.

Advanced communications is not a driver of organizational change, but it is an enabler of change, whether the change is an incremental improvement or a radical restructuring. Organizations must already have embarked on a process of change before they can take full advantage of advanced communications as an enabler of new organizational forms and new business processes. The drivers of this change can be organizational growth or decline, changes in the marketplace or supply base, changes in ownership, technology change, or changes in management's vision – all of which will be influenced to some extent by the process of European integration.

If the hypotheses summarized above are correct, and advanced communications can enable the transformation of organizations, products, services, and product and service delivery, then we might expect to see dramatic and rapid impacts on the economy from the single market programme, including:

(a) significant increases in competitiveness for those organizations and countries that make the best use of advanced communications;

(b) accelerated rates of restructuring in those organizations and sectors that make widespread use of advanced communications;
(c) changes in the patterns and composition of trade to reflect changes in competitiveness;
(d) increased turnover of employment in sectors and countries where advanced communications enables restructuring and underpins the success of new competitors at the expense of traditional market-leading firms (many jobs created and many jobs destroyed);
(e) increased productive capacity in sectors and countries where advanced communications is most widespread.

In practice, however, the realization of these impacts is constrained by the level of penetration of advanced communications. At present, the use of advanced communications is concentrated in the core networks of traditional telecoms operators, yielding cost benefits to customers through the falling costs of traditional telecoms services. Very few businesses or homes have direct access to advanced communications services, because for almost all businesses and households, most advanced communications services are not yet affordable (or available). The *antimonde* presented in Chapter 3 describes a future where many communications services remain beyond the reach of many potential customers, which constitutes a key constraint to European companies' and economies' ability to adjust and take full advantage of the opportunities offered by the fulfillment of the single market.

6. Macro-level impacts on the EU economy

6.1. Introduction

There is no representational model for tracing the effects of corporate spending on telecoms and associated information technologies, on productivity and cost savings. While there are some useful data and empirical modelling techniques, important gaps remain in the understanding of the role played by information in the gamut of productive processes and market interactions that constitute the macroeconomy. As a result, where empirical studies have been carried out, the focus has been on the 'productivity paradox' (the apparent willingness to spend on telecoms and IT without obtaining significant measurable benefits). The potentially large effects of enhanced communications on the decisions of consumers and policy-makers have not been addressed.

Without a standard representational model there can be no universally acknowledged techniques for quantifying the informational benefits of telecoms liberalization.[32] In the absence of such a theoretical framework, empirical modelling can only be partial or subjective and the choice of model is driven by the scope and nature of these subjective choices and the level at which they are made. Accordingly, this chapter adopts a widely used technique based on a simple multiplier-based model (described in Section 6.2) to produce estimates of the EU-level impact of telecoms liberalization and the single information market. This model takes as its starting point the results of the scenario modelling described in Chapter 4 and our understanding of the dynamics of the telecoms sectors and its interaction with the major sectoral users as described in Chapter 5.

The results of the macroeconomic modelling are detailed in Section 6.3. The results indicate that telecoms liberalization may increase EU GDP by 1.18% cumulatively by the year 2005 under the rapid scenario, and by 0.70% under the unsynchronized scenario (both in relation to the *antimonde*). Rapid liberalization may generate some 641,000 net new jobs by the year 2005 within the EU, compared with 263,000 under partial liberalization. However, these results should be interpreted with care. In particular:

(a) the results are derived from differences between scenarios which, while plausible, may not represent true alternative futures;
(b) the macroeconomic model is driven by estimated multiplier effects and has been used to ensure that trade, investment, output, and employment figures are mutually consistent and plausible. However, because of the limitations of such models (as set out in Chapter 2), it does not have a predictive capacity for detailed quantification of the impact of the EU single information market.

6.2. Modelling approach

This section examines the link between the development of the single information market and EU economic growth, employment, trade performance and investment. Although the work has focused on the *qualitative* impacts of a single information market using a sectoral and

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[32] A more complete discussion of the reasons for this and its implications is set out in Chapter 2. Appendix D reviews alternative empirical modelling methodologies that might be used to quantify micro-macro interactions.

macroeconomic basis, we also assess these impacts within a quantified framework so that the relative scale and scope of possible impacts can be understood. While this dual approach has limitations, it is nevertheless able to provide useful insight.

This section sets out the quantified framework for assessing the macroeconomic impacts of a single information market that is consistent with the collective impacts of individual effects. We do not attempt to prove causalities, but make the case for individual positive and negative effects on a logical and reasoned basis, and calculate a set of coherent potential overall impacts. Our objective is to investigate the relative magnitudes of the various effects and show how they inter-relate. To do so, we construct a pragmatic model in which the collective impact of the various effects can be described in a straightforward and consistent fashion.

We have constructed a possible evolutionary path for the EU economy to 2005 under three scenarios based on the scope, scale and speed of development of the single information market. The three scenarios assume the same fundamental macroeconomic policy conditions within the EU (e.g. monetary and fiscal policy stance) and the same outlook for the world economy. The scenarios are summarized in Table 6.1. Table E.2 in Appendix E is based on Table 6.1, and shows the differences between the scenarios.

The 'base case' is a best guess of the likely state of the EU economy in the year 2005 on the basis of widely available forecasts, using IMF, World Bank, OECD and Eurostat sources as appropriate. Because of the linkages between the development of the telecoms sector and the macroeconomy, we have associated this economic base case with the unsynchronized liberalization scenario which, in our view, represents a likely outcome for the telecoms sector in Europe. We have correspondingly reduced the GDP projections for the *antimonde* (no further EU-level action towards the development of a single information market) in accordance with the multiplier effects generated by the *antimonde*'s smaller telecoms sector.

We have focused on the relative differences in the broader economic aggregates between the scenarios. The quantification of these differences has been developed on the basis of the qualitative assessments developed by the study team. These assessments have been expressed in a self-contained macroeconomic model based on identities and key multipliers. It is an *ad hoc* model based on observed macro-behavioural relationships rather than on microeconomic first principles; as such, it does not pretend to capture the wealth of general equilibrium effects. Appendix D describes the general nature of multiplier-based models, and compares their advantages and weaknesses relative to a range of alternative empirical modelling techniques.

The main micro-to-macro transmission links incorporated in the model are: investment, productivity (as captured by the output–labour ratio) and external trade, and the structure of these links is shown in Figure 2.7, repeated here for convenience. Figure E.1 in Appendix E presents a functional depiction of the implementation of Figure 2.7 in our model.

Changes in the outputs of the telecoms sector were used to drive the output of the macroeconomic model through the inter-linked capital investment, productivity and trade channels. Although this provides an assessment of the overall implications of the benefits of the single information market, it should be noted that it is not possible to attribute GDP gains to these factors separately because they interact strongly, or are different manifestations of the

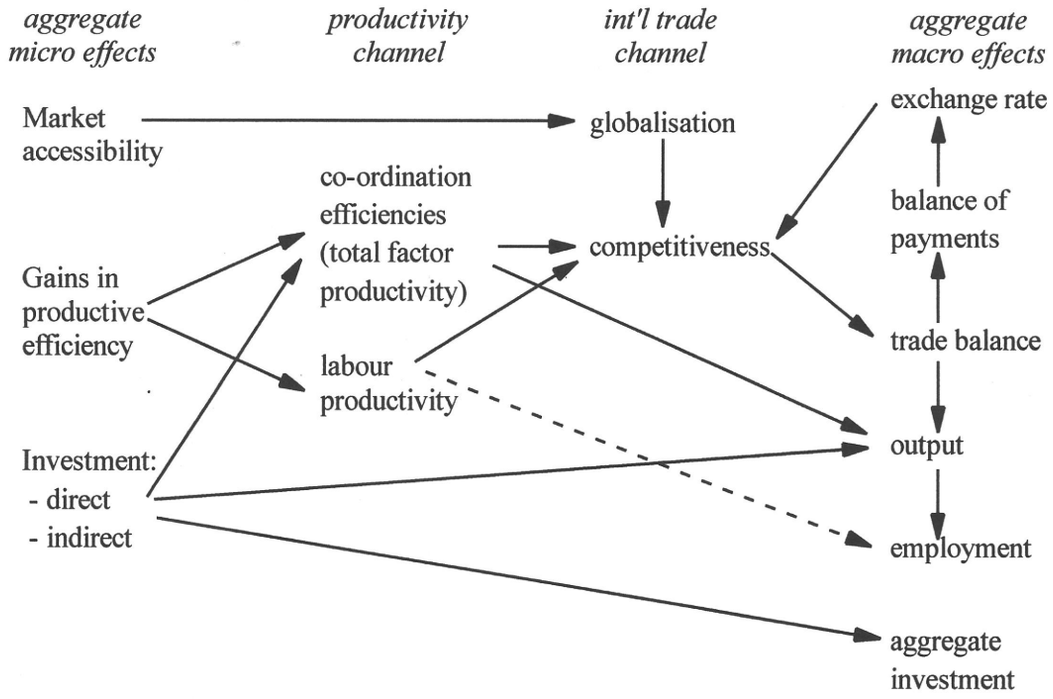
same underlying dynamics, or simply affect the spending patterns of all users of telecoms, and hence tend to increase the purchasing power of most economic agents.

Table 6.1. Macroeconomic performance under alternative telecoms liberalization scenarios

(population figures in thousands, value figures in 1995 ECU billion)

	Actual		Antimonde			Unsynchronized liberalization			Rapid liberalization		
	1995 level	Share of EU GDP (%)	2005 level	Share of EU GDP (%)	1995-2005 CAGR (%)	2005 level	Share of EU GDP (%)	1995-2005 CAGR (%)	2005 level	Share of EU GDP (%)	1995-2005 CAGR (%)
VALUE ADDED											
EU GDP	6,608		8,565		2.63	8,625		2.70%	8,667		2.75
World GDP	22,927		35,545		4.48	35,605		4.50	35,646		4.51
EU GDP/World GDP (%)	28,8		24.1			24.2			24.3		
EU GDP per capita (ECU)	17,716		22,181		2.27	22,336		2.34	22,444		2.39
EU GDP per employee (ECU)	44,613		55,349		2.18	55,601		2.23	55,776		2.26
EMPLOYMENT											
EU population	372,975		386,148		0.35	386,148		0.35	386,148		0.35
EU working population	165,574		169,905		0.26	169,905		0.26	169,905		0.26
as % of total population	44.4		44.0			44.0			44.0		
EU employment	148,113		154,745		0.44	155,123		0.46	155,386		0.48
EU unemployment	17,462		15,160		-1.40	14,782		-1.65	14,519		-1.83
EU unemployment rate	10.5		8.9			8.7			8.5		
TRADE											
World exports	5,123		9,698		6.59	9,708		6.60	9,715		6.61
as % of world GDP	22.35		27.28			27.27			27.25		
EU external (net) exports	553	8.36	767	8.95	3.32	776	9.00	3.46	783	9.03	3.55
as % of world exports	10.79		7.90			8.00			8.06		
EU external (net) imports	624	9.45	852	9.94	3.15	863	10.00	3.28	870	10.04	3.37
as % of world exports	12.19		8.78			8.88			8.95		
EU internal trade	909	13.75	1,341	15.65	3.97	1,364	15.81	4.15	1,380	15.92	4.27
EU gross exports	1,461	22.11	2,107	24.60	3.73	2,140	24.81	3.89	2,163	24.96	4.00
EU gross imports	1,533		2,192		3.64	2,227		3.80	2,250		3.91
EU external trade balance	-72	-1.08	-85	-0.99	1.72	-86	-1.00	1.87	-87	-1.00	1.93
INVESTMENT											
EU investment	800	12.10	1,037	12.10	2.63	1,061	12.30	2.87	1,076	12.41	3.01
EU non-housing investment	615	9.30	794	9.27	2.59	818	9.48	2.90	833	9.61	3.08
as % of total EU investment	76.9		76.6			77.1			77.4		
TELECOMS SECTOR											
EU telecoms capital expenditure	41.7	0.63	53.3	0.62	2.48	70.1	0.81	5.34	80.0	0.92	6.73
as % of EU non-housing investment	6.78		6.71			8.58			9.60		
EU telecoms employment	985.5	14.91	923.8		-0.64	1,037.5		0.52	1,120.6		1.29
as % of EU employment	0.67		0.60			0.67			0.72		
EU telecoms value added	77.7	1.18	81.0	0.95	0.42	104.6	1.21	3.02	119.6	1.38	4.41
per telecoms employee (ECU)	78,861		87,694		1.07	100,827		2.49	106,757		3.08

Figure 6.1. Macroeconomic effects of telecoms liberalization



Source: Analysys.

The model is constructed around three basic identities for aggregate internal demand, balance of payments and labour utilization. The variables calculated residually from these equations are, respectively, EU domestic consumption, the capital account of the balance of payments (on the assumption of no accumulation of net international reserves) and unemployment. There is no monetary sector, and the impact of telecoms liberalization on the government's fiscal balance is not modelled explicitly.

The key macroeconomic parameters that support the scenario simulation exercises are summarized in Table 6.2. These multipliers are associated with the main arrows in the schematic representation of the model in Figure 6.1. Therefore, they constitute the basic driving equation of the model. As the multipliers are specified in elasticity terms, each multiplier specified in Table 6.2 corresponds to a log-linear equation between the corresponding variables.

These parameters are structural, in the sense that they are common to all scenarios. The differences between the scenarios are driven by differences in the value added, employment and capital expenditure of the telecoms sector under each scenario, as described in Chapter 4. (These inputs are shown in Table E.3 in Appendix E for convenience.) In other words, we do not assume different behavioural relationships between scenarios. While it might be reasonable to posit that the degree of telecoms liberalization could affect behavioural relationships, and in particular the magnitudes of the basic multipliers describing the main equations of the model, we opted for keeping these constant to make the results easier to interpret (in the sense of being able to trace differences in scenario results to particular modelling assumptions or equations).

The multipliers were set on the basis of statistical analyses, literature surveys and the requirements for consistency of internally generated results (discussed in Sections D.4 and D.5 in Appendix D). We have not attempted to ascribe their origins to the separate micro-level effects described in Chapter 4, namely, to the greater accessibility, functionality and affordability of telecoms services. However, we are confident that the magnitude of these multipliers is fully consistent with the sectoral observations in Chapter 5 and hence they represent a plausible representation of micro-macro links.

Table 6.2. Key model parameters

Output elasticities. 1% telecoms-induced incremental growth in EU GDP (relative to the base case) is associated with:

(a) 0.35% growth in EU employment,
(b) 1.3% growth in EU indirect (i.e. non-telecoms) non-residential investment,
(c) 1.8% growth in EU external exports,
(d) 1.4% growth in non-telecoms-sector EU external imports,
(e) 2.1% growth in non-telecoms-sector cross-border intra-EU trade.

Import content requirements. Every ECU 100 of additional capital expenditures by telecoms operators requires:

(a) ECU 20 of imports from other countries within the EU,
(b) ECU 15 of imports from outside the EU.

Base case assumptions. Constant annual growth rates for the period 1995 to 2005 associated with the unsynchronized telecoms liberalization scenario:

(a) 2.7% for EU GDP,
(b) 4.5% for world GDP,
(c) 0.35% for EU population,
(d) 3.46% for EU external exports,
(e) 6.6% for world exports,
(f) 3.28% for EU external imports,
(g) 2.9% for EU non-residential investment.

Source: Analysys.

It should be noted that in our model we have focused on labour productivity rather than on total factor productivity gains, mirroring the emphasis of the existing empirical literature. As discussed in Section 2.3, total factor productivity is a notoriously problematical quantity to identify theoretically and empirically, and accordingly plays only a secondary role in our model.

The interactions within the model and the justification for the main assumptions are described below in the context of the discussion of the results.

6.3. Quantitative scenario results

Below we review the differences in the major macroeconomic aggregates (output, investment, employment and trade) under the three scenarios, as detailed in Table 6.1.

Output

Information-induced micro-efficiency gains affect aggregate output by allowing the production of an expanded set of goods from a given level of resource inputs. Similarly, they affect aggregate employment by requiring fewer input resources to produce a given set of goods. The overall impact on aggregate output depends on whether and how the resources liberated by the higher productivity are redeployed in the economy. This is determined by the extent to which productivity gains and the corresponding lower production costs translate into lower output prices. If lower labour input requirements are not eroded through a corresponding rise in wages, aggregate demand could be affected in two ways:

(a) lower output prices increase international competitiveness, and hence tend to increase foreign demand through the trade balance;
(b) as output prices fall rising real wages should stimulate domestic demand, and in particular consumption.

The results indicate that, compared to the *antimonde*, the single information market may increase EU GDP by 1.18% cumulatively by the year 2005 under the rapid liberalization scenario, and 0.70% under the unsynchronized scenario. As noted above, the *antimonde* is a reference case which does not represent the most likely outcome and therefore the economic base case is associated with the 'unsynchronized' scenario. Base case GDP growth for the period 1995 to 2005 is assumed to be 2.7% (consistent with the assumption used in the sectoral simulations in Chapter 4).[33] Figure 6.2 shows the dynamics of the forecast EU GDP growth for the rapid scenario and the *antimonde* relative to the base case.

These results have been compared with empirical findings in other studies in this area, and our estimates of future benefits from the single information market are in line with the benefits of advanced communications estimated by Cohen [1993], Teknibank [1993] and METIER [1995]. It is interesting to note that Cecchini et al. [1988] had estimated overall benefits from the EU's single market programme at around 5% of GDP. Thus, the benefits we estimate from the development of the single information market correspond to 25% of the estimated benefits for the overall single market, taking the *antimonde* and the rapid scenarios as the reference points. Finally, the estimated impact on GDP under the two scenarios represents a 'telecoms value added to total value added' multiplier of around 2.6. This is higher than the 1.4 multiplier used by NERA *et al.* [1996] to estimate the implications of radio use on GDP in the UK, largely because of the additional impact of increased capital expenditure generated as a result of liberalization. Appendix D reviews these and other leading studies of the impact of telecoms on economic growth in more detail.

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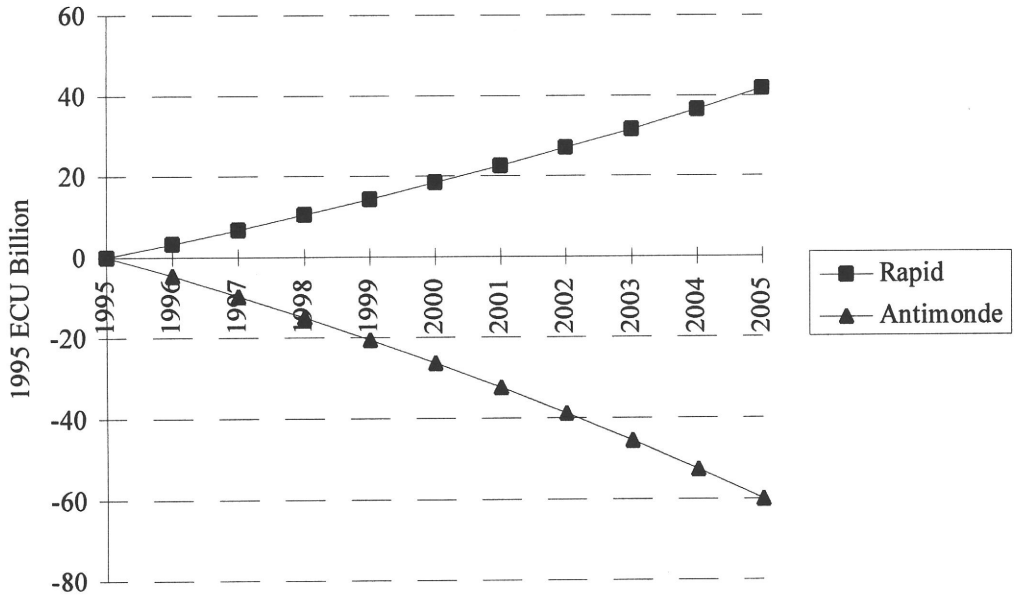
[33] This is the real GDP growth for the EU forecast by the IMF for the period 1997 to 2000. It is within the range of official forecasts of other international organizations: 2.5% forecast by the World Bank for the period 1997 to 2000, 2.8% forecast by the World Bank for the period 1997 to 2002, and 3.0% forecast by the OECD for the period 1997 to 2000.

Figure 6.2. EU GDP projections: differences from base case



Source: Analysys.

Investment

Telecoms liberalization generates a direct investment requirement on the part of telecoms operators as new entrants build networks, existing players respond with increased innovation and demand rises, stimulated by lower prices and a wider range of services. Operators' capital expenditures in 2005 under the rapid scenario were estimated in Chapter 4 to be 50% higher than under the *antimonde*; operators' capital expenditures under the unsynchronized liberalization scenario were estimated to be 32% higher than under the *antimonde*. Thus, telecoms capital expenditures account for 0.92% of GDP by the year 2005 under the rapid liberalization scenario, compared to 0.81% under the *antimonde*. Figure 6.3 shows the forecast evolution of EU-wide non-residential investment over the period 1995 to 2005 under each of the scenarios.

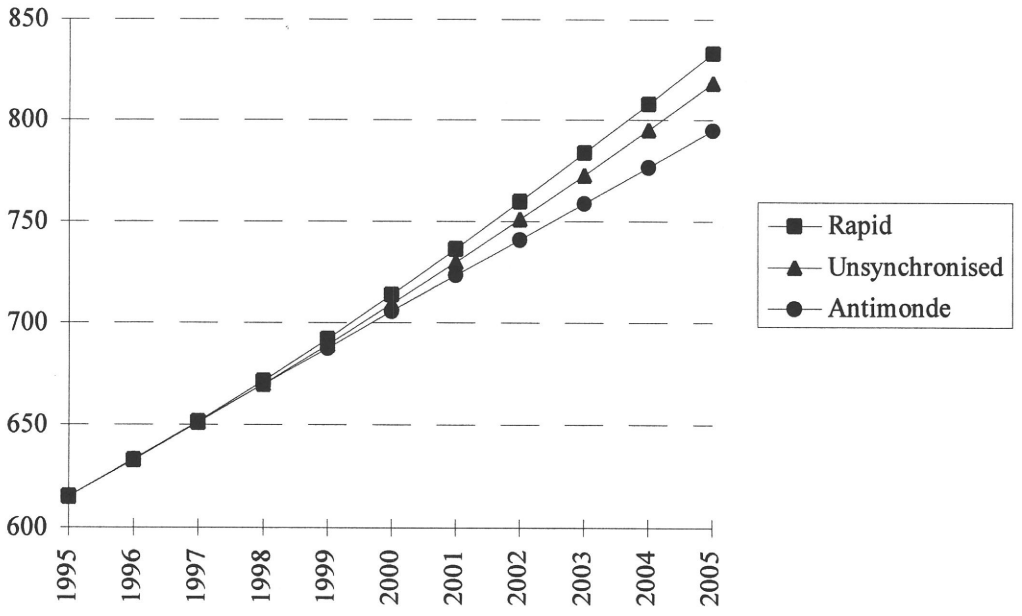
The indirect (non-telecoms sector) effects on aggregate investment depend crucially on the extent to which corporate spending on telecoms complements or substitutes corporate capital spending.

(a) Complementarities would arise if information induced technological advances, either through greater automation of production processes or though increasing technical sophistication of products and services offered. For example, information might induce greater product customization which would result in the need for more sophisticated capital equipment.

(b) Companies might substitute access to cheaper and better information for capital investments if, by using communications, the same capital investment could be used for a wider range of tasks or if new comparative advantages were created in activities which did not require such high levels of capital investment. Cronin et al. [1993b] document econometrically strong substitution possibilities between capital investment and spending on telecoms services at the sectoral level, especially for non-manufacturing segments of the US economy. However, we note that substitution possibilities at the

sectoral level need not result in substitution at the aggregate level because of induced relative price changes.

Figure 6.3. EU non-residential investment projections: all scenarios



Source: Analysys.

We assume that investment in telecoms is a complement more than it is a substitute. Indirect investment effects (i.e. total change in investment less direct investment by TOs) are estimated to be positive and to be 43% to 52% of the direct telecoms capital expenditures. Accordingly, total non-residential investment as a proportion of GDP rises from 9.27% under the *antimonde* to 9.61% under rapid telecoms liberalization.

The incremental investment and GDP growth figures under the rapid and unsynchronized liberalization scenarios imply an incremental capital–output ratio (relative to the *antimonde*) of around 40% or, equivalently, an output–investment multiplier of 2.5 to 3.0. This is at the low end of the range of telecoms investment multipliers estimated by NERA [1993] for Ireland (2.7 to 4.4) and by Hansen et al. [1990] for six rural areas of the EU (2.2 to 5.2). On the other hand, it is slightly higher than DIW's [1984] estimated multiplier of 2.5 for the West German economy in 1980, the 1.5 put forward by Sircana and de Bonis [1992] for the European economy in the early 1980s, and the 1.3 estimated in 1983 for the case of France Telecom reported in Gensollen and Laubie [1995]. These prior estimates of the investment multiplier suggest that the multiplier has been increasing over time, a position which would seem to be supported by several arguments:

(a) The older empirical literature has tended to underestimate the degree to which telecoms and IT investment has affected the rest of the economy.
(b) Telecoms and IT have become more central to many economic processes and have played an increasingly crucial role in realizing benefits from other investments. This should translate into greater 'leveraging' of investments at the aggregate level and hence high multiplier values.

