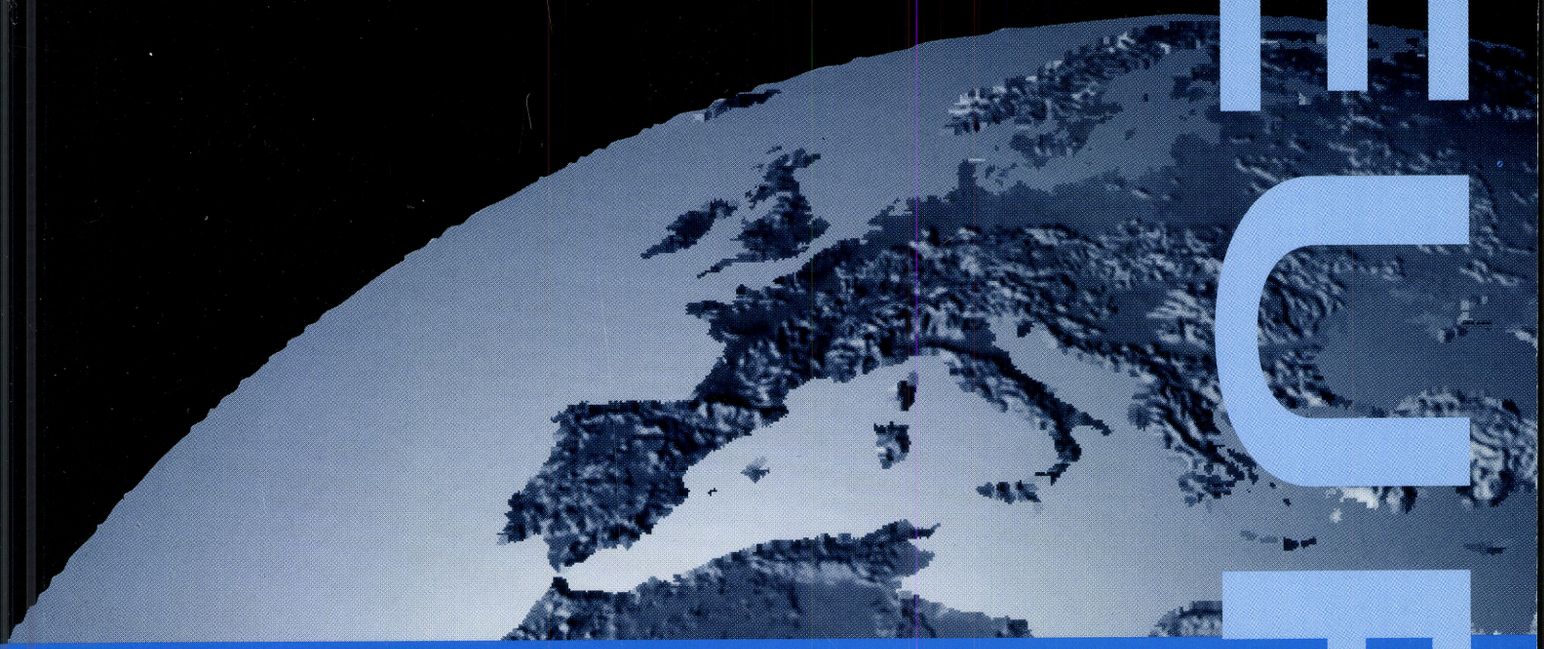
The Single Market Review



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The Single Market Review

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The Single Market Review

IMPACT ON MANUFACTURING

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The Single Market Review

SUBSERIES I: VOLUME 8

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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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by

Analysys Limited

It does not, however, express the Commission's official views. Whilst every reasonable effort has been made to provide accurate information in regard to the subject matter covered, the Consultants are not responsible for any remaining errors. All recommendations are made by the Consultants for the purpose of discussion. Neither the Commission nor the Consultants accept liability for the consequences of actions taken on the basis of the information contained herein.

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ACTS	Advanced Communications Technologies and Services
API	Application Programme Interface
ATM	Asynchronous Transfer Mode
BECU	Billion ECU
CCITT	See *ITU-T*
CDMA	Code Division Multiple Access
CEN	Comité Européen de Normalisation (European Committee for Standardization)
CENELEC	Comité Européen de Normalisation Electrotechnique (European Committee for Electrotechnical Standardization)
CEPT	Conférence Européenne des Postes et des Téléphones
CPE	Customer Premises Equipment
CTR	Common Technical Regulation
D-AMPS	Digital Advanced Mobile Phone Service
DECT	Digital European Cordless Telecommunications
EC	European Commission
EC12	The 12 Member States of the European Community (1994)
ECTRA	European Committee for Telecommunications Regulatory Authorities
ECTEL	European Telecommunications and Professional Electronics Industry Association
EFTA	European Free Trade Area
EITO	European Information Technology Observatory
EN	Europäische Norm / European Standard / Norme Européenne
ERC	European Radiocommunications Committee
ERMES	European Radio Messaging System
ES	ETSI Standard
ESPRIT	European Strategic Programme for Research and Development in Information Technologies
ETNO	European Telecommunications Network Operators Association
ETSI	European Telecommunications Standards Institute
EU	European Union
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GEO	Geostationary Earth Orbiting satellite
GSM	Global System for Mobile Communications: digital pan-European mobile telephony standard
IEC	International Electrotechnical Commission
IMP	Internal Market Programme
IN	Intelligent Network
IP	Internet Protocol
IPR	Intellectual Property Right
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
IT	Information Technology
ITU	International Telecommunications Union
ITU-T	ITU Telecommunications standard published by the ITU Telecommunications Standardization Sector (formerly the CCITT)
LEO	Low-Earth Orbiting satellite
NACE	General industrial classification of economic activities within the European Communities
NET	Norme Européenne de Télécommunications
NRA	National Regulatory Authority
OECD	Organization for Economic Co-operation and Development
ONP	Open Network Provision
PABX	Private Automatic Branch Exchange
PBX	Private Branch Exchange
PC	Personal Computer
PCN	Personal Communications Network
PCS	Personal Communications System
PDH	Plesiochronous Digital Hierarchy
PSDS	Public-Switched Data Service
PSTN	Public-Switched Telecommunications Network
PTO	Public Telecoms Operator
R&D	Research and Development

RACE	Research and development in Advanced Communications technologies for Europe (EC research programme)
SDH	Synchronous Digital Hierarchy
SIC	Standard Industry Classification
SMDS	Switched Multi-megabit Data Service
SME	Small or Medium-sized Enterprise
SMP	Single Market Programme
SNA	Systems Network Architecture (IBM's proprietary data networking protocol)
SPC	Satellite Personal Communications
TCP/IP	Transmission Control Protocol/Internet Protocol
TDMA	Time Division Multiple Access
TEM	Telecoms Equipment Manufacturer
TFTS	Terrestrial Flight Telecommunications System
TMN	Telecommunications Management Network
TO	Telecommunications Operator
UNCTAD	United Nations Conference on Trade and Development
VPN	Virtual Private Network
WAN	Wide Area Network
WARC	World Administrative Radio Conference

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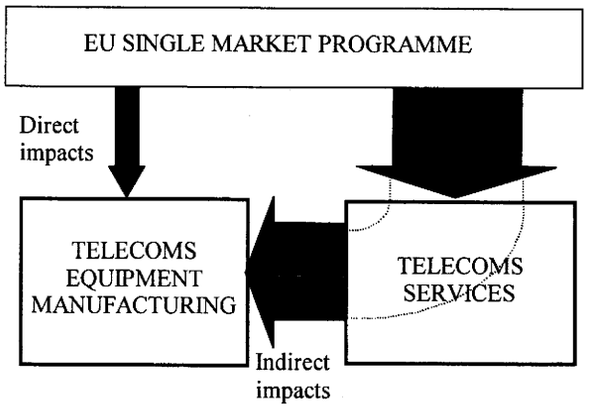
1. Summary

The creation of the European single market is having a profound effect on the European telecoms equipment sector. Although the single market is still developing, and many of its impacts are not yet fully visible, single market measures are contributing both to the reduction of telecoms equipment prices in the EU and to the competitiveness of the EU telecoms equipment manufacturers. These benefits are beginning to pass through to business and residential consumers of telecoms services in the form of lower service tariffs and increased service functionality.

The EU telecoms equipment industry employs over 700,000 people (see Section 4.2.10), and has a turnover of over ECU 30 billion (see Chapter 2). Telecoms equipment production is an important activity for global economic and social development – the supply of affordable, state-of-the-art telecoms equipment is a prerequisite for the development of the European economy and the economies of other regions of the world. Telecoms equipment production is a technology-intensive activity in which the EU has maintained its global competitive position over recent years (see Section 4.2.2). Defending and increasing the competitiveness of equipment manufacturing is a key challenge for the EU. It is therefore important to understand the impact of a major environmental change, such as the single market programme, on the competitiveness of the telecoms equipment manufacturing sector.