(c) Investment in new kinds of communications and IT take a while to pay off because of the time taken to learn how fully to exploit new technology. It could be argued that European economies are only now in a position to reap more benefits from telecoms and IT investments compared to a decade ago when such investments were just taking off (by current standards). Cronin et al. [1993a, 1993b] estimate that the full benefits of telecoms advances take up to 15 years to be realized. Such inherent lags in the manifestation of benefits from increased capital and telecoms intensity would result in low estimates of multipliers during the early stages of such a process.

The model does not capture explicitly any investment effects from changes in direct foreign investment. It might be argued that integration of information within Europe facilitates inward foreign direct investment as it makes it comparatively cheaper for foreign firms to 'jump' the EU's external tariff and serve all of the EU from a single or a few locations. On the other hand, better communications with the rest of the world might also increase the EU's outward foreign direct investment as European companies 'learn' about investment opportunities in more distant, but relatively less competitive, foreign markets. We have assumed that these two effects cancel each other out, leaving both investment demand and the capital account of the balance of payments unaffected.

Employment

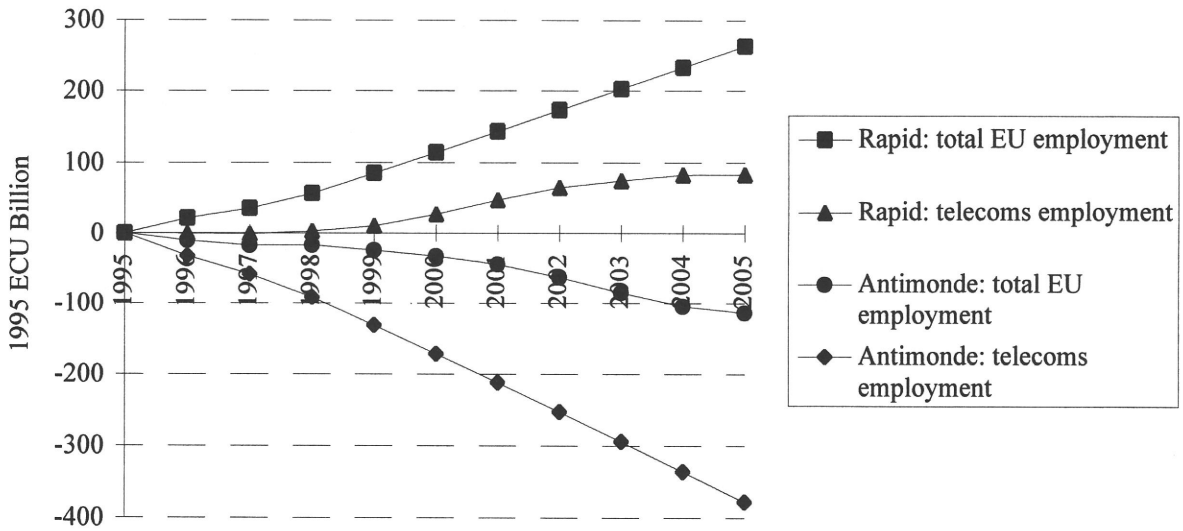
Employment is forecast to be about 641,000 higher under the rapid liberalization scenario than under the base case and about 263,000 higher under the unsynchronized liberalization scenario than under the *antimonde*. Of these total net new jobs created under the rapid and the unsynchronized liberalization scenarios, around 30% are direct employment gains in the telecoms sector, implying that 2.2 jobs are created indirectly elsewhere in the economy for each new job in the telecoms sector itself. Many of these indirect jobs are likely to be in the corporate IT sector or similarly related sectors. Figure 6.4 shows the evolution of both total EU and telecoms sector employment for the rapid scenario and the *antimonde*, relative to the base case.

The demographics underlying the simulations are based on a population growth rate of 0.35% per annum (the estimate contained in Eurostat for the period 1993 to 2005) and a slight decrease in the working population as a proportion of the total population. The economic base case (associated with the unsynchronized scenario) forecasts a reduction in the EU-wide unemployment rate from 10.5% in 1995 to 8.7% by the year 2005. This figure is reduced by 0.2% under the rapid scenario.

In this model we posit only a modest input substitutability between telecoms services and labour. This is in line with the wealth of empirical studies that have been triggered by what has become the 'productivity paradox'. Increased reliance on telecoms usage as an input in production probably induces a significant change in firms' skills mix, but it does not seem to have a significant effect on overall employment levels. It is commonly held that telecoms services might substitute for blue collar jobs due to plant-level co-ordination efficiencies, but this is significantly offset by an expansion in the white collar, information-based jobs which are needed to manage the increasingly sophisticated information processes. This latter effect is supported by the accompanying increase in importance of services and customer service. A low value for substitutability between telecoms services and labour is consistent, for instance,

with Cronin et al. [1993b] and their estimate that the partial elasticity of substitution between labour and telecoms is not significantly different from zero (Cronin et al. [1994]).

Figure 6.4. Total and telephone sector employment projections: differences from base case



Source: Analysys.

However, we believe that investment in telecoms and IT and increased usage will result in productivity gains in the future. There will be increasing productivity gains from greater and more efficient utilization of information because in the coming years the economy will be in a better position to reap the efficiencies not only from the incremental investments in telecoms and IT forecast here but also from past investments. The European economies have only just begun to reap the benefits of a long learning process which will enable them to take much better advantage of telecoms and IT (as discussed above). Accordingly, in the quantitative scenarios, labour productivity across the EU economy (as measured by the aggregate value added per employee) increases slightly with telecoms liberalization. For the year 2005, EU average labour productivity is estimated at ECU 55,601 per worker under the base case, rising to ECU 55,776 under rapid liberalization (both figures in 1995 ECU). Productivity in the telecoms sector picks up much more rapidly, rising from 1.8 times the average EU level under the base case to 1.9 under the rapid scenario.

Productivity effects can be broken down into labour productivity gains resulting from the additional capital investments discussed above, and total factor productivity gains from informational benefits that cannot be attributed to specific factors of production. Whether these productivity gains translate into enhanced competitiveness depends on the extent to which they are dissipated into higher remuneration to the factors of production, namely labour. We assume a labour demand elasticity of output of 0.35% (Table 6.2). The lower growth rate in employment than in GDP is a result of rising wages and the substitution of capital for labour rather than a substitution of telecoms services for labour. This is consistent with the relatively high output–investment multiplier discussed above.

Trade

Trade has always rested on the flow of information, and the creation of our current global trading system has depended on the development of an effective global communications infrastructure. Accordingly, better access to better communications within the EU should enhance the EU's ability to tap foreign markets as well as to liberate some productive resources through imports. The increased tradability of goods and services assumed in the model results from three factors:

(a) the removal of geographical constraints on production,
(b) the revealed competitiveness of activity as a result of productivity gains,
(c) the direct effect on trade in communications equipment.

The formation of a single EU information market is forecast to have a stronger quantitative effect on intra-EU trade than on external EU trade (this is reflected in the trade elasticities of output in Table 6.2). This premise has three justifications:

(a) Intra-EU trade benefits from the single information market on both sides of the transaction (buyer/importer and seller/exporter), while external trade benefits will depend on relations outside the EU with countries that may not match the pace of EU liberalization.
(b) The single information market takes advantage of the wider opportunities offered by operating in a single market within Europe. The ongoing removal of restrictions to intra-EU transfer of goods, services and factors of production, and the increasing harmonization of product and business standards within the EU create a larger set of trading opportunities that can increasingly be exploited with better access to information.
(c) The ability of the EU to exploit gains in competitiveness may be eroded by a compensating relative appreciation of European currencies. This is likely to be increasingly true as after monetary integration there is likely to be much more pressure on the EU as a whole to avoid using competitive devaluation as a trade tool.

In our base case economic scenario, intra-EU trade grows at an annual growth rate of 4.15% over 1995 to 2005, which is 1.5 times faster than EU GDP and 1.2 times faster than external EU exports (see Table 6.3). Under the rapid scenario, intra-EU trade grows at 4.27%.

Table 6.3. Growth rates in trade and GDP (%)

	Intra-EU trade CAGR 1995–2005 (%)	EU exports CAGR 1995–2005 (%)	EU GDP CAGR 1995-2005 (%)
Rapid	4.27	3.55	2.75
Unsynchronized/Base case	4.15	3.46	2.70
Antimonde	3.97	3.32	2.63

Source: Analysys.

In all scenarios, trade forms an important component of GDP, with the increase in intra-EU trade being about 38% of the growth in GDP, and external exports being about 16% of the growth in GDP. These marginal rates are higher than the average values for trade and GDP so

in the base case the ratio of intra-EU trade to GDP increases from the current level of 13.8% to 15.8% by the year 2005, while the ratio of external exports to GDP increases from 8.4% to 9.0% over the same period. The EU's external trade balance registers a slight deterioration in currency terms – largely due to the import requirements to support TOs' incremental capital expenditures – but remains unchanged in relation to GDP. These effects are slightly more accentuated in the rapid scenario (for example, intra-EU trade rises to 15.9% of GDP), and offset in the *antimonde* (for example, intra-EU trade rises to 15.6% of GDP).

6.4. The challenge

> *Opening telecoms to competition, painful as it has been, will prove to be politically and conceptually the easy part. Dealing with the consequences will be the next and more difficult challenge.*
>
> Eli Noam, Columbia Institute of Tele-Information[34]

Technological advances in the telecoms, broadcasting and information industries have created the means to transform many kinds of information – voice, data, video, interactive or switchable message – into a common format, making possible advanced services such as video on demand and teleshopping. As a result, previously distinct boundaries between telecoms, broadcasting, computing and other industrial sectors are disappearing. Simultaneously, the significant potential benefits to be gained from the use of telecoms are becoming apparent. Providing the right conditions to enable information infrastructures to be built, and ensuring that the benefits of the emerging Information Society are distributed widely, efficiently and equitably, must be a priority for the EC and Member State governments.

Europe is on the verge of developing a new telecoms environment that will bring a dramatic increase in the diversity and number of telecoms companies and services, a key step in constructing the Information Society. The arguments in favour of liberalizing European telecoms have largely been accepted and commitment to competition is increasing across the Member States. However, the detailed outcome is unclear, the transition to competition is difficult, and some Member States – those with less advanced networks or internal political resistance to liberalization – will take longer than others.

In this report we have considered two different scenarios for implementing liberalization: a rapid move towards full liberalization, and a more uncertain unsynchronized process in which differential progress and the difficulties of regulation and licensing mean that full liberalization is postponed beyond the time horizon of this study. These two scenarios are compared to the *antimonde* – a benchmark of no further progress in telecoms liberalization throughout Europe. We have shown that liberalization has benefits for the telecoms sector in terms of employment, revenues and investment and that these benefits spill over into the wider EU economy.

A further incentive for undertaking the liberalization programme is the effects that development in the rest of the world will have on the EU telecoms sector. If other major world regions are liberalizing, then not only will reciprocal action be required by the EU in order to enable EU operators to access their markets, but such regions will also develop a

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[34] Noam, Eli M. (1994) 'Beyond liberalization: from the network of networks to the system of systems', *Telecommunications Policy,* Vol. 14, No. 4, p. 294.

competitive advantage through improved affordability, accessibility and functionality of their telecoms services. Furthermore, such developments will not be isolated within rapidly liberalizing regions: experience with international resellers has shown that aggressive operators operating under liberalized regimes can rapidly penetrate unliberalized markets. These effects are part of a more general process of globalization, and clearly challenge the EU's ability to create a single European market in telecoms at its own pace or for any one Member State to resist the liberalization process.

Liberalization in telecoms offers Europe a challenge in terms of implementation of regulations, institutional and market structures, data protection, intellectual property, content and culture. In the wider economy, the challenge is to seize the opportunity being presented, to innovate and to learn how to exploit the immense possibilities which the information revolution presents. These processes are not always beneficial for all concerned; in regional development and employment, policies may be necessary to assist organizations, individuals and communities. Nevertheless, the overall benefits are substantially positive. As Jacques Santer said, ' ... on completion of our liberalization process in 1998, the European Union will have the potential to be the largest telecoms market in the world'.[35] The benefits of this extend well beyond the confines of the telecoms sector to the whole of the EU.

35 Jacques Santer, President of the European Commission. Speech at the opening of the World Telecommunications Forum, Geneva, 3 October 1995.

APPENDIX A

Statistical analysis of the impact of telecoms liberalization on telecoms sector revenues

A.1. Overview

This appendix describes a statistical procedure developed to generate forecasts of telecoms sector revenue for each country within the EU.[36] These forecasts are based on expected growth in GDP per capita, and projections of the development of regulatory and market structure conditions within each country, under each of the regulatory scenarios developed in Chapter 3.

The analysis is in three steps:

(a) Data on a set of eight indicators on regulatory conditions and market structure were collected for the telecoms sectors of 23 OECD countries (including all 15 EU Member States) dating back to 1973. These diverse indicators were subjected to factor analysis to capture the spirit of their trend with a reduced number of indicators. The two resulting principal factors can be interpreted as broadly representing the degree of independence of the TO from government and the extent of competition permitted in the market. We refer to these synthetic variables as the liberalization indices.

(b) The impact of these two liberalization indices on telecoms sector growth was estimated econometrically, with GDP per capita used as a control variable to capture changing economy-wide conditions. Separate equations were estimated for telecoms lines per capita and telecoms revenues per capita in step-wise fashion, on the basis of historical data for the 23 countries as a group.

(c) The future values of the liberalization indices were then produced using forecasts of the eight indicators, built on our view of future regulatory and market structure developments under each of the regulatory scenarios discussed in Chapter 3. These were combined with base case GDP per capita forecasts for EU Member States, to forecast future revenue growth and line penetration within the EU telecoms sector under the three regulatory scenarios, on the basis of the regression results obtained in the second step.

The next three sections of this appendix deal with each of these steps in turn. Figure A.1 summarizes the relationships between the data and the statistical methodologies.

A.2. Factor analysis of telecoms sector indicators of regulation and market structure

The eight regulatory and market structure indicators considered are listed in Table A.1. The corresponding data was collected for each of the 23 OECD countries surveyed for the period 1973 to 1994, from ITU and other sources. Where available country reports had insufficient detail, data items were checked with the operators in question or derived from company reports.

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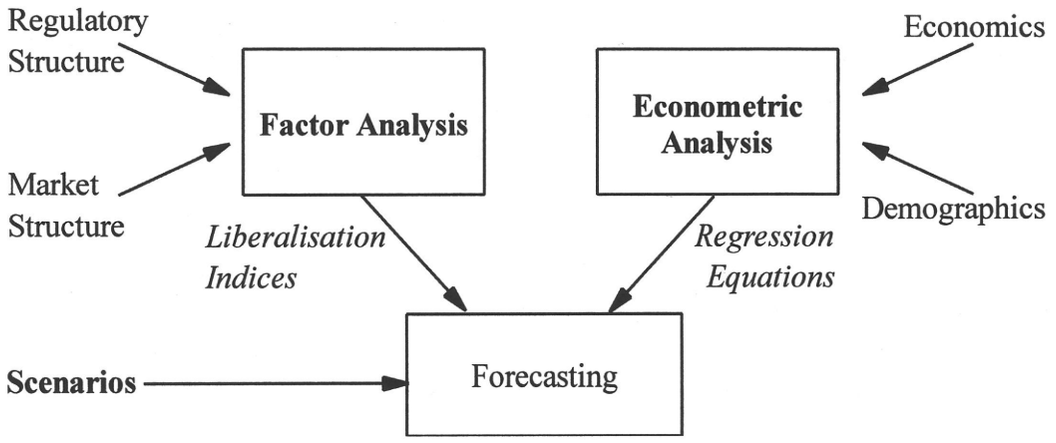
[36] The methodology underlying the model is described in *Internationaler Vergleich der Telekommunikationsinfrastruktur – Staatliche Vorgaben und Ausstattung*, Analysys report for Bundesministerium für Post und Telekommunikation (BMPT), August 1992.

Figure A.1. Outline of statistical methodology



Source: Analysys.

Table A.1. Indicator variables used to construct the liberalization indices

Indicator variables of the independence of the TO from the government (regulatory index)	
Voting shares owned by the government	%
Independent regulator	0 – 1
Public tariff formula	0 – 1
Explicit performance targets	0 – 1
Indicator variables of the level of competition (market index)	
Type 1 competition (infrastructure, public, data and voice)	Yes/No
Type 2 competition (value added service providers)	Yes/No
Mobile competition	Yes/No
Terminals competition	Yes/No

Source: Analysys.

Factor analysis was undertaken on these eight indicators in order to compress their information content into a smaller number of indicators. Factor analysis identifies so-called 'common factors' among the input variables, such that the input variables can be expressed as functions of a small number of these common factors.

We used Principal Components analysis, under which the factors are constructed as linear combinations of the input variables. (All variables were standardized to have 0 mean and a variance of 1. The total variance of the standardized input variables is therefore equal to the number of variables used in the model.) The first principal component identified accounts for the largest amount of variance in the set of input variables; the second principal component is uncorrelated with the first, and accounts for the second largest amount of variance, etc. There are three steps in this procedure.

(a) The first step consists of determining the number of factors to be used in the model. We included all factors with an eigenvalue (i.e. the amount of variance explained by the factor) greater than 1, on the grounds that factors with an eigenvalue of one or less are no better than a single variable. The total percentage of variance explained by the

factors with an eigenvalue greater than 1 is an indication of how well the factor model fits the input variables.

(b) The next step in factor analysis is to undertake multiple regression analysis with the original input variables as the dependent variables, and the factors as the independent variables. A low level of explained variance indicates a low level of commonality with the other variables in the input set, and might be a reason to exclude the variable from the analysis.

(c) As all variables are likely to be related to each of the factors found, i.e. all variables load onto each of the identified factors, it is generally quite difficult to interpret the factors. To enable an easy interpretation of the factors it is required that the variables load onto as few factors as possible. This can be achieved by performing a so-called 'rotation phase'. The rotation does not affect how well the model fits the data, but increases the ease of interpretation.

This analysis revealed that the regulatory and market structure indicators were composed of two related groups. The first group consisted of the indicators relating to the equity share in the national TO retained by the government, the existence of an independent regulator, the implementation of a price cap or tariff formula, and the imposition of performance targets on the incumbent TO. The second group related to the establishment of competition in four areas: terminal provision, mobile network and services, Type 1 (fixed network infrastructure), and Type 2 (fixed network service) competition. These groups were labelled the *regulatory* and *market* indices respectively.

The relationships resulting from factor analysis are expressed in the form:

$$\textit{Regulatory Index} = -0.310*\ln(\textit{Govshare})+0.326*\textit{Indreg}+0.359*\textit{Priceform}+0.304*\textit{Perftarg}$$

$$\textit{Market Index} = 0.326*\textit{Type1Comp}+0.309*\textit{Type2Comp}+0.317*\textit{MobileComp}+0.227*\textit{TermComp}$$

Table A.2 shows summary statistics for the factor analysis used to determine the legal and market indices. Since the significance of the Bartlett test of sphericity was small, the hypothesis that the correlation matrix is an identity matrix is rejected. This indicates that there is significant correlation between the variables on the basis of which common factors may be identified. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy can be used to check whether the correlations are distributed uniformly among the input variables: the higher the value of the KMO test, the more likely it is that only a small number of factors is required to represent the input variables (values of the KMO measure in the region of 0.7 are considered 'fair', and values in the region of 0.8 are considered 'good'). Thus, we can safely reject the possibility that the correlations are between pairs of variables, rather than being uniformly distributed among all the variables.

Table A.2. Summary statistics for the factor analysis used to determine the regulatory and market indices

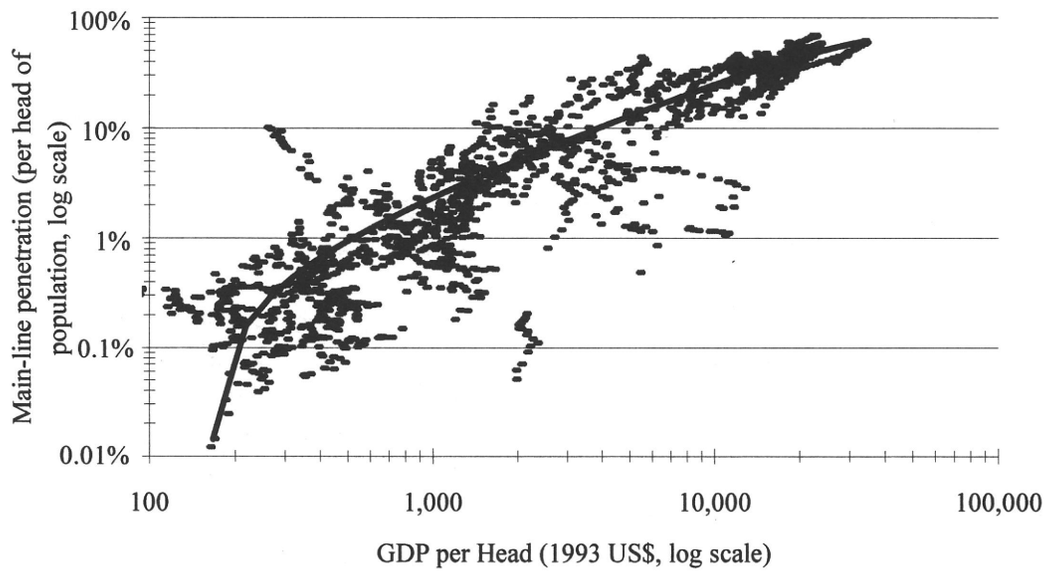
	Regulatory index	Market index
Bartlett test of sphericity: significance	0	0
KMO measure	0.685	0.770
Variance explained by the factor	59%	71%

Source: Analysys.

A.3. Econometric analysis of the impact of liberalization on telecoms sector performance

Many previous econometric analyses have revealed that the dominant indicator in the development of the telecoms sector in any country is GDP per capita. (See Section 2 of Appendix D for a discussion of the empirical literature and of the conceptual limitations of these analyses.) Figure A.2 illustrates the relationship between GDP per capita and main line penetration; a similar relationship exists between GDP per capita and telecoms revenue per head.

Figure A.2. The relationship between GDP per capita and the national average telecoms penetration rate



Source: Analysys.

In this section we develop a model for forecasting telecoms sector revenues based on the liberalization indices, while retaining GDP per capita as a control variable to capture shifting macroeconomic conditions. The OECD data shows that, on average, users spend around 2% of GDP on telecoms services. However, we expect this proportion to vary significantly according to the ease with which users can gain access to services and the perceived value of

the service. We investigate whether we can observe such effects on the basis of our liberalization indicators.

The data used in the econometric analysis is:

(a) Telecoms sector performance, as captured by number of telecoms lines and sector revenues (both in per capita terms). Note that we are making no assumptions about the type of technology or type of service on which users are spending money. In other words, an access line may be a PSTN line, an ISDN line, or a mobile line; similarly, consumers may be buying a PSTN service, a mobile service, or a value added service.
(b) Telecoms liberalization indicators, developed through the factor analysis detailed in the previous section.
(c) Economic control variables, namely GDP per capita. Other economic and demographic variables (such as the urbanization rate, sectoral composition of GDP, the importance of foreign trade in GDP, and labour participation rates) were tested for inclusion as control variables, but none added significantly to the predictive power of the model.

Two equations have been derived which are used to predict telecoms revenue and demand in the EU. These are estimated using annual data since 1973 for the 23 major OECD countries as a group. The equations forecast lines per head and revenue per head, and are of the form:

$$LinesH_t = \exp[0.8 * \ln(GDPperHead_t) + 0.06 * (LegalIndex_t + MarketIndex_t) + 0.03 * (Year - BaseYear) - 6.64]$$

$$R^2\,(Correlation\ Coefficient) = 0.86$$

$$RevenueH_t = \exp[0.72 * \ln(GDPperHead_t) + 0.46 * \ln(LinesH_t) + 0.11 * LegalIndex_t - 0.06 * MarketIndex_t + 0.01 * (Year - BaseYear) - 3.95]$$

$$R^2\,(Correlation\ Coefficient) = 0.88$$

where

$GDPperHead_t$ = GDP per head in year t,
$LinesH_t$ = Lines per head in year t,
$RevenueH_t$ = Revenue per head in year t,
$MarketIndex_t$ = Market index score in year t,
$LegalIndex_t$ = Regulatory index score in year t.

A.4. Forecasting telecoms sector revenues

A forecasting model was derived on the basis of the factor and econometric analyses described above, which was used to investigate the impact of the three regulatory scenarios, outlined in Chapter 2, on the future development of the telecoms sector annually until the year 2005. The steps involved in the forecasting procedure are as follows:

(a) forecasting the values of the eight underlying regulatory indicators listed in Table A.1 for each country group (as described in Chapter 3), on the basis of the regulatory vision in each scenario;
(b) creating the corresponding liberalization indices for each country group on the basis of the results of the factor analysis on historical data;

(c) generating a forecast for GDP per head for each country (from IMF and World Bank sources; these were consistent with base case forecasts in Chapter 6);
(d) feeding this data into the estimated regression equations in step-wise fashion, separately for each country. Specifically, the forecasts of GDP per head and the regulatory and market indices were used to estimate the number of main lines per head in each country, using the results of the first regression equation. This was used as an input to calculate the revenues per head in each country, using the results of the second regression equation. Telecoms revenue for each country was then derived by multiplying this amount by the size of the population in each country, and the total EU telecoms revenue was obtained through summation.

Below we discuss briefly the likely evolution of the liberalization indices in the rapid and unsynchronized scenarios (the *antimonde* assumes no change in either of these indices).

(a) The market index largely comprises measures which either have already entered national legislation or will do so shortly, and which are designed to encourage new entrants. Type 2 (service) competition and terminal competition are already in place and effective within every Member State. Competing mobile operators have now been licensed in every Member State, but have not yet started operations in all cases. The implementation of Type 1 competition has been set for 1998, with derogations for five Member States. The values of the indicators of both mobile competition and Type 1 competition within the market index have been varied under the unsynchronized and rapid scenarios, in order to reflect expectations as to when legislation on these issues will be enacted and become effective in the Member States.[37]
(b) The elements of the regulatory index refer largely to measures that will affect the performance of the incumbent TOs, and are subject to considerable variation across Member States. For example, each Member State (with the exception of Greece) has established a regulatory body separate from the TO, but the final format of that body, and the manner in which it will operate in the post-1998 era, is still a matter for debate in many countries, including France and Germany. Similarly, the appropriateness and format of tariff formulas varies significantly from country to country, and in many cases is unlikely to be fully resolved until the status of the national regulator is finalized. Finally, national governments will respond at different speeds to varying degrees of internal and external resistance to their plans to sell equity in the incumbent TO.

Figures A.3 and A.4 illustrate the predicted variations in the regulatory index for each of the five country groups between 1995 and 2005, under the rapid and unsynchronized scenarios. Group values in these graphs are the weighted average of the individual country index values. The figures illustrate how the gap between Group 1 countries and the rest of the EU is closed significantly under the rapid scenario, with Group 5 countries, in particular, making significant advances in the rapid compared to the unsynchronized scenario.

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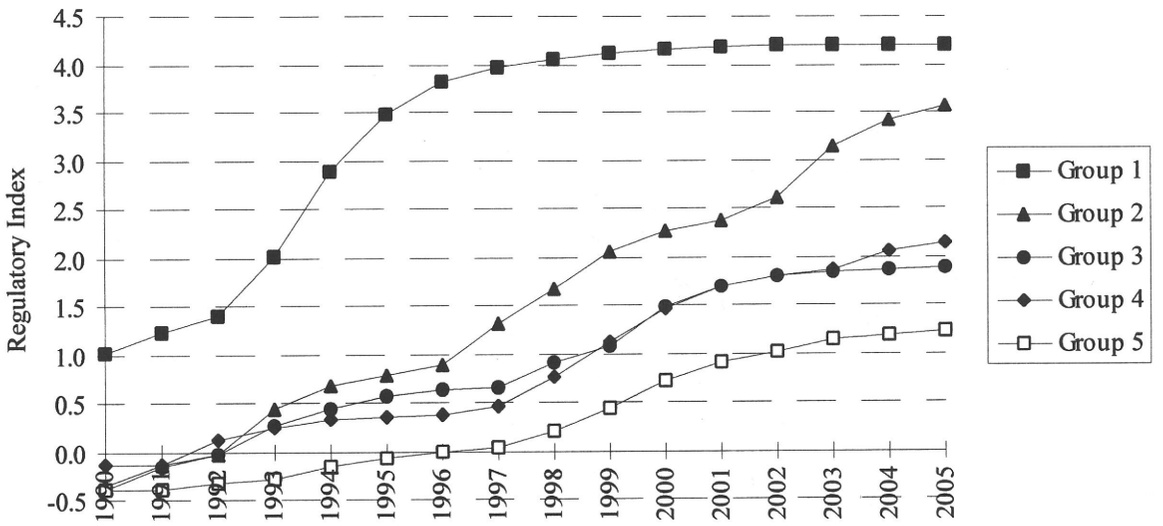
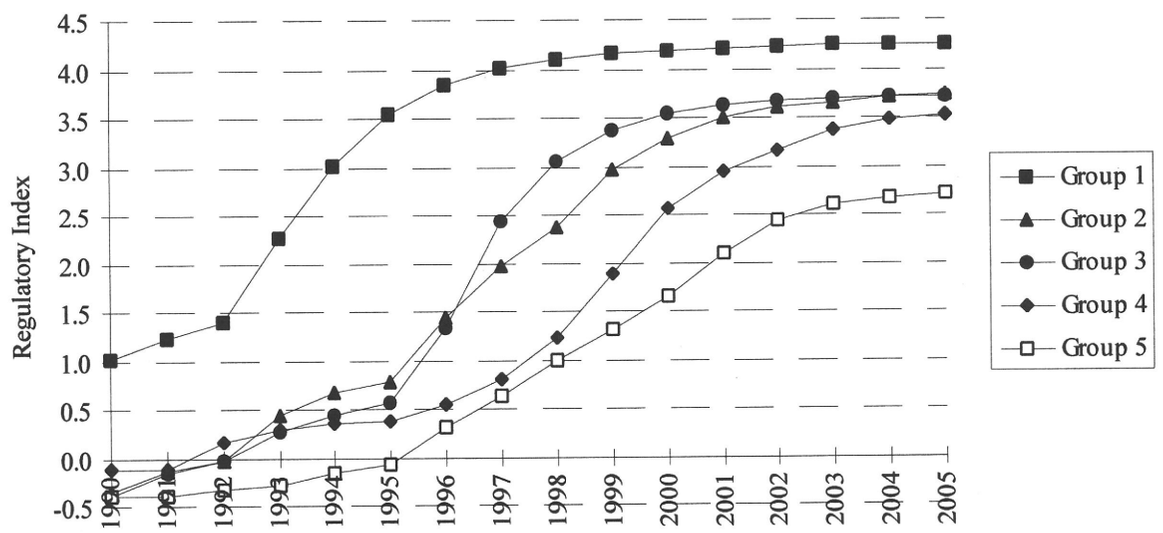
[37] Because of uncertainties over the date at which some of these zero–one variables will change, we have weighted the potential outcomes in each year by our assessment of the relevant likelihoods, to obtain an expected value for each variable in each year. Whilst this expected value will always lie in the interval zero–one, it may sometimes fall in the interior of the interval, rather than at one of the extremes.

Figure A.3. Predicted value of the regulatory index for each group of countries, unsynchronized scenario



Source: Analysys.

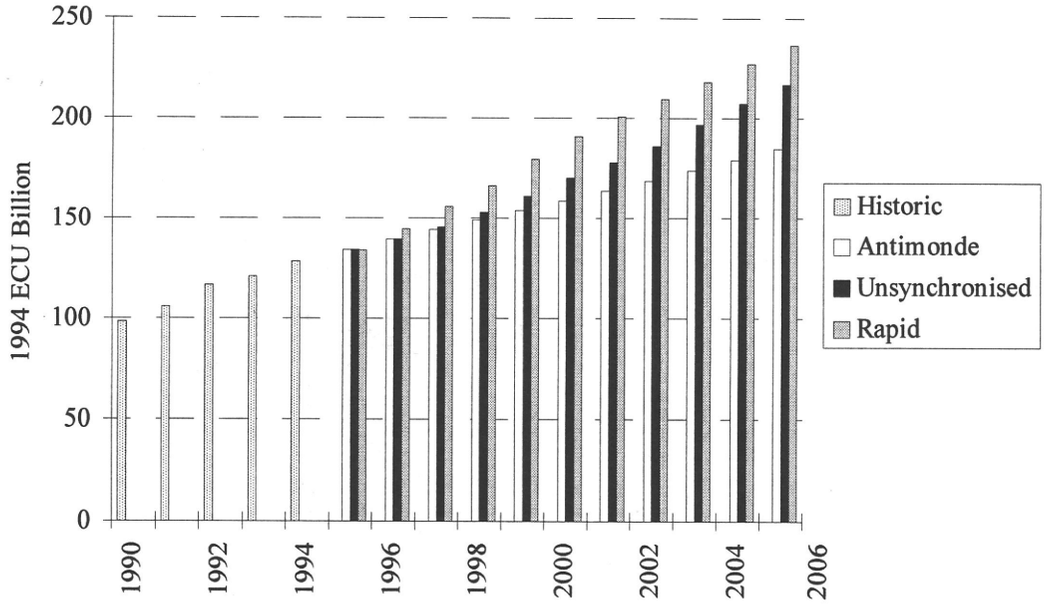
Figure A.4. Predicted value of the regulatory index for each group of countries, rapid scenario



Source: Analysys.

Combining the liberalization indices with the base case GDP forecasts, we obtained the following aggregate revenues accruing to operators and service providers in the EU under each scenario (illustrated in Figure A.5).

Figure A.5. Total sector revenue forecast by regression methodology



Source: Analysys.

APPENDIX B

Telecoms employment and capital expenditure – the recent UK experience

This appendix describes the evolution of employment and capital expenditure in the UK telecoms sector since 1985. Within the EU, the UK has led the way in liberalizing its internal telecoms market and in promoting competition. Its experiences, therefore, provide a useful vantage point from which to assess the likely effects of pan-European telecoms liberalization, since:

(a) operators in most European countries will need to undergo the kinds of adjustments that the British telecoms sector has already gone through;
(b) observation of the interactions between the incumbent and new entrants within the UK can help to inform us about how the EU telecoms sector might evolve before, and even after, other EU countries have attained the current level of competition in the UK market.

This appendix complements the EU-wide assessment of the impact of telecoms liberalization undertaken in Section 4.7 of the main report. It highlights the ways in which the UK experience has informed our pan-European forecasts, especially in the case of capital expenditure by new entrants.

B.1. Employment

Figure B.1 shows employment in the UK telecoms sector for the last decade. Overall employment in the sector grew until 1991, but the strong growth in the number of jobs created by new operators in the sector since 1991 has not matched the sharp drop in employment at BT over that period. The key question is whether other countries will go through such a dramatic job-shedding process as they liberalize their telecoms sector.

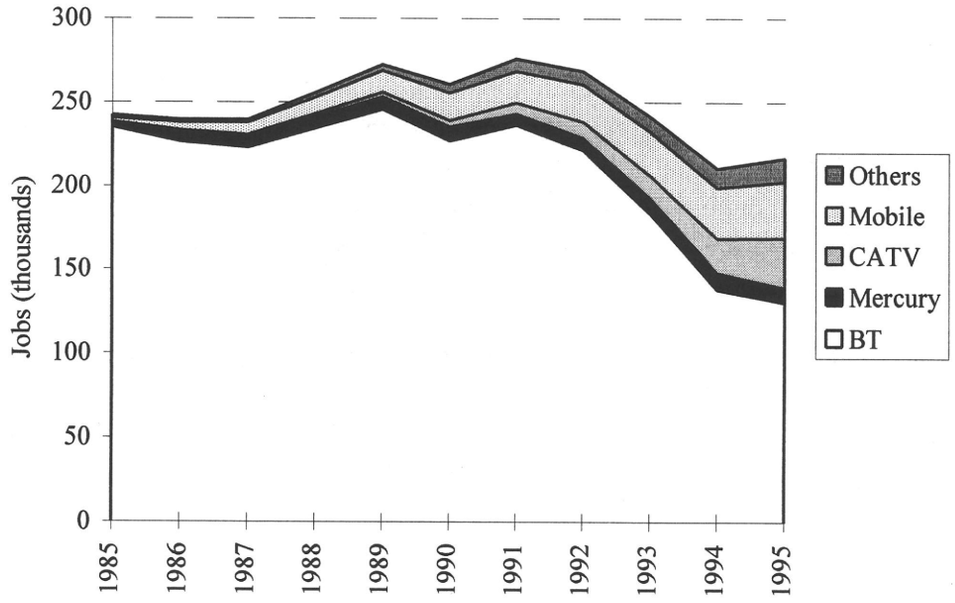
BT's reduction in employment was a response to its historically high level of staffing. It is possible to demonstrate that its staffing levels were high by comparing BT's efficiency with that of other TOs, using the number of telephone lines per employee as a simple measure of labour productivity. This measure is becoming less reliable as a basis for comparisons across operators as operators' activities (and, consequently, the sources of their revenue) become more diverse. However, it is reasonable to use it as a productivity indicator for the late 1980s and early 1990s when the bulk of TO revenues still came from traditional telephony services.

Figure B.2 shows the evolution of the lines per employee ratio for the major TOs in Europe over the period 1985 to 1994. For most of that period, BT's labour productivity was considerably behind that of major European operators, but it is now operating at a more typical level of efficiency, having reduced its staff from 241,124 in 1984 to 132,351 by 1996. Forecasts for the financial year 1995/96 were for BT to shed around 8,000 jobs compared with

approximately 40,000 for each of the previous two years.[38] This suggests that we can expect overall job creation in the UK in the coming years.

This analysis reveals that the starting point of the UK's telecoms sector, when it embarked on its liberalization process, is not typical of where most European countries are now, and that simple extrapolation of the UK experience would be misleading.

Figure B.1. Employment in the UK telecoms sector, 1985–95[39]



Source: Analysys calculations using annual report and ITU data.

An indication of a more likely pattern of employment in a liberalizing country can be achieved by reconstructing Figure B.1 to reflect a hypothetical TO, which operated the BT network but enjoyed a level of labour productivity (as measured by lines per employee) equal to France Telecom's (representing an 'average' level of productivity for continental European TOs). Figure B.3 shows what the total evolution of employment in the UK telecoms sector would have been under these circumstances. It illustrates that, had the labour productivity of BT been at the contemporary level for France Telecom since 1985, total employment would have risen every year for the last ten years at a compound annual growth rate of 2.8%.

This suggests that, as countries such as France, Germany, Italy and Spain liberalize their telecoms markets, they should experience less job destruction than has been the case in the UK. However, it is not reasonable to assume that no productivity gains will be achieved as the incumbent TOs in these countries confront an increasingly competitive market. Thus, employment gains can be expected to be significantly less than the 2.8% suggested by Figure

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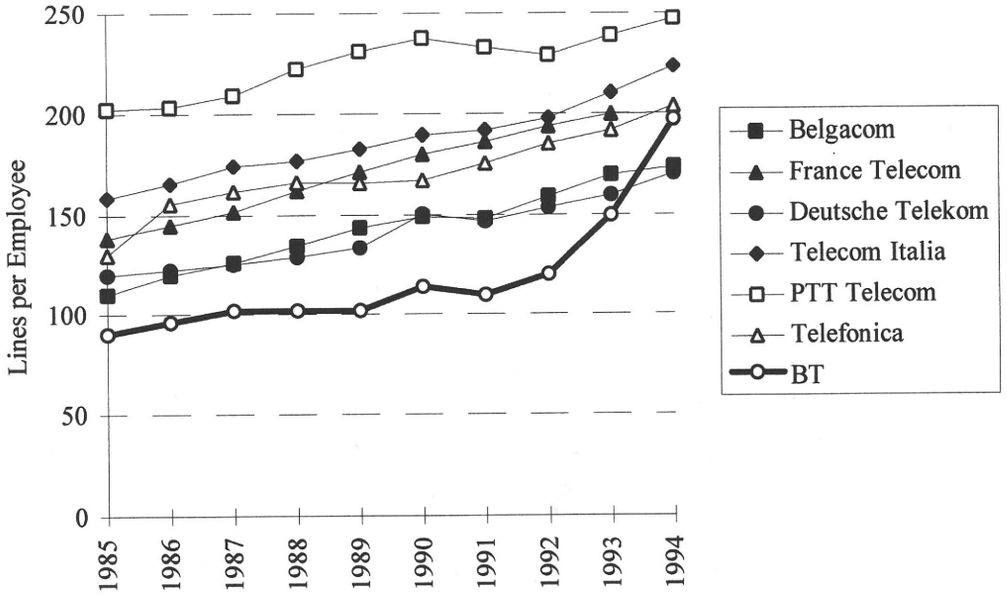
38 See BT WWW page http://www.bt.co.uk/home/newsroom/document/nr9608.htm

39 Mobile includes cellular telephone and paging operators and service providers. Others include AT&T, Cable & Wireless, COLT, Energis, IBM IN, Ionica, Kingston Communications, MFS, NTL, Racal BRT and telecoms subsidiaries of electricity companies.

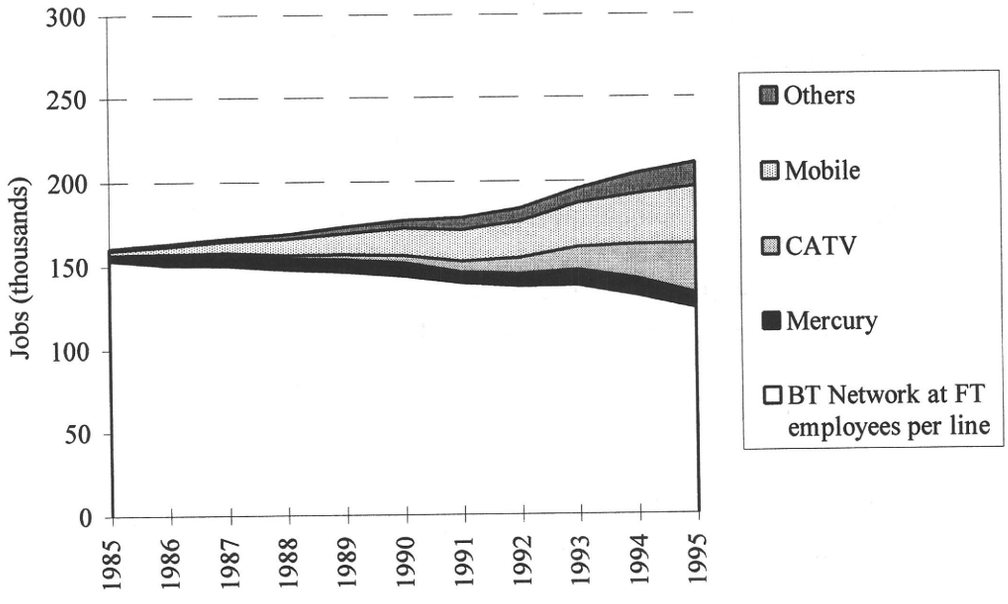
B.3. In fact, the telecoms employment growth forecasts in Section 4.7 of the main report indicate an average employment gain under the rapid liberalization scenario of half this amount: 1.4% per annum.

Figure B.2. Lines per employee for the major European TOs, 1985–94



Source: Analysys calculations using annual report and ITU data.

Figure B.3. Hypothetical development of UK telecoms sector employment if BT had a lines per employee ratio equal to France Telecom's, 1985–95

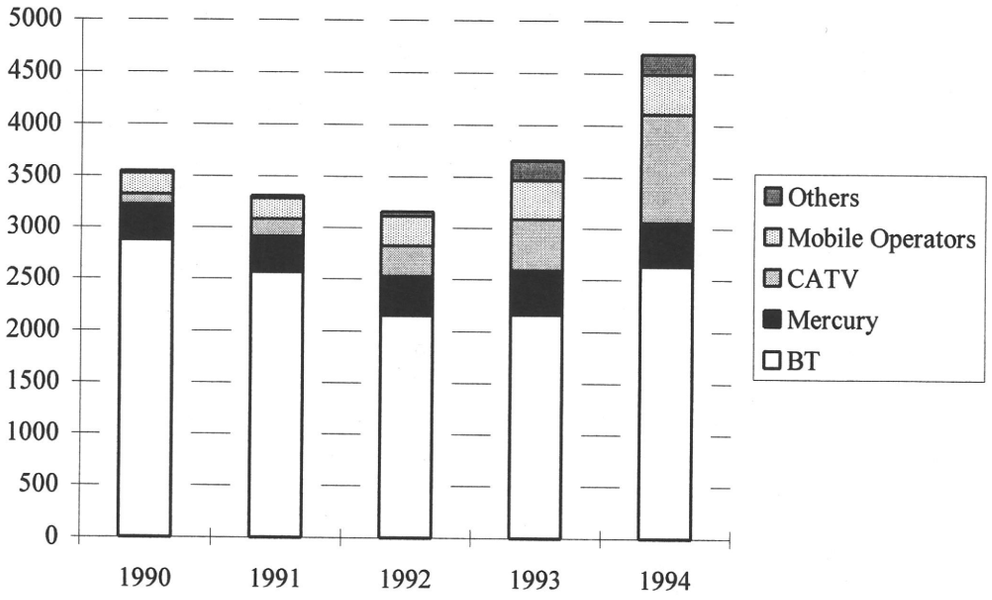


Source: Analysys calculations using annual report and ITU data.

B.2. Capital expenditure

Following full liberalization of the UK telecoms market in 1991, there was an increase in capital expenditure in the sector. Figure B.4 shows a breakdown of capital expenditure by the different operators in the UK between 1990 and 1994. New entrants' capital expenditure rose sharply as they built new infrastructure. BT's capital expenditure fell for the first three years of the decade, mirroring the worldwide fall in capital expenditure, but began to rise in 1993 in response to competition and the need to use the quality of its network as a means of retaining customers.

Figure B.4. Telecoms capital expenditure in the UK, 1990–94



Source: Annual reports, UK Cable Communications Association publications.

In Section 4.7 of the main report, observed capital expenditure by different types of new entrants in the UK formed the basis of the estimates of roll-out capital expenditures by prospective new operators within the EU. The capital expenditure by fixed local loop, fixed backbone network, GSM and DCS1800 operators in the UK, were mapped onto the other Member States in accordance with our forecasts of the number of entrants and the roll-out timetable for new operators in each Member State. Table B.1 shows the roll-out table for new backbone network and local loop operators, and Table B.2 shows the roll-out of new mobile operators. The roll-out investment for each new operator was scaled to that observed in the UK, using the number of telephone lines in the country.

Table B.1. Roll-out of new backbone and local loop operators in the EU

Year	Backbone networks		Local loop networks	
	Unsynchronized	Rapid	Unsynchronized	Rapid
1995	4	4	1	1
1997	6	6	2	3
2000	19	21	9	14
2005	21	22	14	19

Source: Analysys.

Table B.2. Roll-out of new mobile operators in the EU

Year	GSM		DCS1800	
	Unsynchronized	Rapid	Unsynchronized	Rapid
1995	19	19	3	3
1997	21	20	4	17
2000	21	21	6	31
2005	24	23	10	35

Source: Analysys.

APPENDIX C

Sector descriptions

This appendix is based on the results of a large-scale survey of telecoms managers across the EU, undertaken by Analysys [1995a]. The primary objective of this survey was to understand the awareness and expectations that users have of advanced communications, especially within the context of an ATM network. An underlying assumption of the survey was that the affordability, functionality and accessibility of the advanced services discussed would, to a large extent, be determined by the continued opening up of a competitive market for telecoms services. Discussion of the likely evolution of these advanced services, therefore, also captured the subjective view of respondents on the processes of liberalization and their impacts within the EU.

The respondents to the survey were 350 telecoms managers, responsible for telecoms strategy in their organizations. Of these 350 organizations, 300 were large companies with an annual turnover in excess of ECU 200 million, and 50 were medium-sized organizations with an annual turnover of ECU 10–15 million. The interviews were conducted over the telephone in the language of the respondent. Responses were received from 12 countries within the EU, although the majority came from Belgium, France, Germany, Italy, the Netherlands, Portugal, Spain, and the UK.

The survey focused on ten sectors, which account for 54% of European industry and approximately 70% of expenditure by businesses on all telecoms bearer services. The ten sectors were: aerospace, automotive and engineering manufacturing; healthcare; travel and transport; finance; electrical and electronic manufacturing; retail and distribution trades; oil, chemical and pharmaceutical; entertainment, printing and publishing; education; and other government.

The survey covered current and expected future use of advanced communications, the business drivers influencing the purchase of advanced services, the buying criteria, and the impact of advanced communications on the services that TOs are delivering to users. It concentrated on specific applications: EDI, e-mail, EFT (and EFTPOS), LAN interconnect, collaborative working, desktop videoconferencing, multimedia information retrieval, video e-mail, and education and training (i.e. the use of advanced services in delivering education and training, rather than education and training about the services themselves). While not all these services are relevant to every sector, they demonstrate the integration of new technologies into the range of activities undertaken by organizations, and are good indicators of the impact of telecoms services on the development of the five major business strategies: product innovation, market innovation, management of processes, management of relationships and management of resources.

This appendix forecasts the uptake and use of advanced services, as derived from the survey. It covers both existing use of services and anticipated use in 2000, and provides an indication of (weighted) intensity of use of specific services across the sectors and changes in total telecoms expenditure. For each sector studied, relevant data has been aggregated and presented in two figures:

(a) The first figure presents changes in the anticipated use of a range of services between 1995 and 2000, based on a subjective assessment of intensity of use. Weights were given to different levels of use, ranging from 'no use' through 'some use' to 'intensive use', and these weights were then aggregated to give a guide to the anticipated changes in the use of services.

(b) The second figure illustrates the average telecoms expenditure per organization interviewed, showing the actual level of expenditure in 1995, together with estimates of expenditure for 1997 and 2000.

In addition, for each sector where the information is available, a brief description of value added by country is given, to show the distribution of value added activities across the EU. The most consistent data available is for 1992, and thus only covers the 12 Member States of that time. However, the geographical distribution can provide additional insight into the impact of telecoms liberalization on the sectors reviewed. For example, where value added in a sector is concentrated in a few countries (or, in the case of the financial services sector, within a few cities), the benefits of liberalization on the broader economy will be relatively limited. Inevitably, this distribution of value added reflects the strength of the four major economies of the EU, namely France, Germany, Italy and the UK.