While single market measures have had a significant direct effect on many parts of the European telecoms equipment sector, their most profound impact in telecoms equipment manufacturing has been indirect. The changes occurring through the creation of a single market for telecoms services are having a substantial impact on the structure and performance of the European telecoms equipment sector, as illustrated in Figure 1.1 (below). The introduction of competition in telecoms services is causing telecoms operators to be more demanding in their relationships with suppliers.

Figure 1.1. The impact of the single market programme on EU telecoms equipment manufacturing



The single market programme encompasses a very substantial programme of legislation and other measures specifically targeting the reform of the EU telecoms sector (see Chapter 3).

This programme of specific measures has addressed many sensitive and challenging issues, often facing significant resistance and inertia. Telecoms is, in itself, an extremely complex area, covering the intersection of technology, economics, social and industrial policy, and corporate, civil and international law (see Chapter 3). In such an environment, it is inevitable that the process of reform will be slower and less perfect than some may wish. However, the single market programme has made significant progress in the reform of EU telecoms, including telecoms equipment. The remaining obstacles to a truly harmonized and open market are localized and are being addressed by specific implementation actions rather than new primary legislation, and the existence of these remaining obstacles should not obscure the achievements of the main programme of measures.

The most important impacts of the single market programme on the telecoms equipment sector have been to reduce the price of EU telecoms equipment, and to improve the competitiveness of the EU equipment manufacturing sector, as discussed below.

1.1. The impact of the single market programme on EU equipment prices

This study concludes that the primary impact of the single market has been to accelerate the reduction of EU equipment prices by changing the purchasing behaviour of Europe's telecoms operators, which account for over 80% of telecoms equipment purchases in the EU (see Chapter 4).

Figure 1.2 (below) illustrates the trends in real equipment prices from 1985 to 1995, and the estimated impact of the single market programme. In 1985 EU telecoms equipment prices were considerably higher than equivalent prices in other regions. Since 1985 EU equipment prices have fallen dramatically to around one quarter of their 1985 levels in real terms, and the price premium in EU markets has fallen from 20% to 8%. In the absence of key single market measures, the EU would have foregone average equipment price falls of approximately 7% (in total, 1985 to 1995), equivalent to between ECU 1.5 billion and ECU 2.0 billion per annum of additional cost to equipment purchasers in the EU (see Section 4.2.6).

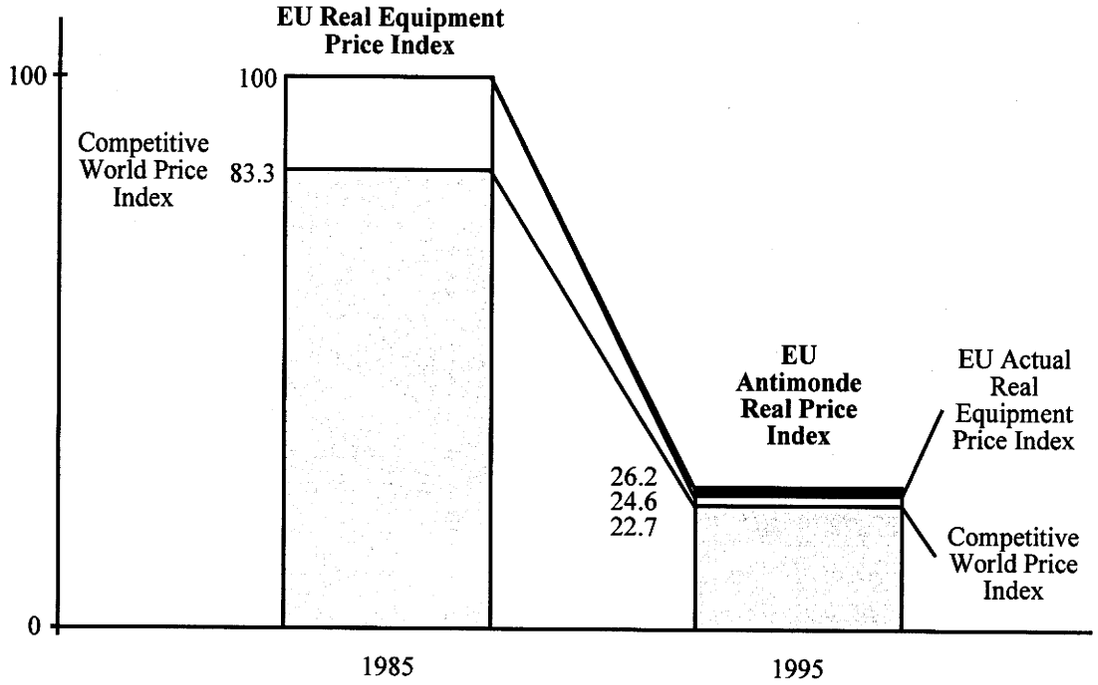
1.2. The impact of the single market programme on equipment manufacturers' competitiveness