The assessment of importance of both the strategies to the sector and the role of telecoms services to developing and implementing a strategic response, is set out in various tables in each sector description. The material presented represents a qualitative judgement of the relative importance of each issue. Where a solid circle is shown the impact is very strong, where a blank circle is shown the impact is extremely weak; the intermediary stages represent increasing degrees of importance. It should be noted that these tables are designed to summarize a mass of material and create a framework in which to discuss the value of telecoms services to the sector. Such a framework is necessarily fraught with methodological issues, but its value lies in focusing attention on key issues and raising a debate.

C.1. Aerospace, automotive and engineering manufacturing sector

The aerospace, automotive and engineering manufacturing sector is one of the most important sectors in the European economy, in terms of employment in high technology sectors, trade within the EU and externally, and research and development. In many countries, manufacturers in this sector are among the largest employers, and more than two million people are employed in the sector as a whole in Europe.

The distribution of value added in this sector between Member States is shown in Table C.1, indicating a relatively high concentration of EU manufacturing engineering in Germany, and to a lesser extent in France, the UK and Italy. The implication of this data is that the impact of telecoms liberalization on this sector will be markedly different between countries. In addition, there will be also be marked geographical contrasts within individual Member States.

C.1.1. Business pressures

Major issues that confront this sector are largely focused on cost control, as new manufacturing technologies and practices are introduced across the industry. These new technologies and practices involve a strong commitment to international collaboration, as firms seek to minimize their production costs and share the risks of product development.

Table C.1. Distribution of value added in the EU: aerospace, automotive and engineering manufacturing sector, 1992 (%)

Belgium	Denmark	France	Germany	Greece	Ireland
2.53	1.46	15.67	45.28	0.17	0.37
Italy	**Luxembourg**	**Netherlands**	**Portugal**	**Spain**	**UK**
11.11	0.06	2.68	0.53	6.45	13.67

Source: Eurostat.

As a well-established global industry, firms are looking for the most economically efficient location for producing each part and sub-assembly; for example, Ford has established product teams that cut across country boundaries and organizational structures. Many companies are siting production in countries where the labour force has similar skills to those found in Europe, but wage rates are far lower. The automotive industry, in particular, makes use of industrializing countries for low-skilled assembly work: for example, both Renault and Mercedes have committed themselves to substantial capital investments in manufacturing capacity in Brazil. Moreover, Mercedes has announced its intention to manufacture 25% of its cars outside the EU within the next ten years; non-EU production is currently about 5%.

There is evidence of a trend towards increasing concentration in the European automotive sector, for example Fiat's purchase of Alfa Romeo and VW's acquisition of Seat and Skoda. In the aircraft sector, this trend is even more pronounced – in recent years, new civil and military aircraft in Europe have been produced by multinational alliances. Those companies that have failed to join international alliances have lost market share and in some cases have closed – Fokker in the Netherlands, for example. This need for businesses to form international alliances is also well illustrated by the current discussions over the future of Dasa and its Dornier Luftfahrt turbo-prop aircraft business.

C.1.2. Telecoms impact

The result of these trends is the creation of more complex organization structures, both geographically and functionally. New telecoms services become an essential tool in minimizing increased costs as a result of this increasing complexity, and demand for telecoms activity will therefore grow:

(a) As the number of sites involved with the construction of a single product increases, so the need for inter-site communications and wide area voice and data services also grows.
(b) New services, such as remote application sharing, make it easier for global organizations to have multinational teams operating over multiple sites. Videoconferencing will be one of the major tools for this collaborative work, and will also be used to substitute some business travel.
(c) Resources of multimedia information for technical, sales and marketing, and managerial purposes will increasingly be held on an organization-wide, as opposed to departmental or individual, basis. For example, Scandinavian Airlines are using multimedia services to distribute technical resources for maintenance schedules across the organization.
(d) Training over dispersed sites will be carried out remotely, using broadband multimedia telecoms services.

The contribution of telecoms services to shaping business strategies is set out in Table C.2. Multimedia and value added services will be key tools for this sector to manage complex multi-site processes, relationships and resources, enabling, for example, closer integration of design, production and marketing.

Table C.2. Contribution of telecoms services to shaping business activities: aerospace, automotive and engineering sector

	Revenue effects		Cost effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Mobile	○	○	○	○	●
Multimedia	◑	◑	○	●	○
Value added services	◑	○	●	●	●
Traditional services	◔	○	◑	○	○
Total impact	◑	◔	◑	●	●

Source: Analysys.

The overall impact of telecoms services on the sector is shown in Table C.3. There is a relatively good fit between the benefits brought by improved telecoms services as a result of liberalization for the sector, and the business pressures that will improve the sector's performance, i.e. improvements in the availability, affordability and functionality of telecoms will have an incremental impact on the sector's performance. These advanced telecoms services will help to reduce the cost structure of the sector by improving the management of processes, external partnerships and relationships, and resources. The importance of these strategies reflects the sector's changing structure, in terms of the growth of inter-organizational behaviour, and the need to improve decision-making processes in order to achieve higher use and better allocation of existing resources.

Table C.3. Overall impact of telecoms liberalization on aerospace, automotive and engineering sector revenues and costs

	Revenue effects		Cost effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Impact of telecoms services	◑	◔	◑	●	●
Importance of strategy	◑	○	●	●	◑
Overall impact of telecoms liberalization	◑	○	◕	◕	◑

Source: Analysys.

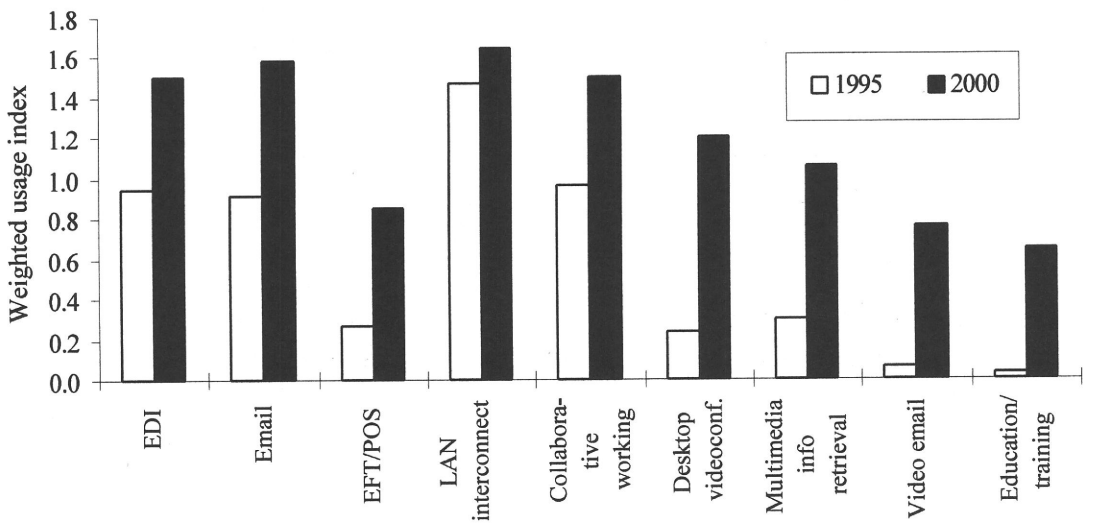
C.1.3. Key applications

Demand for telecoms applications that support the growth of increasingly complex transactions within and between firms in the sector, will increase over time. Our survey suggests that increased inter-organizational activity will require a rapid increase in the use of

EFT and other new services, such as videoconferencing and multimedia information retrieval. These applications are set to grow by a factor of five or six over the period 1995 to 2005. The use of these broadband services will allow for the deepening of inter-organizational collaboration and asynchronous working. In part, the rapid growth in these services will be facilitated by the already high use of existing services, such as EDI and e-mail, which support inter-organizational working and new production systems. Use of these well-established applications is expected to continue to grow by around 50% between 1995 and 2000, as illustrated in Figure C.1.

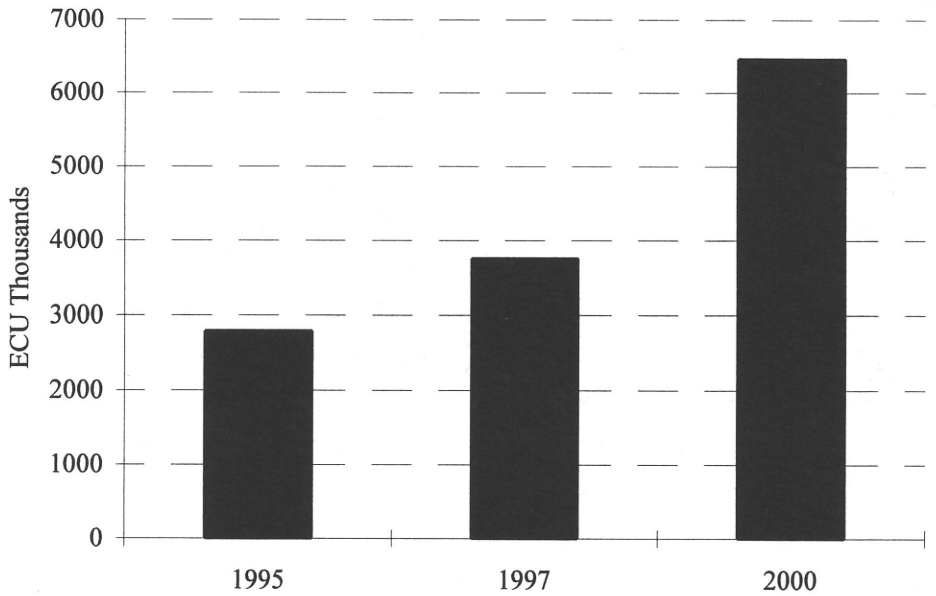
As a result of these increases in use, telecoms managers in the sector expect that their expenditure on telecoms services will increase dramatically over the next five years, from ECU 2.7 billion in 1994 to almost ECU 6.6 billion in 2000 (see Figure C.2).

Figure C.1. Application usage in the aerospace, automotive and engineering manufacturing sector, 1995 and 2000



Source: Analysys.

Figure C.2. Average telecoms expenditure (1995, 1997 and 2000) by aerospace, automotive and engineering manufacturing sector organizations interviewed



Source: Analysys.

C.2. Healthcare sector

Healthcare services represent a major part of the European economy. Healthcare expenditure in the EU amounts to about ECU 500 billion per annum and more than seven million people are employed in the sector.

C.2.1. Business pressures

Changes in the focus of managerial effort and resource allocation decisions are central to the current processes of transformation in the sector. In an effort to improve efficiency, hospital care is being concentrated in fewer, larger establishments, particularly in metropolitan areas. This centralization of resources has increased the need for communication in and between major health institutions and local primary healthcare centres. Information and communications technology is being used to improve services and reduce costs, particularly in administration: patient records, for example. Communications usage is also growing, due to the increasing specialization of healthcare: when a patient has need of a particular set of skills, instead of transporting him or her to a centre of excellence, communications technology can sometimes be used to give the specialist a 'virtual presence'. As the capacity of telecoms links increases, and the price of medical communications systems falls, intensive use could be made of telecoms to offer more effective, faster and cheaper patient care; via, for example, remote diagnosis, medical imaging, remote surgical consultancy and training.[40]

[40] See AIM, *Operation 1992: advanced informatics in medicine, consolidation of results.*

The control of costs is a very important issue for the health sector throughout the EU and other members of the OECD. In part, the pressure on healthcare costs has been created by improvements in medical technologies and clinical practices, leading to an ever increasing number of cases in which medical intervention is possible and desirable. Advances include organ transplants, joint replacements, laser and keyhole surgery, and the successful treatment of major illnesses (heart disease, cancer, diabetes, etc.). The undoubted benefits of such advances do, however, cause healthcare costs to spiral; for example, in 1991, healthcare expenditure in the EU increased by 14% (European Commission [1994a]).

Telecoms can help to control this increase in costs. There is scope for the sharing of expensive equipment between several hospitals, communicating over public or private networks. As mentioned above, telecoms can provide hospitals with access to the specialist services available from centres of excellence through online information systems, videoconferencing, and interactive diagnostic services. Consultations with medical specialists using videoconferencing systems will lead to more efficient throughput of patients, and minimize significant travel, disruption and costs. Storage and transmission of medical records (including X-rays and other detailed information) is resource-intensive; new storage technologies not only decrease the cost of holding machine-readable records, but also allow such records to be accessed quickly and accurately by medical staff.

As a consequence of changes in managerial focus and cost concerns, the emphasis of medical policy is switching from treatment to preventive care. This policy shift is being facilitated by the use of information-intensive systems, and is generating greater demand for communications services (e.g. electronic patient record transfer). There are also indications that the healthcare and pharmaceutical industries will begin to merge, as the former seeks to move to 'disease management' (i.e. using information on prescriptions issued and the purchase of drugs for geographical or real-time analysis, in order to provide a guide to the movement of disease through a population). There is already evidence of this integration occurring in the treatment of cancer in the USA; for example, the purchase by Zeneca of several large cancer treatment centres. One consequence of this integration will be the translation of existing behaviour into a rich information resource. Ultimately, changes such as those outlined above will lead to increased levels of demand for telecoms services.

C.2.2. Telecoms impact

The contribution of telecoms services to shaping business strategies is set out in Table C.4. This shows that multimedia services possibly offer the most significant 'business' contributions to the healthcare sector, in terms of both revenue and cost effects. Moreover, it is clear that telecoms services can play a particularly significant role in developing strategies for the management of processes and relationships.

The inter-relationship between the relevance of telecoms services and specific business pressures is shown in Table C.5. It is evident that while telecoms may play a significant role in shaping market innovations, such benefits are of relatively limited value to the healthcare sector. However, in terms of cost control, the major application of telecoms services is in areas of managing processes and relationships. Given that managing processes is one of the most important pressures in the healthcare sector, the impact of telecoms is likely to be significant.

Table C.4. Contribution of telecoms services to shaping business activities: healthcare sector

	Revenue effects		Costs effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Mobile	◑	○	○	○	◑
Multimedia	○	◕	●	●	○
Value added services	○	○	●	●	○
Traditional services	○	○	◑	◑	◑
Total impact	◔	◑	◕	◕	◔

Source: Analysys.

Table C.5. Overall impact of telecoms liberalization on healthcare sector revenues and costs

	Revenue effects		Cost effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Impact of telecoms services	◔	◑	◕	◕	◔
Importance of strategy	◑	○	●	◑	●
Overall impact of telecoms liberalization	◑	○	●	◑	●

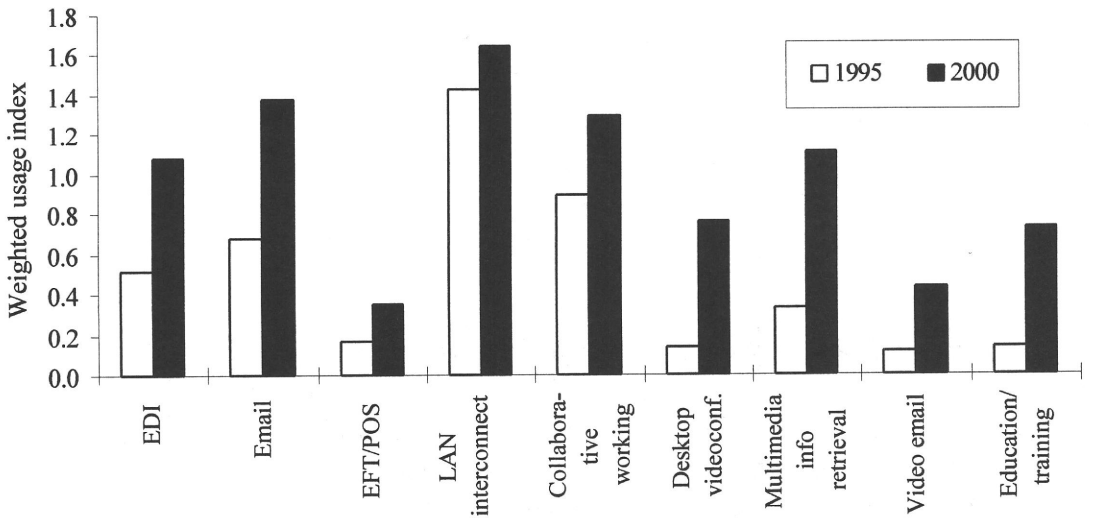
Source: Analysys.

C.2.3. Key applications

The organizational changes in the healthcare sector are reflected in the demand for a variety of telecoms services. These changes in the demand for services and consequent effects on expenditure are set out in Figures C.3 and C.4. The scope and financial incentives for using new and advanced telecoms to improve services in the healthcare sector is considerable. Of particular note is the significant increase in the use of multimedia application systems and videoconferencing. The expected change in the use of these services confirms the growing importance of remote diagnosis and online access within the sector over the next five years.

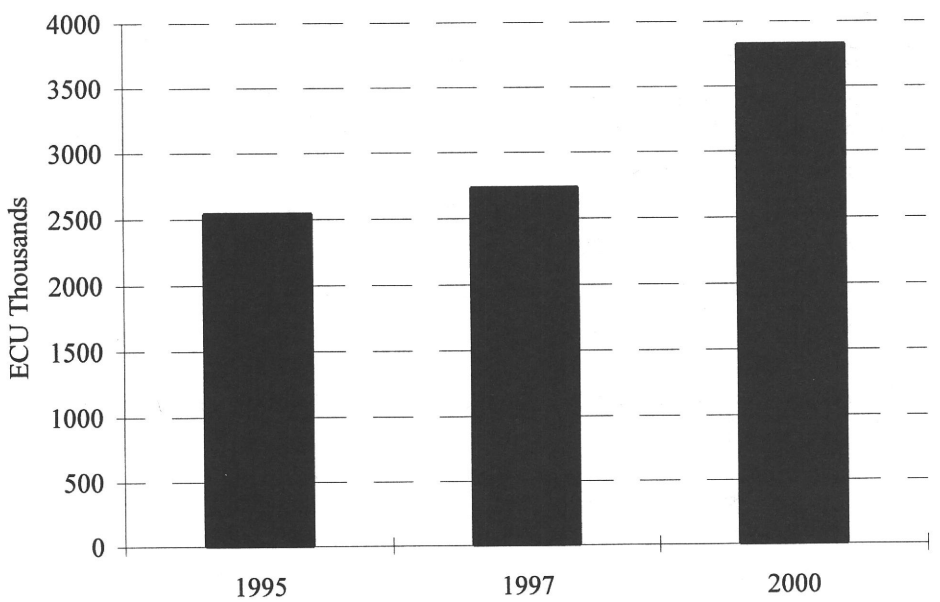
The expectations of health service telecoms managers regarding expenditure on telecoms services up to 2000 reflect the increasing importance of telecoms in the sector. Despite severe resource constraints, the telecoms managers interviewed expect expenditure on telecoms services to increase by 50% in real terms between 1995 and 2000. Telecoms is one of few areas within the sector that will experience an increase in available budget over that period.

Figure C.3. Application usage in the healthcare sector, 1995 and 2000



Source: Analysys.

Figure C.4. Average expenditure (1995, 1997 and 2000) by healthcare sector organizations interviewed



Source: Analysys.

C.3. Travel and transport sector

The travel and transport sector covers all aspects of road, rail, water and air transport, as well as the tourism industry. In total, this sector accounts for about 6% of European GDP, and is growing in importance in Europe, reflecting greater trade between EU Member States.

C.3.1. Business pressures

In this sector, the co-ordination of mode shifts in a journey is of critical importance in sustaining the competitiveness of a product. Retailers and consumers are concerned with the delivery of goods within a guaranteed period; thus, in freight transport, the goods need to be monitored at all stages in a journey through 'track and trace' systems. The need for this is particularly acute since the transport sector is having to respond to changes brought about in other sectors, like, for example, the adoption of lean manufacturing. In effect, there is a growing need to establish 'common knowledge' between all the organizations involved in the manufacture, distribution and consumption of a product or service (Cremer [1990], Borman et al. [1992]).

There is a gradual shift away from government involvement in the sector, towards private provision of travel and transport. This process has perhaps gone furthest in the UK with, for example, the ongoing process of the privatization of British Rail. Furthermore, it has been argued by CGEA, the transport division of Compagnie Générale des Eaux, that credibility gained in the UK market will enable firms to open up markets elsewhere in Europe.[41] One of the consequences of increased competition and deregulation is the ability of firms to move into related markets and offer a wider range of services. For example, Stagecoach in the UK and CGES in France are proving to be formidable competitors, as they use both bus and rail deregulation to build integrated transport infrastructures in specific localities, and introduce new working procedures that increase efficiency.

C.3.2. Telecoms impact

The contribution of telecoms services to shaping business strategies is set out in Table C.6. In this sector, value added services offer the most significant contributions in terms of both revenue and cost benefits. However, in terms of revenue-orientated strategies, multimedia services appear to be most significant. The use of multimedia services, especially in the travel industry, is opening up the possibility of creating new products, such as highly customized holidays. Also in the travel industry, new distribution channels are changing the market reach of individual service providers; for example, the marketing reach of a hotel through the use of the Internet can now be seen as being global.

Table C.6. Contribution of telecoms services to shaping business activities: travel and transport sector

	Revenue effects		Cost effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Mobile	○	◑	○	◑	◑
Multimedia	●	●	○	◑	○
Value added services	○	●	●	●	●
Traditional services	○	○	○	◔	○
Total impact	◑	●	◑	●	◑

Source: Analysys.

41 *Financial Times*, London, 28 May 1996, p.7.

The inter-relationship between the relevance of telecoms services and specific business pressures is shown in Table C.7. While telecoms may play a significant role in shaping market innovations, such innovations are of relatively modest importance in the travel and transport sector. However, in terms of cost control, the major application of telecoms services is in managing relationships.

Table C.7. Overall impact of telecoms liberalization on travel and transport sector revenues and costs

	Revenue effects		Cost effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Impact of telecoms services	◑	●	◑	●	◑
Importance of strategy	◑	◑	◔	●	◑
Overall impact of telecoms liberalization	◑	◕	◔	●	◑

Source: Analysys.

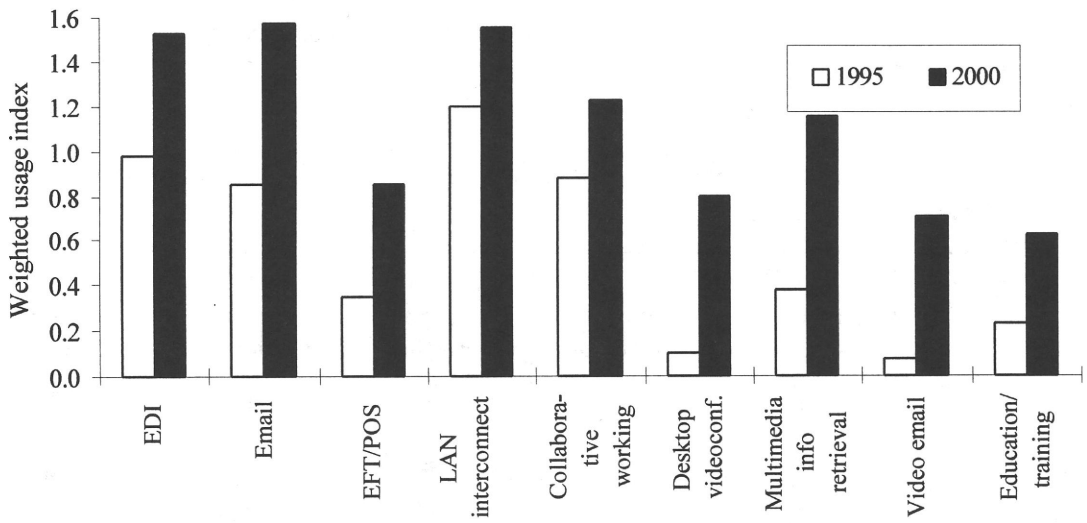
C.3.3. Key applications

The organizational changes occurring in the industry are leading to a demand for a variety of telecoms services. These changes in the demand for services and consequent effects on expenditure are set out in Figures C.5 and C.6. The travel and transport sector is one in which the scope and incentive for using new and advanced telecoms to improve services is considerable. Of particular note is the significant increase in the use of multimedia application systems to support new revenue-generating innovations; however, it should be noted that such innovations are not of the highest importance in the sector as a whole.

As shown in Figure C.5, the main applications currently being used in this sector are EDI and e-mail, reflecting the nature and structure of the industry, particularly its growing transactional intensity: it is estimated that the use of EDI and e-mail will increase by approximately 50% over the next five years. A significant increase in the use of EFT, both at the point of sale and for transferring funds between organizations, is also anticipated. A substantial increase in the use of videoconferencing and multimedia information retrieval is expected.

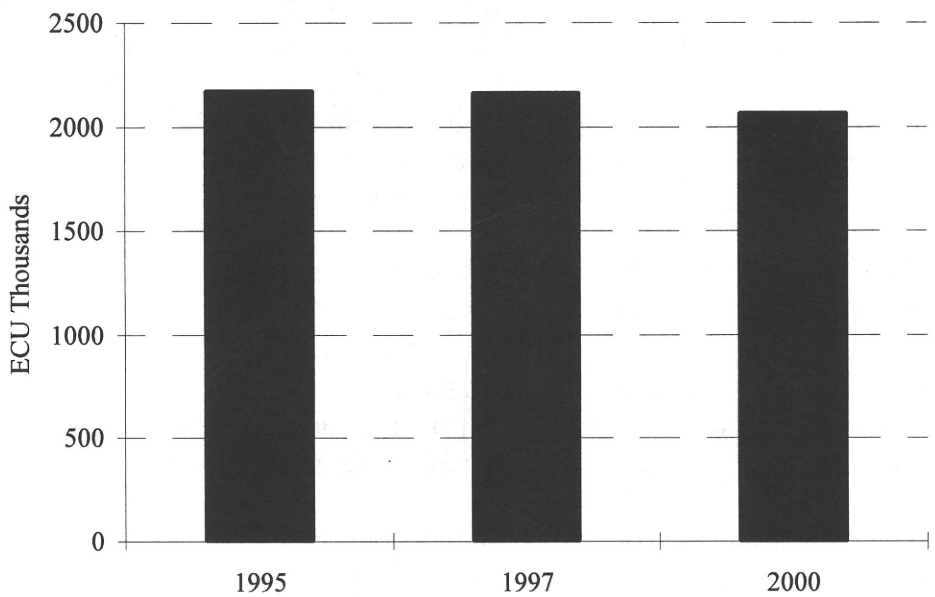
The expected development of telecoms expenditure by the travel and transport sector between 1995 and 2000 is shown in Figure C.6. Unlike most other sectors, the travel and transport sector shows a slight decrease in the expected level of expenditure over this period. This is primarily because a large proportion of telecoms expenditure in this sector is on mobile communications, where prices are expected to fall more dramatically than in other sectors, due to the combined effects of competition and improved technology allowing message-based, rather than speech-based, communication. Falling prices will offset the substantial increases in the use of telecoms services measured in volume terms.

Figure C.5. Application usage in the travel and transport sector, 1995 and 2000



Source: Analysys.

Figure C.6. Average telecoms expenditure (1995, 1997 and 2000) by travel and transport sector organizations interviewed



Source: Analysys.

C.4. Finance sector

The finance industry is not uniformly spread across Europe: in the UK and Luxembourg, the finance sector accounts for over 16% of GDP, compared with an average of 7% for the rest of Europe. The uneven geographical distribution is illustrated in Table C.8, which shows total value added for the EU on a country-by-country basis. Furthermore, the financial industry tends to be concentrated within few locations within each country.

Table C.8. Distribution of value added in the EU: finance sector, 1992 (%)

Belgium	Denmark	France	Germany	Greece	Ireland
3.21	1.10	16.71	26.71	0.45	0.73
Italy	**Luxembourg**	**Netherlands**	**Portugal**	**Spain**	**UK**
19.23	0.41	4.43	1.95	9.67	15.41

Source: Eurostat.

C.4.1. Business pressures

The main issues in this sector are related to cost control and the development of new distribution channels. While product development is an important issue for the industry, it will play a secondary role to these other business strategies.

The trend towards globalization has seen the European finance sector become more integrated. Over the past five years, individual companies have become more international in their operation, partly as a response to the strengthening of European monetary institutions and the changing of the regulations governing the sector. A recent example of this international activity is the acquisition of the Bristol & West building society in the UK by the Bank of Ireland in spring 1996. Banking has, of course, been international for some time, with banks operating in many countries as a matter of course. This is particularly true of investment banks, most of which have a presence in many of the major financial centres of the world. However, the European insurance market is now beginning to move away from a rigid separation of insurance markets between Member States. The so-called third generation EU directives, to provide the framework for a real internal market for insurance services, came into effect in mid-1994.[42]

In terms of telecoms demand, the international communications activities of financial institutions will become relatively more important as the market becomes less nationally oriented and the structure of firms mirrors this change. As a consequence of this growing international activity, financial centres such as London, Paris and Frankfurt have become major targets for new TOs planning to enter liberalized telecoms markets in 1998.

In the financial services sector, the use of new technologies has not only led to the creation of new products and highly sophisticated variants of existing products (such as options trading and derivatives) but also the reshaping of services offered to the general public. The financial services sector in Europe is considerably more liberal than those in the USA or Japan, in terms of allowing different types of financial services companies to operate in one another's markets. For example, in Europe it is becoming common for banks to offer insurance cover. The management of complicated packages of financial services for customers, covering banking, insurance and other requirements, is predicated on the use of new technologies.

Perhaps the most notable changes are occurring around the introduction of telephone-based financial services. In recent years, financial institutions that deal with the public have

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42 92/49/EEC (OJ L 228, 11.8.1992, p. 1) and 92/96/EEC (OJ L 360, 9.12.1992, p. 1).

recognized that maintaining a presence in town centres is less cost-effective than dealing with customers by telephone. Organizations such as the First Direct bank and Direct Line Insurance in the UK are now offering banking and insurance services respectively, entirely by telephone. The cost benefits of doing business this way are considerable: organizations providing these services are able to cover the costs of the telephone calls made to them by their customers, and are still in a position to undercut financial institutions operating in a more traditional manner. The implications of increased use of telecoms for this type of financial service are obvious – not only is there a telecoms component in every transaction carried out, but also the operation of such services relies on the interaction of computer systems across many financial institutions.

C.4.2. Telecoms impact

The finance sector has been one of the early beneficiaries of liberalization in the telecoms sector. It has a high expenditure on telecoms, and is therefore an obvious target for new entrants; for example, MFS has already started to invest and offer service in the City of London and in Frankfurt. These new entrants will stimulate incumbent operators to reduce the prices of their services in advance of full liberalization in 1998.

The sector already makes heavy use of telecoms services: the effects of liberalization will be to reinforce existing trends, and thus telecoms will continue to have a major impact on the industry. As liberalization fosters the rapid development of new services, so the demand for multimedia and value added services is likely to grow. As Table C.9 shows, the demand for new services, such as multimedia, is being driven by applications that help to limit costs; for example, on-the-job training will result in an increase in the flexibility of the workforce. However, the use of valued added and multimedia services also plays an important role in shaping new strategies to achieve additional revenues.

Table C.9. Contribution of telecoms services to shaping business activities: finance sector

	Revenue effects		Cost effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Mobile	○	○	○	○	○
Multimedia	◕	◑	●	●	◑
Value added services	◕	●	◕	●	◑
Traditional services	◔	●	○	◑	◑
Total impact	●	●	●	●	●

Source: Analysys.

The inter-relationship between the relevance of telecoms services and specific business pressures is shown in Table C.10. What is evident here is that there is the potential of a strong synergy between the use of telecoms services and market innovations; such innovations are important in the finance sector. In terms of cost control, the major applications of telecoms services which are of commercial significance to the sector are in managing relationships and processes.

Table C.10. Overall impact of telecoms liberalization on finance sector revenues and costs

	Revenue effects		Cost effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Impact of telecoms services	●	●	●	●	●
Importance of strategy	◕	●	●	●	●
Overall impact of telecoms liberalization	◕	●	●	●	◕

Souce: Analysys.

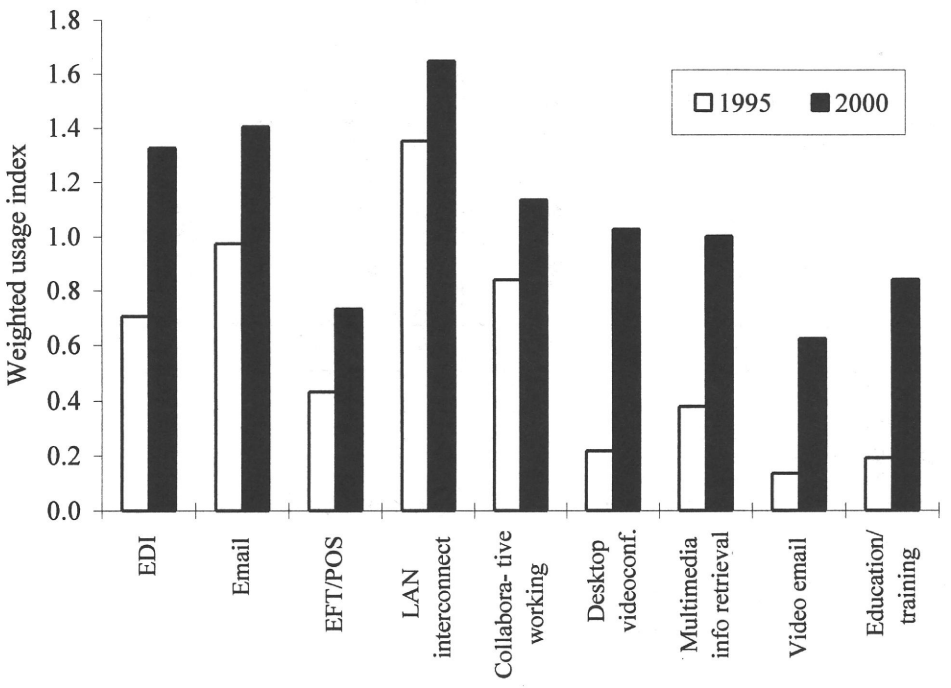
C.4.3. Key applications

Applications such as EDI are being used to bypass intermediaries in several sectors. For example, in the finance sector, they are being used in new product developments and in the adoption of innovative, and seemingly highly effective, market entry strategies, as clearly demonstrated in the UK by Direct Line Insurance (which offers direct sales of insurance services). This process of 'disintermediation' allows new forms of co-ordination strategies to be used, inevitably changing the nature of transaction costs. By changing the relative level of these costs, the use of telecoms challenges the existing structure of firms and the boundaries between firms, leading to a new distribution of activities between markets and hierarchies.

The anticipated use of advanced telecoms services in the financial sector between 1995 and 2000 is shown in Figure C.7. Use of EDI will nearly double in the period, and there will also be growth in EFT, both at the point of sale and between organizations. In addition, there will be considerable take-up of applications requiring greater bandwidth such as videoconferencing and multimedia information retrieval.

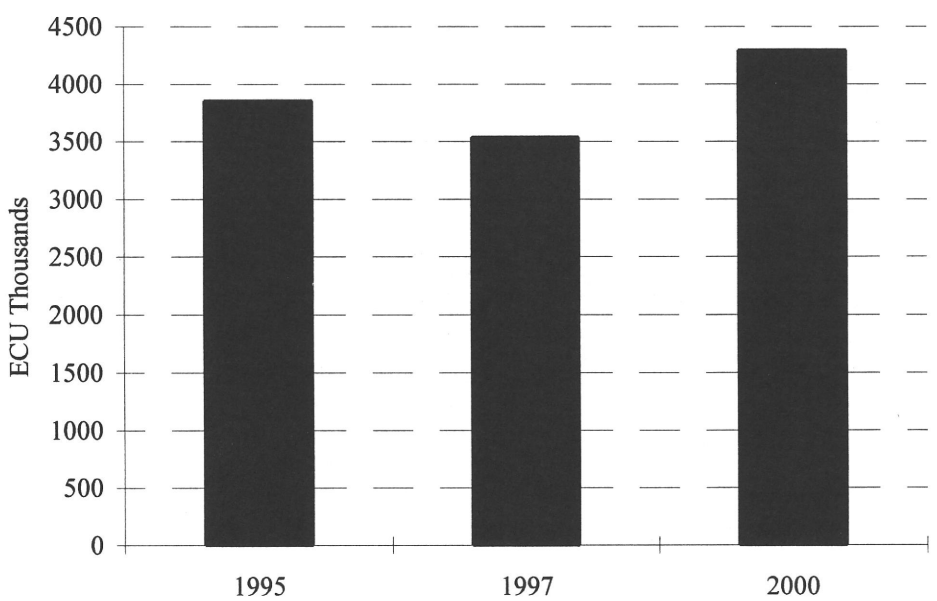
The increase in take-up of advanced services will not compensate for the reduced prices paid for basic services by this sector and, as a result, overall telecoms expenditure in 1997 will fall, especially in the banking sector. However, the growth of the insurance sector combined with the expected growth in telephone-based banking and insurance services will see overall revenues grow again to increase over the whole period by more than 10% (illustrated in Figure C.8).

Figure C.7. Application usage in the finance sector, 1995 and 2000



Source: Analysys.

Figure C.8. Average telecoms expenditure (1995, 1997 and 2000) by finance sector organizations interviewed



Source: Analysys.

C.5. Electrical and electronic manufacturing sector

The electrical and electronic manufacturing sector contributes in excess of 10% of the output of EU industry. It has a turnover of more than ECU 250 billion and employs more than 2.5 million people. The distribution of value added across EU Member States is shown in Table C.11. As for the automotive, aerospace and engineering manufacturing sector, Germany has an above-average share of value added in this sector. Elsewhere in the EU, production (in terms of value added) is largely concentrated in France, the UK and Italy.

Table C.11. Distribution of value added in the EU: electrical and electronic manufacturing sector, 1992 (%)

Belgium	Denmark	France	Germany	Greece	Ireland
2.1	1.1	16.5	46.6	0.2	0.9
Italy	**Luxembourg**	**Netherlands**	**Portugal**	**Spain**	**UK**
12.0	N/A	3.9	0.5	4.1	11.9

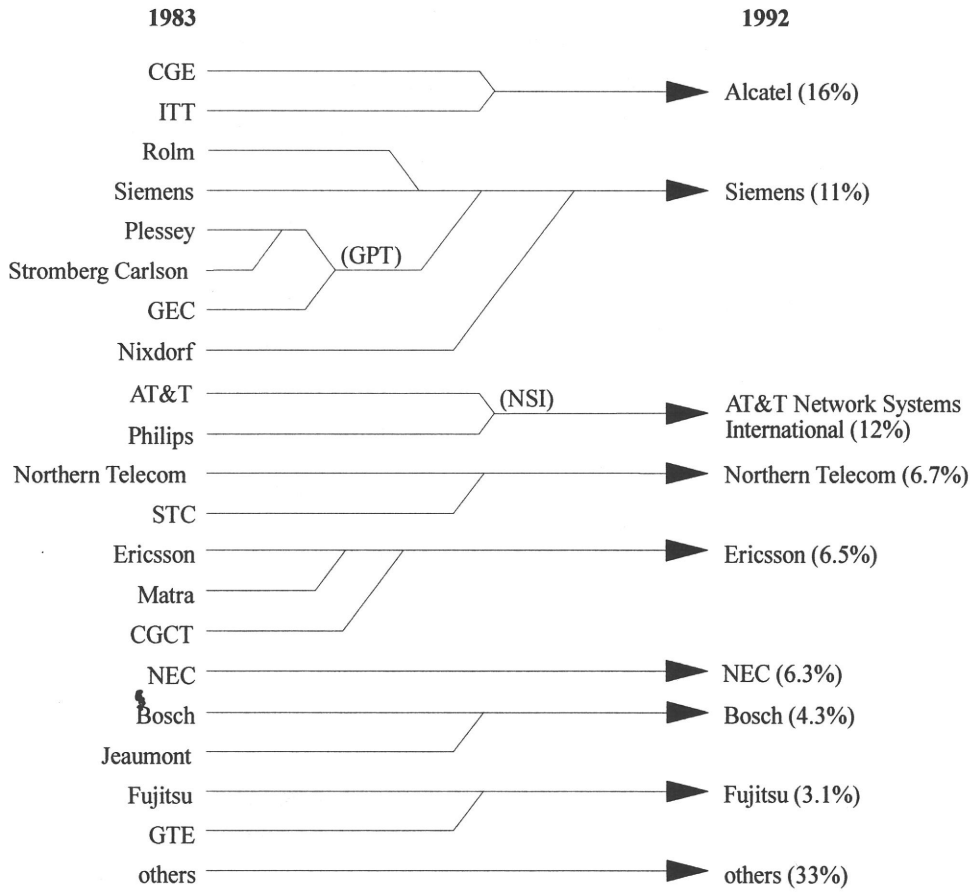
Source: Eurostat.

C.5.1. Business pressures

In the electrical and electronic manufacturing sector, the process of industrial restructuring has brought about two distinct responses: the relocation of manufacturing to relatively low cost regions; and a growth in mergers and acquisitions. In the extremely competitive world of electrical and electronics products, manufacturing costs are critical to business success. In Europe, the relatively high level of wages and the social overheads demanded by governments make the cost of manufacturing these products very high, when compared to emerging economies, whose levels of productivity in certain cases are comparable to those in Europe. Cost advantages outside Europe were not fully exploited in the past because barriers to trade and import duties offset many of the potential benefits; however, international agreements have now removed many of these barriers. Companies that seek to take advantage of this new freedom will find that running their manufacturing operations separately from their other activities greatly increases their need for voice and data communications.

The electrical and electronics sector has been the subject of numerous mergers and acquisitions: for example, Figure C.9 shows the consolidation of the world telecoms equipment market between 1983 and 1992. There is a constant flow of start-up companies specializing in new technologies such as ISDN and ATM, but as they grow these companies are very likely to be subject to takeovers by large organizations. Mergers and acquisitions require organizations to face the problem of integrating other organizations that have different structures and are geographically disparate. This process can be greatly facilitated by using telecoms to integrate management and allow collaboration between design and other experts. There will be significant scope for using videoconferencing and CAD as a tool to bring about this integration.

Figure C.9. Consolidation of the world telecoms equipment market, 1983 to 1992



Sources: ITU [1994], Vietor and Yoffie [1993], Analysys estimates.

In the electrical and electronic manufacturing sector, there is a particularly synergistic relationship between the functionality of hardware and software. Given that both these technologies exist within the products of the sector, inevitably one technology can constrain or facilitate changes in the other. At one level this relationship is captured in the mutual interdependence between developments in semiconductors and in operating systems in PCs, as witnessed by the close relationship between Intel and Microsoft. However, this type of dynamic relationship is also able to change the course of a sector radically. The most obvious example of this is the rise of the PC and the 'fall' of IBM as a result of rapid enhancements in the common technical resources, notably integrated circuits, shared between PCs and mainframes. A similar threat is evident in the current debate about the future of the PC versus the use of distributed online processing services.

An important element of the blurring market boundaries is the erosion of 'domestic' markets. This is perhaps best illustrated in the electronic and electrical manufacturing sector, particularly in relation to telecoms equipment. Historically, many TOs have purchased the bulk of their equipment from 'national champion' manufacturers, but increasing commercial pressures, rapid technical changes and the rules imposed on procurement by the EC Directive

on Utility Procurement[43] are leading to more genuine competition in the market for telecoms equipment. Manufacturers are targeting new markets in Europe and worldwide, and now need to maintain a sales and marketing presence in many more locations. The concept of national markets as secure bases from which to build export markets, has been eroded.

C.5.2. Telecoms impact

The contribution of telecoms services to shaping business strategies is set out in Table C.12. This shows that a diverse range of applications can benefit the development of specific business strategies, and no one service makes a particularly distinctive contribution, with the possible exception of value added services. In part, this reflects the existing intensity of the use of telecoms services in the sector.

Table C.12. Contribution of telecoms services to shaping business activities: electrical and electronic manufacturing sector

	Revenue effects		Cost effects		
	Product innovation	**Market innovation**	**Management of processes**	**Management of relationships**	**Management of resources**
Mobile	○	○	○	◔	◔
Multimedia	◑	○	◑	●	○
Value added services	◑	●	◑	◑	◔
Traditional services	○	◔	○	◔	○
Total impact	◑	◑	◑	●	◔

Source: Analysys.

The inter-relationship between the relevance of telecoms services and specific business pressures is shown in Table C.13. The overall impact of telecoms and business strategy development, results in a major contribution being made in terms of product innovation. In terms of cost-orientated strategies, the major contribution of telecoms is in terms of managing relationships.

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[43] Council Directive 92/13/EEC of 25 February 1992 co-ordinating the laws, regulations and administrative provisions relating to the application of Community rules on the procurement procedures of entities operating in the water, energy, transport and telecommunications sectors (OJ L 76, 23.3.1992, p.14). This directive came into effect on 1 January 1993.

Table C.13. Overall impact of telecoms liberalization on electrical and electronic manufacturing sector revenues and costs

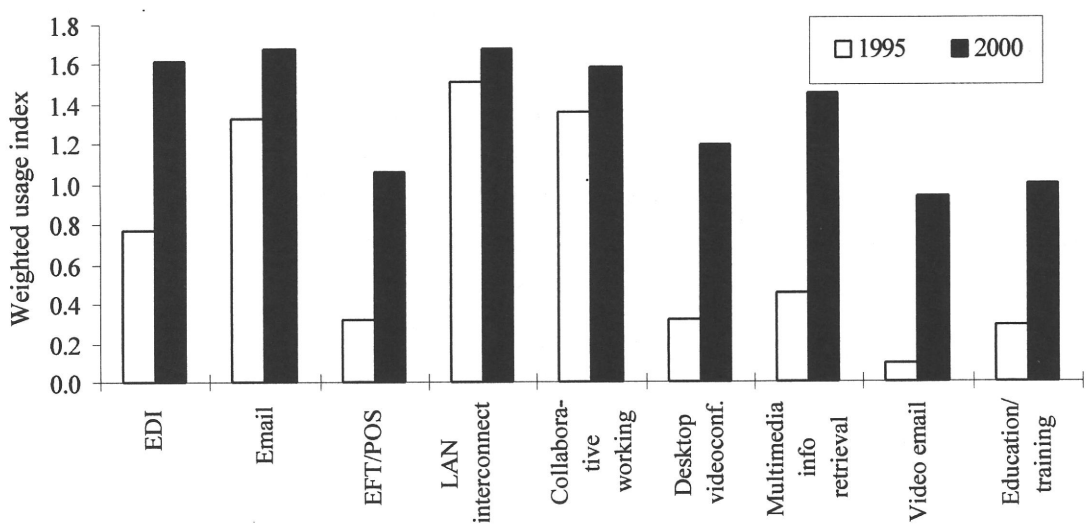
	Revenue effects		Cost effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Impact of telecoms services	◑	◑	◑	●	◔
Importance of strategy	●	◔	●	●	◑
Overall impact of telecoms liberalization	●	◕	◕	●	○

Source: Analysys.

C.5.3. Key applications

The anticipated change in the level of usage of different applications in the electrical and electronic manufacturing sector is shown in Figure C.10. Applications such as LAN interconnection, e-mail and collaborative working are already well established in the sector. EDI use is set to grow considerably, driven by increased use of 'just in time' manufacturing techniques. More advanced applications such as videoconferencing and multimedia information retrieval are likely to grow even more dramatically, due to the demands imposed by working in geographically diverse, yet functionally integrated, organizations.

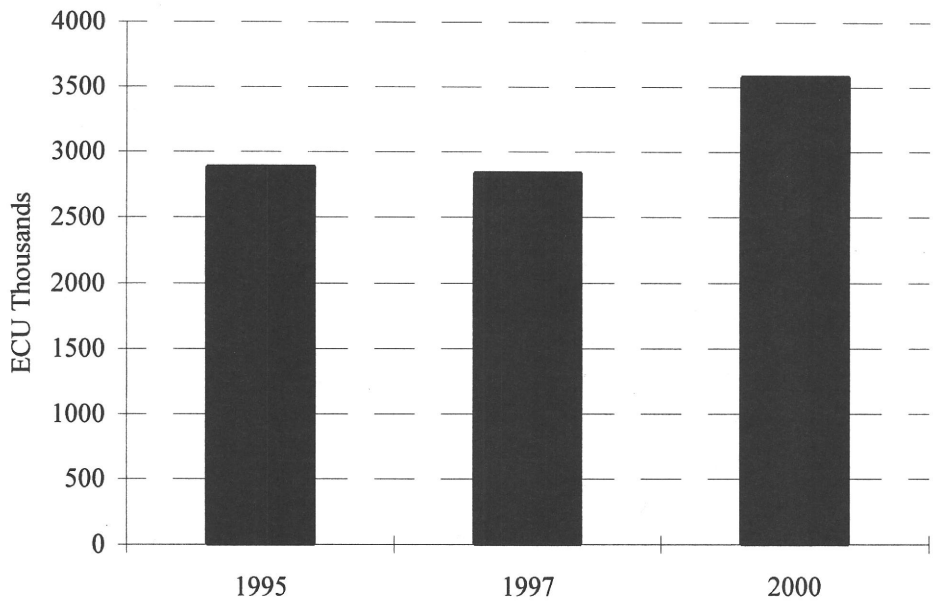
Figure C.10. Application usage in the electrical and electronic manufacturing sector, 1995 and 2000



Source: Analysys.

The level of overall expenditure on telecoms in the sector is expected to be stable in the short term, with increased use of international communications being offset by falling international tariffs brought about by the intensification of competition. However, as use of broadband applications such as videoconferencing and multimedia information retrieval increases, expenditure will rise, so that by 2000 expenditure will be nearly 25% higher than current levels, as illustrated in Figure C.11.

Figure C.11. Average telecoms expenditure (1995, 1997 and 2000) by electrical and electronic manufacturing sector organizations interviewed



Source: Analysys.

C.6. Retail and distribution sector

The retail and distribution sector currently accounts for around 14% of output and employment in the EU. The distribution of value added across the EU is shown in Table C.14, demonstrating the concentration of value added in France, Germany, Italy and the UK.

Table C.14. Distribution of value added in the EU: retail and distribution sector, 1992 (%)

Belgium	Denmark	France	Germany	Greece	Ireland
3.7	2.1	20.2	19.3	1.0	0.6
Italy	**Luxembourg**	**Netherlands**	**Portugal**	**Spain**	**UK**
22.6	0.2	4.2	1.4	8.5	16.2

Source: Eurostat.