The single market is contributing to the competitiveness of European equipment manufacturers by both generic and specific impacts:

(a) generically, by increasing the competitive intensity of EU equipment markets and accelerating the development of a large and harmonized European equipment market;
(b) specifically, by contributing to the development of individual areas, such as ensuring radio spectrum availability for the GSM standard in mobile communications, and encouraging standards development in areas such as ISDN.

These measures, in combination with the efforts of equipment manufacturers themselves, have sustained the competitive position of EU equipment manufacturing in a period of growing global competitive intensity. Telecoms equipment manufacturing is notable as a high technology sector in which EU competitiveness has been sustained over recent decades.

Figure 1.2. The impact of the single market programme on EU telecoms equipment prices

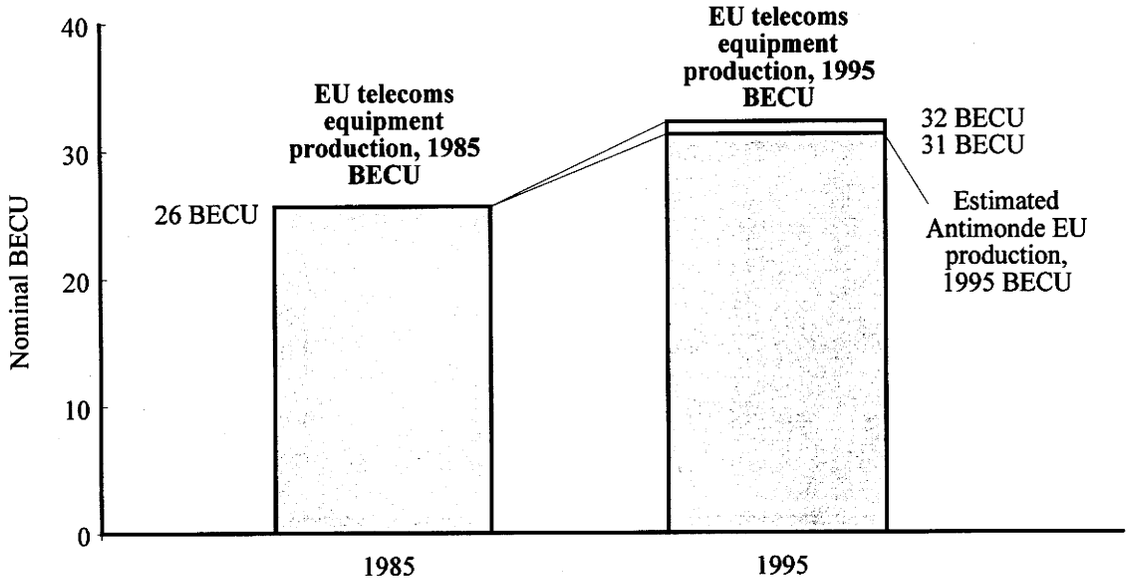


In the absence of key measures and actions, the global market share held by EU manufacturers would be below its current level (see Section 4.1.2). Each percentage point of global market share is equivalent to approximately ECU 0.8 billion of equipment sales, and this study finds that it is probable that current EU telecoms equipment production would be reduced by at least ECU 1 billion in the absence of the single market programme (equivalent to 14% of current EU external exports of telecoms equipment). In the absence of single market measures this output would have been met by non-EU production, through increased penetration of EU markets and increased containment of EU export growth. It is not tenable, however, to attribute any specific portion of current world market share entirely to single market measures; rather the single market programme has assisted the development of several aspects of competitiveness. Figure 1.3 (below) illustrates the assertion that around ECU 1 billion of EU production would have been lost to non-EU manufacturers in the absence of the competitiveness impacts of the single market programme.