C.6.1. Business pressures

In the retail sector there has been an inexorable rise over the last 20 years of powerful retailers in each Member State of the EU: for example, in the UK, 70% of all groceries are purchased from six companies. As the scope for further expansion becomes limited by the already extensive coverage that many national retailers have within their home country, these firms are expanding into other countries: the single market has removed many obstacles which deterred retailers from looking to other Member States for new business. For example, a number of French and German supermarket chains, such as Carrefour and Aldi, are expanding into the UK.

In terms of telecoms activity, the geographical diversity of large operators requires data and voice communications and, for large stores, is frequently at a level that warrants the use of leased lines. The use of EFTPOS makes it easier to monitor and co-ordinate sales and stock activity centrally, and customer preferences and expenditure patterns can be analysed faster and more accurately. A number of changes in the retail business mean that both retailers and distributors are finding EDI applications an increasingly useful means of communicating with their supplier:

(a) the range of goods stocked is increasing, complicating the ordering process;
(b) orders are becoming more frequent as stocks are maintained for shorter periods;
(c) the relationship with transport contractors becomes more important, as more goods have to be transported from producer to the point of sale.

In the retail sector, the use of new technologies is opening up the possibility of creating new distribution channels. Currently, the most common form of distance selling in Europe is mail order using a catalogue. This form of retailing is very successful, with a turnover of more than ECU 30 billion (about 2.5% of the retail sector as a whole). In the USA, home shopping via television is more prevalent and accounts for around 3.5% of total retail turnover. However, the rise of Internet services is creating a major opportunity to develop new distance-selling services. The growth of retail activity over the Internet, even though in its infancy, is already revealing two important trends that separate it from catalogue selling:

(a) Internet selling makes it possible for potential customers to compare products from both local and international firms. As international distance selling grows in volume, prices in local markets will be put under pressure to stay in line with Internet prices.
(b) 'Branding' will become increasingly important as a way of securing the trust required for transactions to occur.

However, development of significant retail activity over the Internet will be closely related to enhancements in credit payments and logistical functions that offer guaranteed delivery within a minimum period.

C.6.2. Telecoms impact

The contribution of telecoms services to shaping business strategies is set out in Table C.15. Only a relatively limited contribution can be made to revenue-orientated strategies. By contrast, the major impact of telecoms appears to be in shaping the management of processes and relationships. In terms of specific service offerings, the greatest benefit appears to be derived from multimedia and valued added services. Both these groups of service offerings make an equal contribution in terms of cost-orientated effects, but multimedia offers the greatest benefits in terms of product and market innovations. With regard to market innovations, multimedia offers the prospect of creating a new and effective distribution channel which could supplant existing mechanisms. At its simplest, multimedia can be used by organizations to create an immediate yet virtual presence across an entire market in advance of, and in some cases as a substitute for, building new outlets.

The inter-relationship between the relevance of telecoms services and specific business pressures is mapped out in Table C.16. This shows that the overall impact of telecoms and business strategy development results in a major contribution being made in terms of market

innovation. In terms of cost-orientated strategies the major contribution of telecoms is in managing processes and relationships.

Table C.15. Contribution of telecoms services to shaping business activities: retail and distribution sector

	Revenue effects		Cost effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Mobile	○	○	○	○	◑
Multimedia	◔	◕	●	◕	○
Value added services	○	◑	◕	●	○
Traditional services	○	○	○	◔	○
Total impact	○	◕	◕	●	◔

Source: Analysys.

Table C.16. Overall impact of telecoms liberalization on retail and distribution sectors revenues and costs

	Revenue effects		Cost effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Impact of telecoms services	○	◕	◕	●	◔
Importance of strategy	◔	◑	●	●	○
Overall impact of telecoms liberalization	○	◕	●	●	○

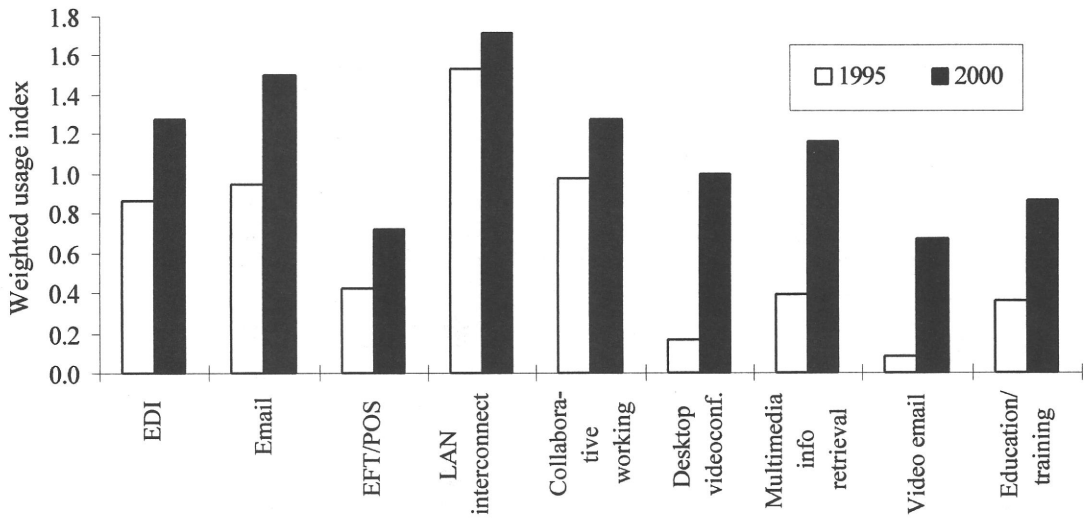
Source: Analysys.

C.6.3. Key applications

The use of advanced telecoms services in this sector is illustrated in Figure C.12, showing that e-mail, EDI and, in particular, LAN interconnection are already well established; the growth in these applications will therefore be relatively low between now and 2000. The use of EFT and EFTPOS will increase significantly, as more retail outlets invest in the appropriate technologies, and the financial services sector supports the widespread diffusion of the services between more organizations. There will be significant growth in the use of broadband applications such as videoconferencing and multimedia information retrieval, as distance selling and 'electronic malls' on the Internet are used more intensively.

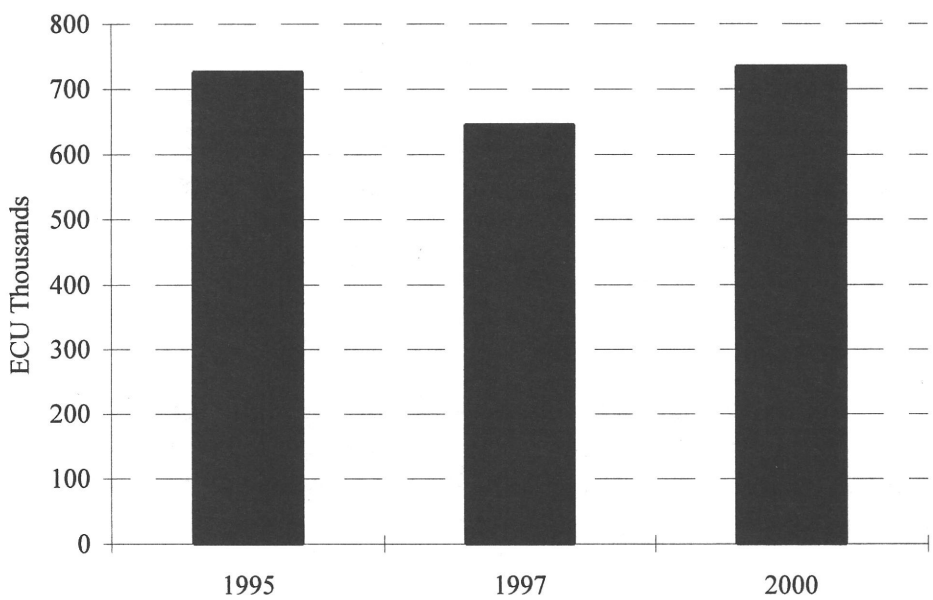
The expected pattern of expenditure on telecoms services in the retail and distribution sector is shown in Figure C.13. Telecoms expenditure will fall in the short term as the benefits of competition in the telecoms sector outweigh the increase in the use of advanced services in the retail sector. As retailers extend their international operations, both through opening up new outlets in different countries and by sourcing more of their products internationally, so the growth of telecoms revenue will be fuelled by increases in international telecoms traffic.

Figure C.12. Application usage in the retail and distribution sector, 1995 and 2000



Source: Analysys.

Figure C.13. Average telecoms expenditure (1995, 1997 and 2000) by retail and distribution sector organizations interviewed



Source: Analysys.

C.7. Chemical, pharmaceutical and oil sector

This sector covers exploration for, refining of and distribution of oil products as well as the wider chemical industry. The sector turnover is around ECU 500 billion and it employs more than two million people. Europe is the leading producer of chemicals in the world, well ahead of other major traders such as the USA and Japan. As Table C.17 illustrates, economic activity in the chemical, pharmaceutical and oil sector is unevenly distributed across the EU

countries, with major contributions to value added being made by Germany, France, the UK, and Italy.

Table C.17. Distribution of value added in the EU: chemical, pharmaceutical and oil sector, 1992 (%)

Belgium	Denmark	France	Germany	Greece	Ireland
4.70	1.67	17.40	32.23	0.36	2.31
Italy	**Luxembourg**	**Netherlands**	**Portugal**	**Spain**	**UK**
11.33	N/A	5.56	N/A	7.40	17.04

Source: Eurostat.

C.7.1. Business pressures

The chief characteristics of the structure of these industries are that they are highly vertically integrated and dominated by large firms. Europe is in a good competitive position in these industries with respect to the other main trading regions of the world. During the 1980s, many European companies expanded into the USA, mainly to take advantage of favourable exchange rate conditions, rather than as part of a strategic objective for expansion. Over-capacity built up, however, and this has led to stagnation and adjustment in the 1990s, as some of the spare capacity has been eliminated.

In basic chemical products and pharmaceuticals, the industry is geared to high-volume mass production. The chief characteristics of its cost structure are a high degree of expenditure on plant – the industry is very capital intensive – and high energy consumption, reaching 40% of costs in some industries. The industry spends a relatively high proportion – 5% – of its turnover on research and development (R&D), and competition in the industry is oriented towards innovation in new products and chemical processes to increase efficiency and reduce costs.

In the past, it was common for companies operating in this sector to have corporate R&D laboratories. However, there is now a strong trend towards having R&D distributed throughout the geographical spread of the organization, mainly as a result of the global nature of the organizations in this sector and the number of mergers and acquisitions in the sector. When organizations expand through mergers and acquisitions, the R&D capabilities cannot easily be merged into one in a single geographical location, as the R&D staff are more likely to resign than to move. In order to keep these valuable staff, the organization needs to foster collaborative working. Such collaboration will result in increased demand for all types of telecoms, with broadband communications that allow videoconferencing and sharing of data files being very important in this sector.

The whole sector faces increasing regulation of its activities. The developments in concern for the environment in recent years have meant that the activities of oil and chemical companies are being monitored increasingly carefully by national governments and by the European Commission, while pharmaceutical companies are strongly regulated when launching new products to ensure that the public is not exposed to harmful drugs. The management of information submitted to the regulatory authorities is currently cumbersome, but telecoms

could be used to improve this communication, rendering obsolete the need to submit extensive documentation to regulators.

C.7.2. Telecoms impact

The contribution of telecoms services to shaping business strategies is set out in Table C.18, which shows that only a relatively limited contribution can be made to revenue-orientated strategies. The major focus for the use of telecoms in this sector is on limiting costs, with the major impact being in the management of processes and relationships. Progress in the sector is centred on improving chemical processes and products. Consequently, telecoms only have a direct impact on the cost structure of the sector through the usage of group working to allow collaborative research across multiple sites. This reduces research costs and improves the quality of research, by enabling the most appropriate personnel in the company to work together. The single most significant service offering is multimedia, particularly in its contribution to managing processes, relationships and resources. The argument here is that the use of high bandwidth interactive multimedia services will dramatically shape the way in which management processes in this sector evolve. Such services will allow for the concentration of expertise, while at the same time allowing for the widespread access and dispersal of information throughout the organization.

Table C.18. Contribution of telecoms services to shaping business activities: chemical, pharmaceutical and oil sector

	Revenue effects		Cost effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Mobile	○	○	○	○	○
Multimedia	◑	○	●	●	●
Value added services	○	○	◑	●	○
Traditional services	○	○	○	○	○
Total impact	◑	○	◑	●	◑

Source: Analysys.

Table C.19 shows the inter-relationship between the relevance of telecoms services and specific business pressures; the overall impact of telecoms and business strategy development results in a major contribution being made in terms of market innovation. In terms of cost-orientated strategies, telecoms can make an important contribution in terms of managing processes, relationships and resources. Telecoms will have an effect on improving the efficiency with which companies in this sector are managed, because the sector is very highly concentrated. The application of telecoms to management functions will improve operating efficiency by improving information flows.

Table C.19. Overall impact of telecoms liberalization on chemical, pharmaceutical and oil sector revenues and costs

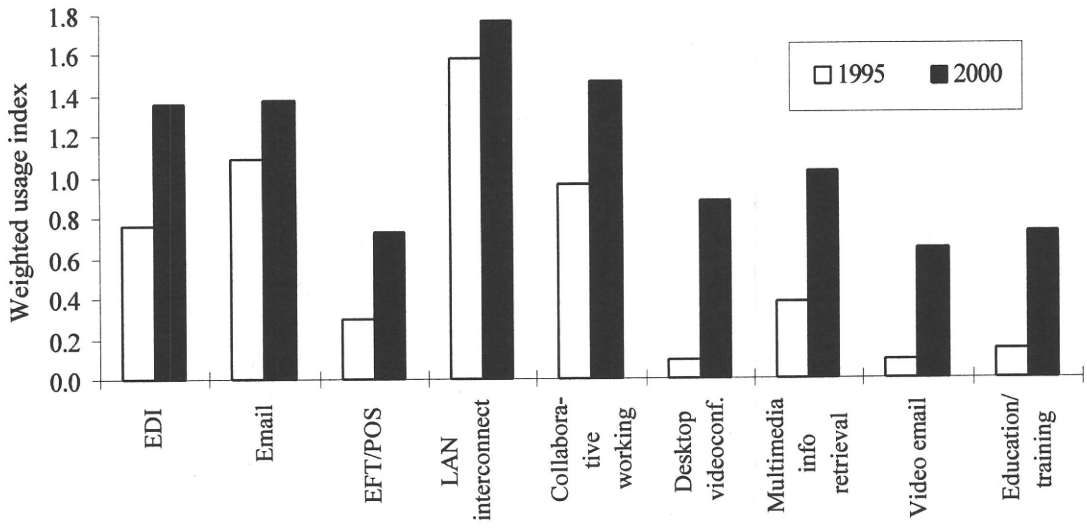
	Revenue effects		Cost effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Impact of telecoms services	◑	○	◑	●	◑
Importance of strategy	●	○	●	◕	◕
Overall impact of telecoms liberalization	●	○	◑	◕	◑

Source: Analysys.

C.7.3. Key applications

The uptake and use of advanced services in the chemical and related sectors are given in Figure C.14, showing that LAN interconnect is the most widely and intensively used of the advanced services. The evidence also indicates that e-mail and EDI are well used, with relatively high rates of growth forecast for these services. For video-based services and multimedia information retrieval, high rates of growth from a low base are anticipated.

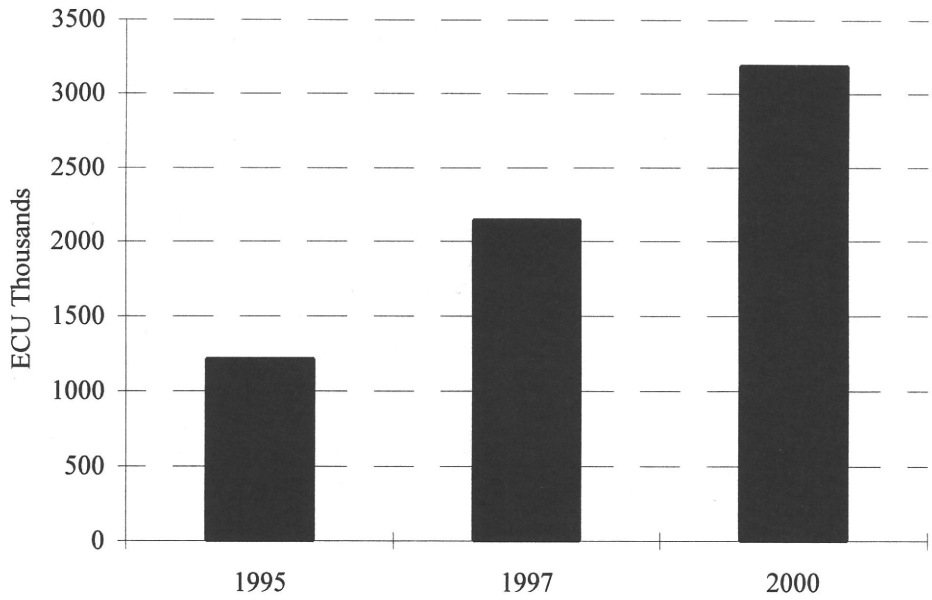
Figure C.14. Application usage in the chemical, pharmaceutical and oil sector, 1995 and 2000



Source: Analysys.

The anticipated pattern of expenditure in the sector is shown in Figure C.15. Despite substantial cost savings brought about by lower telephony prices, managers expect a consistent growth of expenditure, fuelled by a rapid diffusion of advanced services and the interdependence of the industry across national boundaries.

Figure C.15. Average telecoms expenditure (1995, 1997 and 2000) by chemical, pharmaceutical and oil sector organizations interviewed



Source: Analysys.

C.8. Entertainment, printing and publishing sector

This sector covers the production and printing of books, newspapers and magazines, plus television, radio, the record industry and the film industry. The turnover of the sector is in excess of ECU 150 billion per annum, mainly concentrated in four countries – France, Germany, Italy and the UK – as shown in Table C.20.

Table C.20. Distribution of value added in the EU: entertainment, printing and publishing sector, 1992 (%)

Belgium	Denmark	France	Germany	Greece	Ireland
3.4	1.6	14.4	21.6	0.2	0.7
Italy	**Luxembourg**	**Netherlands**	**Portugal**	**Spain**	**UK**
14.4	N/A	8.8	N/A	8.3	26.6

Source: Eurostat.

C.8.1. Business pressures

In the entertainment, printing and publishing industries there is considerable debate as to the effect of new delivery mechanism processes and products on the industry and on relationships with consumers. For example, developments in local loop technology will allow customers to download films on demand over telephone lines or broadband cable. Similarly, there are strong possibilities for music to be downloaded from the Internet rather than purchased on physical media such as tapes or compact discs. In the Netherlands, one record company is already experimenting with the local printing of compact discs (i.e. printing in the retail outlet)

– it has been argued that local printing makes it possible to overcome many of the problems associated with aligning stock to consumer needs (Boumann [1995]).

Many newspapers and periodicals have already established a presence on the Internet, allowing access to their publications; some papers are using 'intelligent agents' to learn the reading behaviour of individual consumers, so allowing the development of personalized newspapers. The development of a set of generic 'intelligent agents' would allow the creation of individualized newspapers from a variety of sources, thereby adding value to the existing products and services (but possibly creating a new threat to the newspaper industry).

Access to the Internet is perhaps best seen as a necessary, but not sufficient, condition of new distribution networks having a significant impact on the industry. At the moment these services are in their infancy and are hampered by numerous difficulties, such as the lack of suitable payment systems for material, the limited bandwidth available to customers and the relatively small proportion of their target audience having subscribed to a delivery system.

In the entertainment, printing and publishing sector, the arrival of new delivery mechanisms and proposed developments, including digital radio and digital television, have generated considerable discussion about the convergence of computing, telecoms and entertainment media. Such convergence would have enormous implications for the structure of the sector and its use of telecoms. At the moment there is a vast and highly differentiated infrastructure in place to distribute publications, films and music. The substitution of this infrastructure by the use of a common communications network over which products are delivered, will lead to a massive increase in telecoms usage.

The presence of large cross-media organizations, such as News International and Bertelsmann, is having a dramatic effect on the sector. These diverse organizations, which have grown largely through acquisitions, exploit differentiated regulations across the EU to offer services across an array of previously distinct markets. These organizations are therefore able to exploit substantial economies of scale and scope, and thus can leverage considerable competitive resources to expand market share. They need to make significant use of telecoms both to manage these diverse activities and to create new market opportunities.

C.8.2. Telecoms impact

The contribution of telecoms services to shaping business strategies is set out in Table C.21. In terms of revenue-orientated strategies, relatively important contributions can be made to both product and market innovation. However, telecoms appears to have only a relatively limited impact in shaping the management of processes and relationships. The major impact on the sector comes from the use of multimedia and value added services, particularly in revenue-orientated strategies. These services permit the creation of new products and services and, by radically changing the distribution channels, allow for new markets to be opened up or for a new presence to be established in an existing market.

Table C.22 shows that the overall impact of telecoms and business strategy development results in a major contribution being made in terms of both product and market innovation. Telecoms appears to make a relatively minor contribution to cost-orientated strategies, except in the case of managing relationships.

Table C.21. Contribution of telecoms services to shaping business activities: entertainment, printing and publishing sector

	Revenue effects		Cost effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Mobile	○	○	○	○	○
Multimedia	●	●	◕	◑	○
Value added services	◑	●	◑	◑	◔
Traditional services	○	○	○	○	○
Total impact	●	●	◕	◑	◔

Source: Analysys.

Table C.22. Overall impact of telecoms liberalization on entertainment, printing and publishing sector revenues and costs

	Revenue effects		Cost effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Impact of telecoms services	●	●	◕	◑	◔
Importance of strategy	◕	◕	◔	●	◔
Overall impact of telecoms liberalization	●	●	◔	◕	○

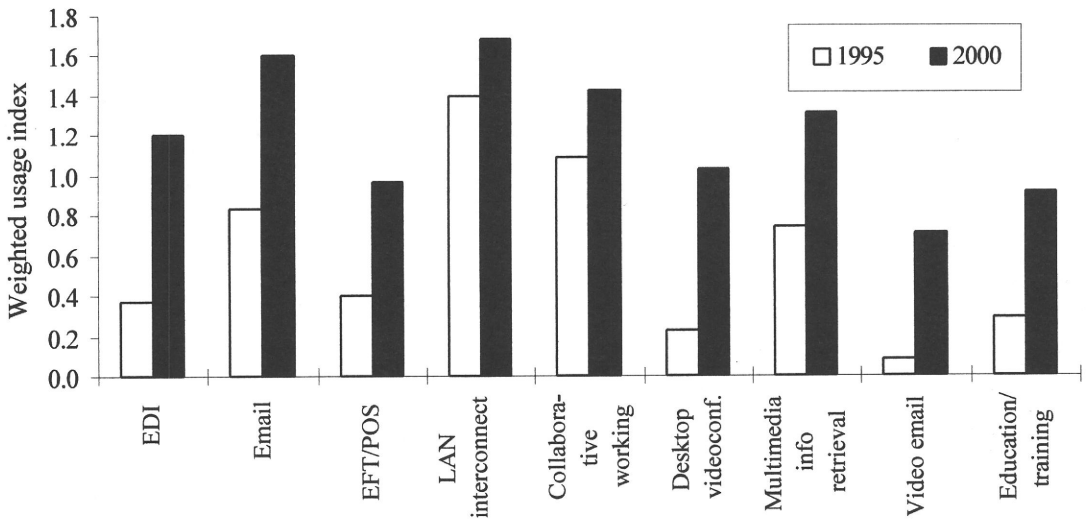
Source: Analysys.

C.8.3. Key applications

The current use of advanced telecoms service is shown in Figure C.16, indicating that LAN interconnection is already the most dominant application, but its future growth is relatively modest. As with other sectors, use of broadband services is expected to grow relatively strongly over the period as new services are used to underpin the development of distribution channels, particularly to mass markets.

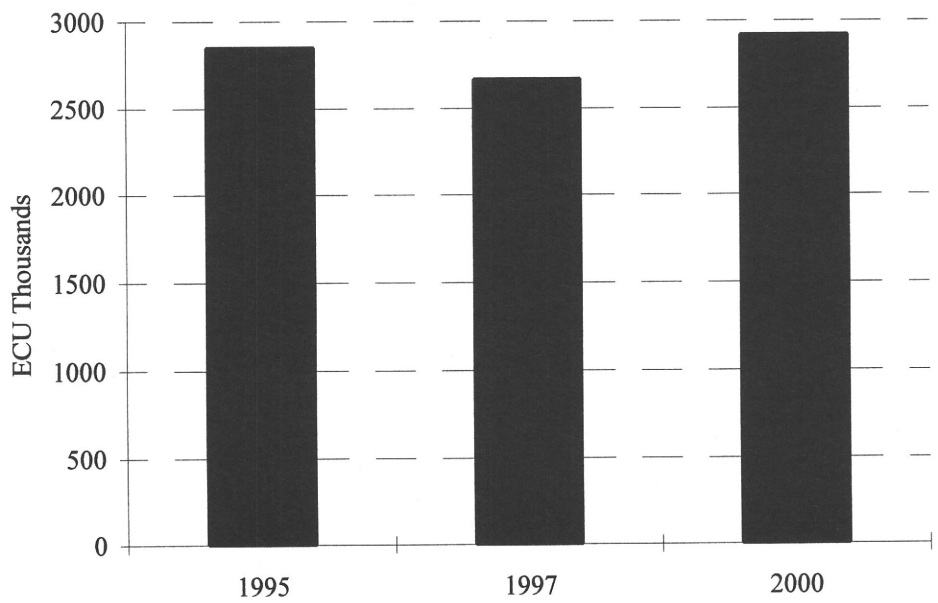
The expected pattern of expenditure on telecoms in the sector is shown in Figure C.17. In common with some sectors, expenditure is initially expected to decrease with the introduction of competition in the telecoms sector, as falls in telephony prices are not completely offset by growth in the use of services. However, this trend is reversed by the year 2000, with a slight rise in expenditure across the whole period. One of the key issues is the extent to which the industry will pay for the telecoms costs of developing and sustaining new distribution channels, or whether these additional costs will be borne by the consumer.

Figure C.16. Application usage in the entertainment, printing and publishing sector, 1995 and 2000



Source: Analysys.

Figure C.17. Average telecoms expenditure (1995, 1997 and 2000) by entertainment, printing and publishing sector organizations interviewed



Source: Analysys.

C.9. Education sector

Education is a strategic policy area for all European governments, but it is subject to considerable resource constraints. Governments have thus found it difficult to achieve their objectives for education, particularly its expansion at the tertiary level.

C.9.1. Business pressures

In the education sector, there is considerable debate about the focus of managerial attention. The public policy debate about employment and the effectiveness of labour markets is inevitably raising questions about the supply of labour and its skill profile, thus leading to discussion of the educational system. A key aspect of this debate is the extent to which education should emphasize skills training (which may lead to short-term gains in labour market efficiencies) rather than a high standard of general education (which may lead to greater flexibility in the workforce in the longer term).

The traditional approach to education in Europe has been for an individual to follow formal education to the desired level and then stop. However, new more flexible patterns of employment may include the interweaving of periods of training and education. Better employment prospects will tend to be available to those who add to their educational qualifications throughout their working life. For most adults, particularly those with families, this interweaving of employment and education will not be possible if the provision of education remains bounded by traditional delivery mechanisms, such as schools and colleges. Consequently, the demand for distance learning courses will increase. It will be necessary to provide interactive facilities that will allow people to participate in courses from home, including real-time assessment. Course material will be accessible over the Internet, as will access to databases, libraries and other research sources, thus making available a greater diversity of resources than have previously been provided via traditional delivery mechanisms.

Considerable attention is being given to the use of a wide range of new learning technologies in an attempt to alleviate pressure on the education sector in a period of severe resource constraints. Recent developments such as the World Wide Web and browser technology have made the Internet easier to use, and it is becoming a useful resource for students following courses in non-technical areas, with the Internet becoming an essential tool for research in tertiary education. These developments have also made the Internet more suitable for use in primary and secondary schools.[44]

C.9.2. Telecoms impact

The contribution of telecoms services to shaping business strategies is set out in Table C.23. Only relatively minor contributions can be made to revenue-orientated strategies; by contrast there appears to be a relatively major contribution from the use of telecoms services in shaping the management of relationships, processes and resources. The major benefits to the education sector stem from the use of multimedia and valued added services. Combined, these service offerings create a structure within which the design, delivery and use of educational services will be transformed. Thus, such services will facilitate the development and diffusion of distance learning and, with this change, policies for 'learning throughout life' can be more easily achieved.

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[44] See, for example, BT's tailored Internet provision for schools at: http://www.infohighway.co.uk/internews/news42/00010128.htm

Table C.23. Contribution of telecoms services to shaping business activities: education sector

	Revenue effects		Cost effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Mobile	○	○	◔	○	◑
Multimedia	◑	◑	◔	◑	●
Value added services	○	◑	◑	●	○
Traditional services	○	○	◔	◑	◔
Total impact	○	◕	◑	◕	◕

Source: Analysys.

The inter-relationship between the relevance of telecoms services and specific business pressures is shown in Table C.24. The overall impact of telecoms and business strategy development results in a contribution with regard to market innovation. In terms of cost-orientated strategies, telecoms appears to make relatively stronger contributions with regard to managing processes and resources, rather than the management of relationships.

Table C.24. Overall impact of telecoms liberalization on the education sector revenues and costs

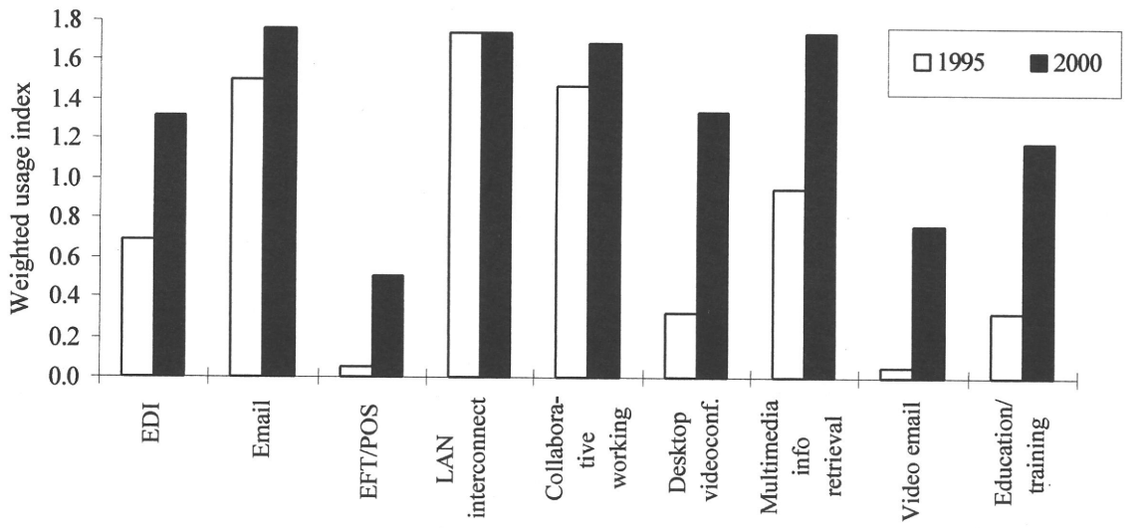
	Revenue effects		Cost effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Impact of telecoms services	○	◕	◑	◕	◕
Importance of strategy	○	◑	◑	○	◑
Overall impact of telecoms liberalization	○	◕	◑	◔	◑

Source: Analysys.

C.9.3. Key applications

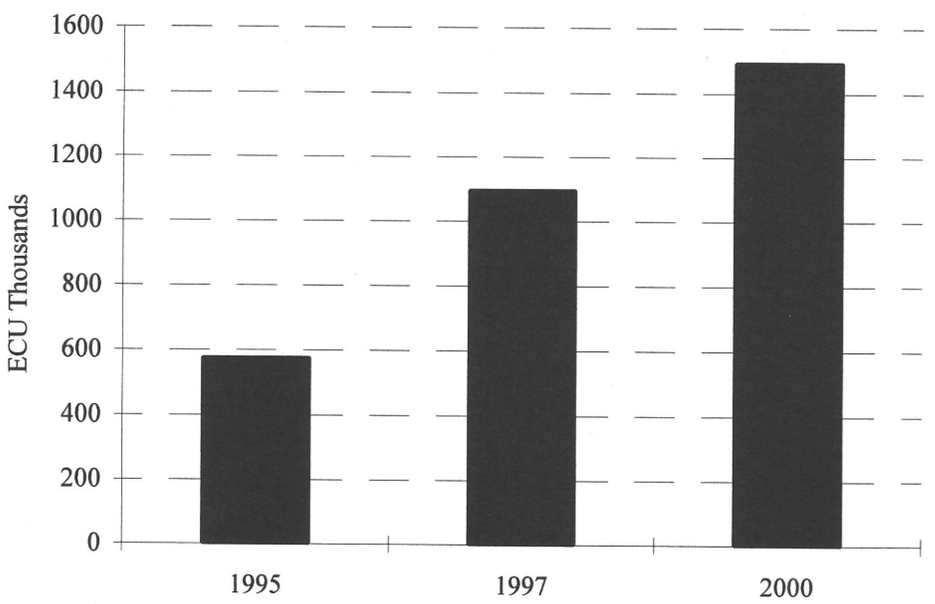
The main applications used in the education sector are shown in Figure C.18. Not surprisingly, there are currently a large number of e-mail transactions in the sector, because the academic and social networks are geographically dispersed and unstable, and e-mail partially compensates for these characteristics. Extensive use of e-mail within the university sector is in part a reflection of its early adoption of the technology. There is also a very high level of LAN interconnection, but the telecoms managers interviewed indicated that they did not expect a significant increase in uptake. There will be a marked increase in the use of broadband applications by the end of the decade. The use of telecoms for education and training is set to rise significantly, reflecting the trend towards distance education. In particular, this will influence the uptake and use of video-based services, as attempts are made to create a 'virtual' campus and allow interaction between students in geographically dispersed locations.

Figure C.18. Application usage in the education sector, 1995 and 2000



Source: Analysys.

Figure C.19. Average telecoms expenditure (1995, 1997 and 2000) by education sector organizations interviewed



Source: Analysys.

The overall spend on telecoms by organizations in the education sector is set to more than double by the end of the decade (see Figure C.19). The main driving force for this increase in expenditure will be the development of new educational technologies and the extent to which new communications-based technologies are able to act as a substitute for existing methods and resources.

C.10. Other government sector

The other government sector covers the operation of public administration and welfare services. Welfare expenditure (excluding healthcare) accounts for about 16% of GDP in EU countries. Public administration, including those who administer the welfare services, accounts for around 13% of EU employment.

C.10.1. Business pressures

There are a number of major business pressures in this sector which are affecting both the nature of the sector, particularly its organizational structure, and the demand for telecoms services:

(a) Pressure on government spending is focusing more sharply on the administrative areas than on front-line services in health and education.
(b) The sector has traditionally been subject to overstaffing due to public employment policy and civil service employment rights. However, the tolerance for overstaffing in the public service is waning, and large swathes of the public sector are being moved into agencies and the private sector.
(c) There is a growth in 'market testing', whereby elements of government service have to bid against other independent organizations for a specified set of activities in open competitive processes.

Although the institutions in this sector tend to be large organizations because they are run by central government, many of the individual units are small and have a large degree of autonomy. The sector is information intensive, although much information is kept on paper records and information from the public is most often input in paper form. Recently, the other government sector has been under pressure to reduce its expenditure as governments in Europe have tried to keep overall spending under control in the face of economic recession.[45]

C.10.2. Telecoms impact

There is considerable potential for increased use of telecoms in this sector because it deals with a large amount of information. First, telecoms could be used to substitute for a lot of expenditure, currently caused by physically transmitting information between establishments. Second, there is scope for moving to wide and local area networking, if more client server architectures are installed to handle information flows efficiently. However, constraints on government funding will limit the rate at which telecoms use can be increased in this sector. Moreover, the large investment in installing and adapting working practices to mainframe-based information systems will increase the costs of changing to more telecoms-intensive systems.

The contribution of telecoms services to shaping business strategies is set out in Table C.25, showing that only relatively minor contributions can be made to revenue-orientated strategies. However, there appear to be relatively major contributions in shaping the management of relationships and processes. Valued added services are the single most important type of

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45 Receipts from taxation have fallen and demands for expenditure, e.g. unemployment benefits, have risen.

service in securing enhancements within the sector, making their greatest contribution in terms of delivering cost savings.

Table C.25. Contribution of telecoms services to shaping business activities: other government sector

	Revenue effects		Cost effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Mobile	○	○	○	○	○
Multimedia	○	◔	◔	◔	◑
Value added services	○	◑	◕	◕	◔
Traditional	○	○	◑	◔	○
Total impact	○	◑	◕	◕	◑

Source: Analysys.

The inter-relationship between the relevance of telecoms services and specific business pressures is shown in Table C.26. The major advantages to be gained from the use of telecoms in developing strategies in this sector are in the management of processes and relationships.

Table C.26. Overall impact of telecoms liberalization on other government sector revenues and costs

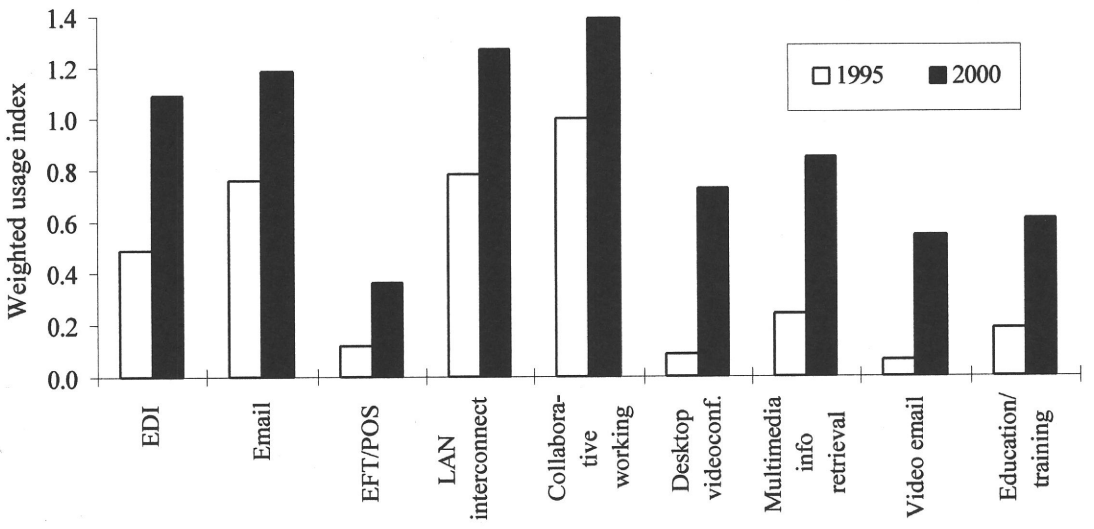
	Revenue effects		Cost effects		
	Product innovation	Market innovation	Management of processes	Management of relationships	Management of resources
Impact of telecoms services	○	◑	◕	◕	◑
Importance of strategy	○	○	●	◑	◑
Overall impact of telecoms liberalization	○	○	●	◕	◔

Source: Analysys.

C.10.3. Key applications

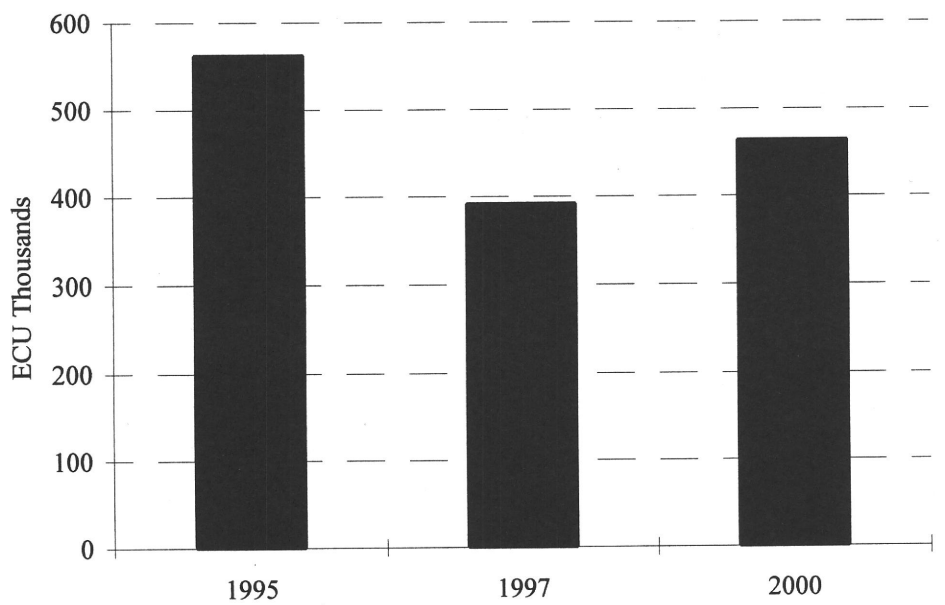
The use of advanced telecoms applications and the anticipated changes in the use of these services are shown in Figure C.20. Although the sector is information-intensive, the use of advanced communications is inhibited by the structure of government processes and the relatively low level uptake of information and communications technologies. Thus, the level of LAN interconnection is currently relatively low compared to other sectors. Use of video-based services is set to grow relatively rapidly, but from a low base, and absolute levels of uptake are likely to remain low. The use of other services is also anticipated to grow, but less rapidly than for video-based services. Services such as EDI and e-mail will continue to be important in reshaping activity within this sector.

Figure C.20. Application usage in the other government sector, 1995 and 2000



Source: Analysys.

Figure C.21. Average telecoms expenditure (1995, 1997 and 2000) by other government sector organizations interviewed



Source: Analysys.

The expected telecoms expenditure for the sector is illustrated in Figure C.21. There is set to be a sharp fall in government telecoms expenditure as procurement departments negotiate terms in a competitive environment, taking advantage, in particular, of lower prices for basic services. However, telecoms expenditure is expected to grow in the longer term as advanced services are used to achieve greater levels of efficiency and effectiveness. This sector is unique among those reviewed, in that increasing use of advanced services is not expected to offset the lower costs associated with improved procurement of basic services.

APPENDIX D

Modelling micro–macro links: a review of methodological approaches and empirical results

This appendix reviews alternative empirical model estimation or calibration methodologies employed in academic literature. In particular, it examines econometric models, input–output models, computable general equilibrium models, and *ad hoc* models based on multipliers and identities. A concluding section reviews a catalogue of related empirical findings that have been generated on the basis of these empirical techniques.

D.1. Econometric models

Econometric approaches seem tempting for two reasons. First, they offer an opportunity to utilize the greatest amount of information as they can potentially exploit both history (time series data) and geography (cross-sectional data) in a systematic fashion. Second, most econometric studies of telecoms penetration and economic development have consistently shown a good statistical fit (see, for instance, Karlsson [1992]).

However, these two advantages – the potentially massive amounts of data that can be brought to bear and the apparent robustness of results – are undermined by a set of conceptual problems derived from a lack of established theory. The problems relate to the arbitrary selection of explanatory variables, the difficulty in establishing causality, the structural stability of estimated parameters, and the consistency of results; they are discussed below.

D.1.1. Arbitrary selection of explanatory variables

Single-equation models or step-wise estimation of single equations can always be challenged on the basis of *ad hoc* selection of regressors. The regression equation(s) might be derived as the reduced form of an endogenous growth model, but the intrinsic flexibility of growth models means that it is hard to avoid at least the suspicion of 'data mining', i.e. compensating for the lack of theoretical structure with overwhelming data power.

D.1.2. Difficulty in establishing causality

A second problem associated with simple regression models linking telecoms variables with macroeconomic variables is that, in the absence of guiding theory, it is hard to infer causality from simple correlations. There might be some reverse causality (from dependent variable to explanatory variable) if, for example, as is likely, telecoms penetration affects growth (supply side) and growth in turn generates telecoms spending (demand side). The correlation might also be spurious to some extent, in that it may be caused by an omitted variable correlated with both. For instance, labour mobility might trigger both growth (more efficient use of labour resources) and telecoms spending (calls back home).

If the regression specification does not address these causality issues properly, regression test statistics will be biased, thereby questioning the apparent robustness of the fit. Furthermore, without a clear idea of which variables are the drivers (i.e. the dynamics of the relationship) it is not possible to infer policy implications from the estimated correlations. Unfortunately, as discussed in Chapter 2, it is difficult to establish causality on theoretical grounds. Empirical

tests of causality such as Granger-Sims have systematically shown two-way causality between aggregate telecoms investment and GDP: see Hardy [1980], Cronin et al. [1992] and DRI/McGraw-Hill [1991]. However, Teknibank [1993] tests causality at a sectoral rather than a macro level (using an error-correction model) in five countries, and fails to establish a strong causal link between telecoms investment and sectoral value added or productivity. A further problem is that common causality tests do not catch the possibility of causality through omitted variables, as they only test for temporal precedence.

The 'low-tech' solution to the causality problem would be to search for an instrumental variable to act as a proxy for those explanatory variables that are suspected of being caused, at least in part, by the dependent variable. Unfortunately, nobody has come up with an appropriate instrument which is correlated with (some dimension of) telecoms usage but not with other potential drivers of telecoms usage, such as economic growth.

The more complex approach is to recognize the multiple causalities and reflect them in a proper system of equations estimated jointly. Röller and Waverman [1994] were the first to attempt to estimate the inter-relationship between GDP and telecoms investment, by estimating the parameters of a system of three equations that 'endogenizes' the demand and supply of telecoms infrastructure and investment. They confirm strong causality in both directions in OECD countries for the period 1970 to 1990.

Causality is a common problem for regression specifications incorporating macroeconomic variables as derived from a growth model. It is much less of a problem when econometric specifications are derived from firm- or sectoral-level production or cost functions. This methodology is used, for instance, by Cronin et al. [1994] to quantify the direct savings to educational services providers attributable to reductions in the relative price of telecoms and its substitution for more costly inputs. They estimate a set of cost-share equations derived from a translog cost function as a system of seemingly unrelated regressions. However, the procedure takes relative input prices (e.g. cost of labour and capital) as given, and hence it does not internalize any relative price effects. While this procedure might be acceptable in narrow sectoral applications like the one used by Cronin et al., it clearly cannot be used to investigate economy-wide effects.

D.1.3. Structural stability of estimated parameters

The third conceptual problem with the econometric approach concerns the stability of estimated parameters in the face of structural changes in the economy. Methodologies which focus on historical relationships, no matter how statistically sound, cannot claim to provide anything more than a subjective prediction of future developments, if the relationships are expected to change significantly. The interaction of communications with the economy is in a period of fundamental transition, as we move from a traditional communications environment to an advanced communications environment.

The problems with using historical statistical analysis to project forward into the future stem from the fact that dynamics need not be stable. For instance, regulatory reform under the EU's telecoms liberalization measures, and the technological advances and convergence that might be triggered as a result, will change the ways in which people communicate. The transition to an advanced communications environment is likely to stimulate creative and destructive forces

in the macroeconomy, which are much stronger and more far-reaching than the relatively mild positive impacts that have been identified in a traditional communications environment.

An associated problem is that units of measurement used in statistical analyses might become obsolete as technical and regulatory conditions change (METIER [1995]). For instance, the concept of a 'main line', based on the traditional copper connection to a home or business site, is becoming increasingly meaningless. As a result, multi-channel connections (e.g. ISDN and multiplexed access lines), mobile connections, centrex services and high-speed connections are not being captured reliably or consistently in industry statistics. As 'main lines' data becomes increasingly artificial, the interpretation of important derived variables, such as revenue per main line, becomes more difficult. Similarly, the 'call minute' is an increasingly inadequate measure of telecoms usage, as the relative importance of data and video traffic grows, and voice, video and data are increasingly carried on shared infrastructures. Moreover, no alternative measure of volume has gained common acceptance, and there are significant problems with all of the alternatives.

Dynamics might also change because of saturation effects which introduce non-linearities. For instance, many EU countries are close to saturation levels for 'main line' penetration, and the marginal economic impact of additional main lines is likely to be much less than when penetration was lower. Extrapolating historical correlations so that penetration continues to rise in line with economic output is unlikely to be correct.

These critiques undermine the usefulness of parameters, estimated on the basis of historical data, to forecast the future of telecoms. Using dummy variables to reflect such technological or regulatory 'shocks' is a crude way of improving the fit of the data to historical data, but does not necessarily improve the predictive power of the model, unless one can forecast the strength and timing of future shocks exogenously. This is clearly not the case with technology or regulation.

D.1.4. Consistency of results

If different equation specifications are used to estimate the impact on various macroeconomic variables (e.g. GDP, employment, trade), there is no reason to expect macroeconomic consistency in the results. In other words, macroeconomic impacts cannot be estimated independently, because such a methodology would fail to take into account basic macroeconomic identities and general equilibrium feedback loops. This points towards the need for estimating a fully specified micro–macro model as a system of equations – one that not only captures micro–macro causalities adequately but also exploits macroeconomic identities. Unfortunately, no fully appropriate telecoms-specific model has been developed to date.

D.2. Input–output models

Input–output tables represent a snapshot of material flows in the economy. Given their sectoral detail, they have a long tradition in economics as the principal tool for mapping the economy-wide effects of changes in a particular sector. The matrix representation of sources and uses of products and services is a convenient device for aggregation of results, through simple algebraic manipulation in a consistent fashion.

The shortcomings of input–output tables as a modelling device are well-recognized. Co-efficients represent average resource use for an 'average' firm in an industry, and hence are mere statistical artefacts. Moreover, input–output models embody fixed proportion production relationships for all sectors, and either do not have any dynamics or incorporate dynamics in an *ad hoc*, clumsy fashion. The major factors that input–output tables fail to capture are summarized below:

(a) *Changes in relative prices.* Input–output coefficients do not permit the substitution of inputs on the basis of relative price effects. Thus, in the particular case of telecoms, they fail to capture the whole 'affordability' dimension of deregulation. In a dynamic setting, observed changes in input–output coefficients do not distinguish between price and quantity effects.

(b) *Technological and process change.* Input–output tables represent a static depiction of technology, are often based on technology which is up to ten years old (DIW [1984]), and are rarely produced more frequently than every five years. They are thus particularly ill-suited to analyse sectors, such as telecoms, which experience rapid technological evolution. Moreover, as firms innovate in their organizational processes, input–output coefficients may change independently of investment in telecoms facilities.

(c) *Realization of economies of scale.* Input–output coefficients represent scalable production relationships, and hence fail to capture economies of scale. As a consequence of demand growth, firms may well be able to realize new forms of economies of scale, and the extent to which these are realized will result in changes in actual input–output coefficients over time.

(d) *Changes in product quality.* Actual input–output coefficients change not only with technology but also with the nature of the product itself. This will not be captured adequately by published tables.

(e) *Aggregation of disparate companies and production techniques into a single industry classification.* Input–output tables embody an arbitrary sectoral aggregation to typically up to 100 sectors. The magnitude of coefficients is very sensitive to the definition of the sectors, especially for sectors such as telecoms, which are characterized by diverse activities and services: for example, a significant issue in relation to the definition of the telecoms sector is whether, and how, cable TV activity should be included. Also, the emergence of a new industry or service in an established industrial classification will result in changes in the observed input–output coefficient.

(f) *Changes in coefficients brought about by changes in the composition of consumer demand.* The coefficients can vary over time as a consequence of changes in the composition of consumer demand. For instance, consumers may well respond to the availability of new telecoms services by substituting them for other inputs (such as travel) or by complementing them with other inputs (such as entertainment).

(g) *Changes in coefficients of one industrial sector due to investments made by upstream firms.* Input–output tables do not purport to capture external effects. Thus, changes in actual input–output coefficients, and the consequent saving in resources, may be the result of activity within the telecoms sector itself (e.g. new infrastructure investment) or of actions from upstream industries (e.g. investments creating technological spillovers).

Input–output methodology was used by DRI/McGraw-Hill [1991] to quantify the improvements in the economy's productivity attributable to changes in the production and consumption of telecoms services and, implicitly, to investment in telecoms infrastructure between 1963 and 1982. The methodology employed was to replace the 1982 input-output

coefficients for the telecoms sector by their 1963 value and to substitute end-user telecoms consumption values in 1982 to equal 1963 levels. Cronin et al. [1992] extended the methodology to examine the impact of telecoms advances on sectoral prices, international competitiveness and trade. However, NTIA [1991] critiques this methodology along the lines expressed above.

Beyond these theoretical shortcomings of the input–output methodology, there is the practical problem that there are no reliable EU-wide input–output matrices. Given that the objective of the study is precisely to analyse EU-wide benefits of *integration* of the information market, it is not possible not follow Teknibank's [1993] approach of analysing the effects on a country-by-country basis.

D.3. Computable general equilibrium models

The chief attraction of general equilibrium models lies in the consistency of their results, since they are derived from a coherent theoretical framework, represented in a self-contained set of equations and data. They also provide a convenient mechanism for running counterfactual scenarios which are consistent with each other, by simply varying specific parameters of the model. Moreover, general equilibrium models in principle provide a framework for analysing the impact of improved access to information by consumers, which is entirely neglected in input–output models or regression analyses based on production or cost functions.

However, for all their consistency, the quality of the results can only be as good as the theoretical framework from which the model is derived. While computable general equilibrium models are widely used to study many macroeconomic and sectoral issues, there is no existing satisfactory model focusing on the microeconomics of the telecoms sector. Most models represent the supply side through crude production functions which combine factor inputs (labour, possibly broken down by skill level, and capital) with a material input (itself a composite of products mapped by an input–output table) (see, for instance, Dervis et al. [1979]). This rigid supply-side representation is not suited to service sectors that do not have a very well defined 'traditional' production function, and is particularly unsuitable for telecoms, which is characterized by rapid innovation. Also, the valuation of capital employed in telecoms becomes critical as an input parameter in the production function. No appropriate telecoms-oriented model has been developed to our knowledge, so there is no precedent on which to base our study.

Computable general equilibrium models embody an assumed degree of 'perfection' of markets and of the speed of adjustment to 'equilibrium'. These basic assumptions – which reveal the subjective philosophical perspective of the modeller – will drive the results to a very large extent. By definition, competitive models are biased towards liberalization benefits, and often produce massive benefits from price liberalization or tax reductions that do not seem to correspond with reality. One can moderate the results by using some elements of imperfect competition (at the cost of increasing the complexity of the model), but it is still true that model construction inevitably entails 'assuming your results' in a very fundamental way.

Aside from the assumed 'perfection' of markets, computable general equilibrium models share the classical assumption of costless (and hence symmetric) availability of information – a premise that seems to negate the very essence of that which is being measured in this study.

Computable general equilibrium models are subject to the criticism shared by all models estimated or calibrated on historical data, that the model cannot be expected to be stable when shocked by structural changes (either technological or policy-induced). In addition, because these models are typically calibrated using a very restricted set of data (e.g. one year) in order to ensure their consistency, the results are typically very sensitive to the choice of base year – the time at which technological, market and macroeconomic relationships are 'locked-in'.

A final limitation of general equilibrium models relates to the fact that they are an inherently static framework, since they assume a state of equilibrium. As DIW [1984] notes, the speed of technical change in the telecoms sector may preclude the assumption of market short- or long-run equilibrium which underpins general equilibrium models. General equilibrium models can be solved dynamically through an iterative procedure, but the dynamic links between one 'equilibrium' and the next need to be specified exogenously. This would appear to be too rigid a formulation to capture adequately the dynamic interactions among macroeconomic outcomes, technology and regulation that characterize the telecoms sector.

D.4. *Ad hoc* models based on multipliers and identities

This section reviews a catch-all category of *ad hoc* models which do not pretend to capture the wealth of general equilibrium effects. Use of these models is premised on the acceptance of certain theoretical 'compromises', but they do constitute the most common forecasting tool in practice. Multiplier models are conceptually simple, but may be operationally very complex and detailed; they can include anything from a 'back of the envelope' calculation to fuller spreadsheet-based depictions of economic relationships, such as the World Bank's Revised Minimum Standard Model (RMSM).

The building blocks of such models are macro-accounting identities (internal and external balance plus, depending on the application, a set of budget constraints for each type of agent); a representation of inter-dependencies among macroeconomic variables; and exogenous parameters. The models force internal consistency of results by calculating (explicitly or implicitly) certain variables residually on the basis of the identities. A second set of variables is calculated by relying on scalable linear relationships (constant multipliers) with other variables to characterize pass-through effects. Multipliers greater than one represent positive linkages or feedback, due to, for instance, complementarities in consumption or production, or externalities. Multipliers less than one represent a negative feedback or dampening, due to, for instance, relative price shifts inducing substitution or displacement effects. A third set of variables are calculated essentially exogenously, through a constant growth rate or constant-share formulation.

The results of these models are very directly driven by the parameters (especially the multipliers) fed into them. These can be applied on the basis of historical statistical relationships (including supporting regression analyses) or of acquired sectoral expertise. Many researchers have based their parameter settings on the basis of interviews, 'expert' opinions, and case studies. This is the case with Cohen [1992], Teknibank [1993] and BIPE-Conseil [1996]. For instance, BIPE-Conseil [1996] bases its model calibration on 'direct interviews of the various industry players, supplemented by a user approach to country-based and new service-based case studies, and fleshed out with input from experts in each country', and also appears to use some input-output data. The results of the model are then 'submitted for adjustment and validation to the experts in the different countries involved'.

Other studies parameterize the model on the basis of detailed microeconomic data from case studies, such as Hansen et al. [1990], NERA [1993], and NERA and Smith System Engineering Ltd [1996]. Microeconomic methodologies tend to place less emphasis on general equilibrium (multiplier or displacement) effects. The main drawback of these models is their weak micro- and macroeconomic theoretical underpinning. The absence of a formal framework means that the priors of the modeller are 'hard wired' into the model in the form of the economic relationships depicted and their parameterization.

On the other hand, the use of such models can be defended on two grounds:

(a) As argued in Chapter 2, existing theory does not shed much light on the firm-level or macroeconomic implications of the single information market. Where the theoretical state of play is considered to be deficient or insufficient, the lack of underpinnings to that theory would appear to be less of a problem.
(b) The transparency of these models, or, rather, their lack of pretence of complexity and objectivity, means that it is easy to understand the model's assumptions, as these are exposed at the highest level of the model. In more sophisticated models, the assumptions are buried more deeply within the model structure. Multiplier models recognize the inherent subjectivity of any modelling exercise, and provide a means for incorporating sectoral expertise in a fairly transparent fashion.

These models are best suited for quantifying the effects of concrete policies or technologies on narrow market segments. The current study does not fall into either of these categories.

D.5. The role of telecoms in economic development: a survey of the empirical literature

This section reviews other researchers' empirical findings on a range of related issues, and contrasts them with our own. While the various results are disparate in terms of the nature of the issues examined and the countries and time period under analysis, they can be used as a rough 'sanity check' on the orders of magnitude of the effects we are forecasting. Note that this is not a complete list of empirical studies on the relationship between telecoms and growth, nor does it cover the closely related studies on the relationship between IT and growth: for a survey of IT-related empirical studies, see Kambil [1995].

Most of the following studies have been referred to in this appendix or in Section 2.2. For each study, we paraphrase (in italics) the results as the authors themselves stated them; for the most relevant, we also comment on how their results correspond to those of this study.

(a) Cecchini et al. [1988]: *The potential impact of the overall single market programme on the EU would be about 5% of GDP (over an unspecified period of time).* We are thus estimating that one-tenth of Cecchini's claimed benefits operate through the single information market component of the overall single market agenda.
(b) Teknibank [1993]: *The incremental output growth of GDP of the EU due to the introduction of broadband communications from 1993 to 2008 is estimated at 2.7% of EU GDP (ECU 129 billion) under a 'neutral' scenario and as much as 6% of EU GDP (ECU 285 billion) under an 'accelerated' scenario.* These simulations capture not only regulatory changes but also technological advances, and hence are much broader than ours. The magnitudes estimated seem to be much larger than would seem plausible, given our results.

(c) DRI/McGraw-Hill [1991]: *By 1982, the US economy had saved US$ 81 billion (1990 US$) in primary inputs stemming from telecoms advances since 1963. This quantity is equivalent to 1.9% of 1982 GDP.* Again, these simulations capture not only regulatory changes but also technological advances, and hence are much broader than ours. However, in this case, the magnitudes they are estimating are much more consistent with our results.

(d) Cronin et al. [1992]: *In 1982, US exports would have been US$ 13 billion (1990 US$) lower in the absence of telecoms advances between 1963 and 1982. This would have represented a drop of 0.3% in the export/GDP ratio. Similarly, cumulative US exports over 1977–82 would have been US$ 49 billion (1990 US$) lower.* This paper is an extension of DRI/McGraw-Hill [1991], and the results are broadly in line with the latter, and with this study.

(e) Cohen [1992]: *Creating a more favourable environment for investments in broadband communications could enable US industries to create as much as US$ 321 billion in net new GNP growth, and add 0.4% to annual US productivity growth in the 16 years after 1992. These gains would come on top of the gain of US$ 191 billion in US output that is already expected, if present trends in broadband investment continue.* These gains correspond to 5.3% and 3.2% of 1992 GDP, respectively. These magnitudes are more in line with Teknibank's [1993] than with DRI/McGraw-Hill [1991] – not surprising since Teknibank built on Cohen's methodology. Thus, they would appear to be much larger than would seem plausible, given our results.

(f) METIER [1995]: *The difference in EU employment between a scenario where advanced communications develops rapidly in the EU and a scenario where take-up is slow could be five to six million jobs by 2010, corresponding to around ECU 300 billion (1995 ECU) of EU GDP (i.e. 4.6% of total).* These magnitudes are also in line with Teknibank [1993] and Cohen [1992].

(g) Röller and Waverman [1994]: *A 1% increase in the telephone penetration rate in OECD countries 1970 to 1980 increases economic growth by 0.98%.* This number is hard to reconcile with our own given that Europe has very high levels of telephony penetration. Thus, the impact of the single information market will probably be felt in ways other than the deepening of telephone penetration.

(h) Cronin et al. [1994]: *Cumulative cost savings in the educational services sector due to advances in telecoms production and the education sector's consumption of telecoms from 1963 to 1991 amounted to US$ 77 billion (1991 US$).* This cumulative figure is equivalent to 1.3% of 1991 GDP. This is a very large number given the rather limited sectoral coverage. In fact, it is hard to reconcile this number with the broader results of DRI/McGraw-Hill [1991].

(i) Cohen [1993]: *During the 1993 to 1997 period, savings from broadband communications in the US are estimated to be 0.02–0.06% of total consumer spending. During the 2003 to 2007 period, these savings represent 0.25–0.49% of consumer spending.*

(j) AD-EMPLOY [1994]: *In the context of a net growth in Danish private sector jobs of 6.9% from 1976 to 1990 arising from all causes, the use of advanced communications services made a positive contribution of 4.1%. In other words, development and use of advanced services was responsible for 60% of new private-sector jobs creation.*

(k) NERA [1993]: *A £180 million investment in telecoms in Ireland could increase GDP by £490–790 million and create an estimated 5,800–7,100 jobs. The GDP expansion corresponds to 1.5–2.4% of 1993 GDP.*

(l) Cronin et al. [1993]: *Total US economy-wide productivity gains attributable to advances in telecoms averaged 25% 1975 to 1991. They also conclude that the full benefits of telecoms advances take up to 15 years to be realized.*

(m) NERA and Smith System Engineering Ltd [1996]: *The overall estimate of GDP associated with radio use in the UK is in excess of UK£ 100 billion (over 1% of GDP). The net employment effect is 300,000 jobs.*

(n) Aschauer [1989]: *The productivity levels achieved by the US economy would have been as much as 0.9% higher during the 1970s, had the level of public non-military investment been increased by 1%. He also claims that the return to private investment between 1970 and 1988 would have been 2.9% higher (from the actual 7.9%). Finally, he finds that a 1% increase in the level of 'core' infrastructure could increase GNP by 0.24%, and that, after about four years, each additional dollar spent on public investment infrastructure can raise private investment by 45 cents.*

APPENDIX E

Modelling approach and detailed results

Figure E.1 depicts the functional relationships in the model. There are four types of quantities:

(a) **Telecoms sector data inputs** (shown within diamonds). These are the telecoms sector forecasts generated in Chapter 4. They are scenario-dependent and vary annually, and are thus the key data that distinguish the macroeconomic results across scenarios and across time. As described in Section 4.6.3, the telecoms employment forecasts draw on the telecoms revenue forecasts for their trend. Likewise, telecoms value added forecasts are based on the trend of revenues, as well as the capital intensiveness of the telecoms sector (and hence, indirectly, the capital expenditures). The values of these variables for the three scenarios are displayed in Table E.1.

(b) **Macroeconomic output variables** (shown within ellipses). These constitute the main results of the model. Their estimated values under each of the three scenarios are displayed in Table 6.1. Table E.2 is a manipulation of Table 6.1 and shows the corresponding differences between the scenarios.

(c) **Multipliers** (shown in italics). These represent the transformation between telecoms sector data inputs and macroeconomic variables, and between intermediate macroeconomic variables and output macro variables. The key scenario-independent multipliers are listed in Table 6.2. Table E.3 shows the scenario-dependent multipliers assumed or generated by the model.

(d) **Macroeconomic residual variables** (shown within rectangles). These quantities are calculated residually on the basis of macroeconomic identities (represented by the terms in angular brackets) to ensure consistency. They ensure internal balance (with consumption calculated as the excess of domestic aggregate supply over net domestic investment and net foreign demand, assuming a constant level of government expenditures), external balance (with the capital account being driven by the trade balance, assuming a constant level of net international reserves, debt service flows and tranfers), and labour balance (with unemployment calculated as the difference between the exogenously determined size of the working population and employment). Since these residual variables are calculated entirely endogenously, their main contribution is as a check on the plausibility of the model. The values of these variables are shown in Tables 6.1 and E.2.

Figure E.1. Functional representation of macro model

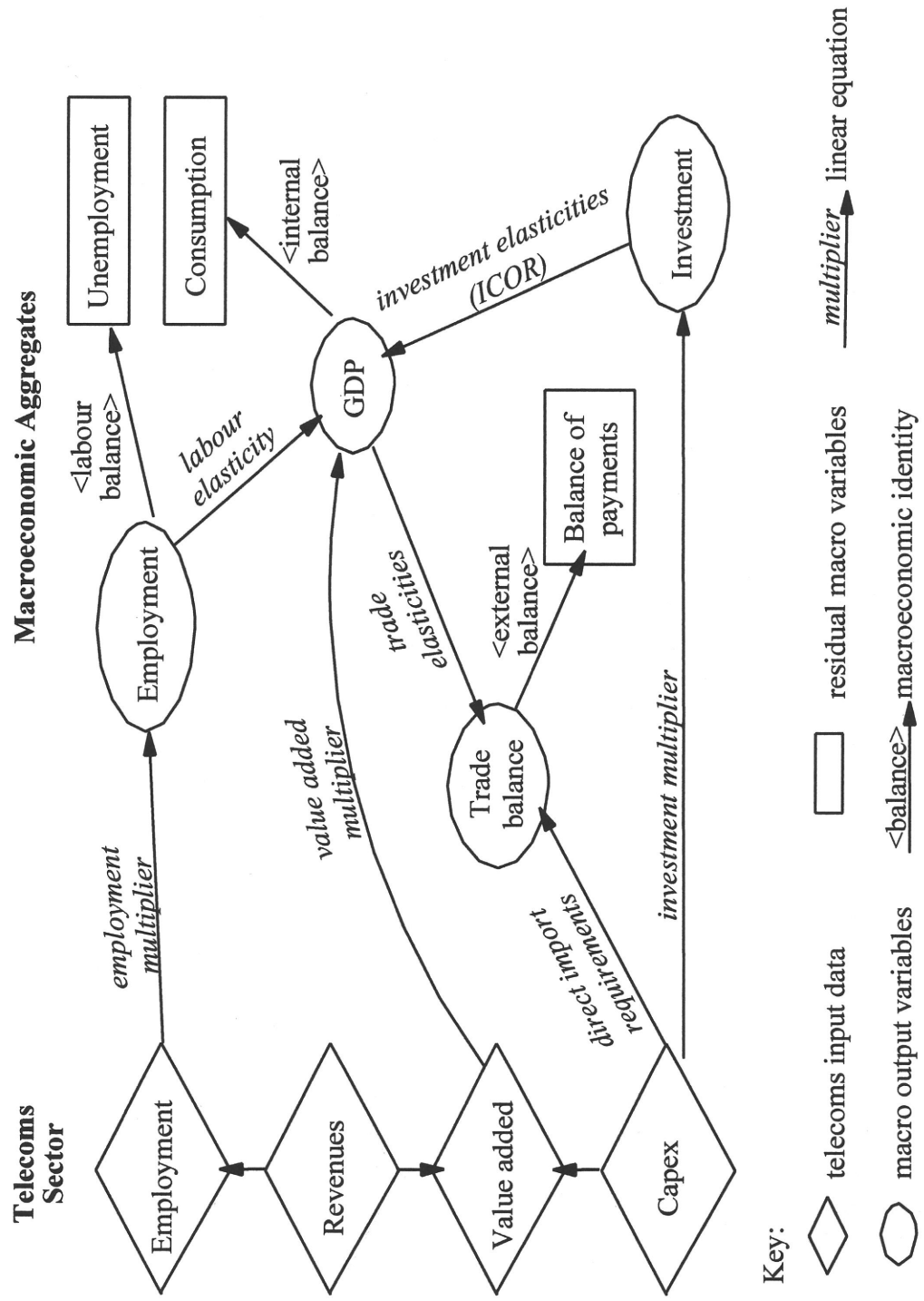


Table E.1. Annual EU-wide telecoms sector projections

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Telecom employees (million)											
antimonde	0.985	0.978	0.981	0.981	0.971	0.953	0.947	0.941	0.937	0.933	0.924
unsynchronized	0.985	0.989	0.999	0.998	0.996	0.986	0.991	1.004	1.021	1.037	1.038
rapid	0.985	0.988	0.997	1.001	1.006	1.013	1.038	1.068	1.096	1.120	1.121
Capital expenditures (billion, 1994 ECU)											
antimonde	40.5	41.8	42.9	44.0	45.0	46.1	47.2	48.3	49.4	50.5	51.7
unsynchronized	40.5	42.0	43.6	47.0	50.9	54.1	57.6	60.5	63.3	66.1	68.1
rapid	40.4	43.4	47.0	52.	59.1	63.6	68.0	71.5	73.7	76.1	77.6
Telecom value added (billion, 1994 ECU)											
antimonde	75.5	76.1	76.6	76.8	77.1	77.3	77.6	77.8	78.1	78.4	78.7
unsynchronized	75.5	76.1	77.1	78.8	81.6	84.9	87.1	89.4	93.2	97.3	101.6
rapid	75.5	79.1	83.2	86.3	90.8	94.6	98.1	101.6	106.1	111.1	116.2
Telecom revenues (billion, 1994 ECU)											
antimonde	134	140	147	155	161	165	170	175	179	183	185
unsynchronized	134	142	152	161	168	175	183	192	201	209	214
rapid	134	143	153	163	172	181	192	205	216	227	233

Table E.2. Differences in macroeconomic performance among telecoms liberalization scenarios

(population figures in thousands, value figures in billion (1995 ECU))

	Unsynch. – Antimonde			Rapid – Antimonde			Rapid – Unsynch.		
	2005 level	Share of EU GDP (%)	1995–2005 CAGR (%)	2005 level	Share of EU GDP (%)	1995–2005 CAGR (%)	2005 level	Share of EU GDP (%)	1995–2005 CAGR (%)
VALUE ADDED									
EU GDP	60		0.07	102		0.12	42		0.05
World GDP	60		0.02	102		0.03	42		0.01
EU GDP/World GDP (%)	0.13			0.22			0.09%		
EU GDP per capita (ECU)	156		0.07	264		0.12	108		0.05
EU GDP per employee (ECU)	252		0.05	427		0.08	175		0.03
EMPLOYMENT									
EU population	0		0.00	0		0.00	0		0.00
EU working population	0		0.00	0		0.00	0		0.00
as % of total population	0.00			0.00			0.00%		
EU employment	378		0.02	641		0.04	263		0.02
EU unemployment	-378		-0.25	-641		-0.42	-263		-0.18
EU unemployment rate (%)	-0.22			-0.38			-0.15%		
TRADE									
World exports	10		0.01	16		0.02	7		0.01
as % of world GDP	0.0			0.0			0.0		
EU external (net) exports	10	0.05	0.13	16	0.09	0.22	7	0.03	0.09
as % of world exports	0.09			0.16			0.06%		
EU external (net) imports	11	0.06	0.13	18	0.09	0.22	7	0.04	0.09
as % of world exports	0.10			0.17			0.07%		
EU internal trade	23	0.16	0.18	39	0.27	0.30	16	0.11	0.12
EU gross exports	33	0.21	0.16	56	0.35	0.27	23	0.14	0.11
EU gross imports	34	0.00	0.16	57	0.00	0.27	23	0.00	0.11
EU external trade balance	-1	-0.01	0.14	-2	-0.01	0.21	-1	0.00	0.07
INVESTMENT									
EU investment	24	0.20	0.24	39	0.31	0.38	15	0.11	0.14
EU non-housing investment	24	0.22	0.31	39	0.34	0.50	15	0.13	0.19
as % of total EU investment	0.54			0.86			0.32		
TELECOMS SECTOR									
EU telecoms capital expenditure	16.9	0.19	2.86	26.7	0.30	4.25	9.8	0.11	1.39
as % of EU non-housing investment	1.87			2.89			1.02		
EU telecoms employment	113.7		1.16	196.8		1.94	83.1		0.78
as % of EU employment	0.07			0.12			0.05		
EU telecoms value added	23.6	0.27	2.60	38.6	0.43	3.99	15.0	0.17	1.39
per telecoms employee (ECU)	13,132		1.42	19,063		2.01	5,930		0.59

Table E.3. Summary of results

(employment figures in thousands, value figures in billion (1995 ECU))

	Telecoms sector	Macro economy	Multiplier
Value added (output)			Macro/telecom
rapid–unsynchronized	15.0	41.7	2.78
unsynchronized–*antimonde*	23.6	60.0	2.54
rapid–*antimonde*	38.6	101.8	2.64
Investment			Macro/telecom
rapid–unsynchronized	9.8	15.0	1.52
unsynchronized–*antimonde*	16.9	24.3	1.44
rapid–*antimonde*	26.7	39.3	1.47
Incremental output–capital ratio			
rapid–unsynchronized	1.5	2.8	
unsynchronized–*antimonde*	1.4	2.5	
rapid–*antimonde*	1.4	2.6	
Employment			Macro/telecom
rapid–unsynchronized	83.1	262.7	3.16
unsynchronized–*antimonde*	113.7	378.0	3.32
rapid–*antimonde*	196.8	640.7	3.25
Incremental output–labour ratio			
rapid–unsynchronized	0.181	0.159	
unsynchronized–*antimonde*	0.208	0.159	
rapid–*antimonde*	0.196	0.159	
Value added per employee			Telecom/macro
rapid	0.107	0.056	1.91
unsynchronized	0.101	0.056	1.81
antimonde	0.088	0.055	1.58
Exports			
rapid–unsynchronized		6.8	
unsynchronized–*antimonde*		9.7	
rapid–*antimonde*		16.5	
Imports			
rapid–unsynchronized	1.5	7.3	
unsynchronized–*antimonde*	2.5	10.9	
rapid–*antimonde*	4.0	18.3	
Internal trade			
rapid–unsynchronized	2.0	15.8	
unsynchronized–*antimonde*	3.4	23.3	
rapid–*antimonde*	5.3	39.1	

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