The broad conclusions of this study concerning EU competitiveness are consistent with a survey of telecoms trade associations [DRI, 1995] undertaken on behalf of the EC. The survey found that 'the increased competition within the EU, brought about by single market measures, has increased the global competitiveness of the EU industry'.

The global telecoms equipment sector has undergone major technological and structural changes during the last ten years, which makes it extremely difficult to attribute particular changes to the introduction of the single market. For this reason the quantitative assessments of the impact of the single market (above) are made on the basis of hypotheses comparing actual developments with the probable development of the sector in the absence of a single market programme.

Figure 1.3. The impact of the single market programme on EU telecoms equipment production



As part of its impact on prices and competitiveness addressed above, the single market programme has:

(a) significantly altered the relationships between EU equipment manufacturers and their major customers, the telecoms operators. The prospect of competition in telecoms services has made telecoms operators change from exclusive and integrated relationships with equipment manufacturers to more open and commercial relationships with a wider range of suppliers (see Section 4.2.1);
(b) improved EU manufacturers' access to economies of scale and scope, through the reduced fragmentation of the EU marketplace (see Section 4.2.3);
(c) removed the main legal and administrative barriers to market access, encouraging cross-border activity and new entrants, particularly small manufacturers (see Section 4.2.4);
(d) contributed to increased levels of competition in EU telecoms equipment markets (see Section 4.2.7);
(e) accelerated the restructuring of large EU equipment manufacturers, with a consequent negative impact on employment in the sector (see Section 4.2.10);
(f) reduced the price of telecoms equipment for EU consumers, and increased the range of products that are available (see Section 4.2.11).

The outstanding obstacles to a harmonized and open EU telecoms equipment market are all matters of implementation rather than matters requiring further single market measures. The major area where obstacles remain are the harmonization of equipment approvals (particularly for terminal equipment) and the development of EU standards (again, particularly in the area of terminal equipment – see Section 3.3). Both these areas are the focus of continuing efforts at EU and national levels. The timetable for the reform of the telecoms services market has been set since 1993, focusing on the liberalization of voice services and infrastructure in 1998, and the major purchasers of telecoms equipment, the telecoms operators, are preparing themselves for the arrival of full competition. Their purchasing behaviour has already changed dramatically, and will continue to become more demanding. The purchasing imperatives of

the telecoms operators will continue to turn the EU equipment market into a truly integrated single market.

The single market programme has provided vital additional impetus to the evolution of the European telecoms equipment sector, at a difficult period of its development. The benefits of the single market programme will continue to accumulate over the coming years. For example, the price premium for telecoms equipment in the EU (relative to US prices) is likely to disappear by the year 2000. Based on their experience of the competitive pressures now apparent in the EU single market, EU manufacturers will continue to transform themselves to face the challenges of an increasingly difficult and competitive global marketplace.

2. Introduction

The purpose of this study is to investigate the effectiveness of measures taken to create a single European market for telecoms equipment. The study forms part of a larger work programme undertaken by the European Commission to establish the impact of measures to create single markets across a wide range of products and services.

For the purposes of this study, the telecoms equipment sector has been defined to cover the categories of equipment shown in Figure 2.1.[1]

Figure 2.1. Categories of telecoms equipment

Telecoms Equipment	Network Equipment	Switching	
		Transmission	Copper
			Fibre
			Wireless point-to-point
			Wireless access
			Satellite
		Network and subscriber management systems	
	Terminal Equipment	Business CPE	PBX
			Fax
			Modems
			Other
		Residential CPE	Handsets, etc.
		Mobile handsets	

A simple value chain for telecoms equipment manufacturers is shown in Figure 2.2. The boundaries between the equipment manufacturing activity, its suppliers and its 'neighbours' are not easily defined, and are becoming steadily more diffuse. Although some equipment manufacturers are becoming active as telecoms operators (e.g. Siemens, Philips, and Alcatel), the boundary between these activities is still very clear.

Although the telecoms equipment sector is large and strategically important (world-wide telecoms equipment sales exceed ECU 80 billion per annum), turnover in the sector is equivalent to less than 0.5% of world output.[2] EU telecoms equipment production was approximately ECU 29 billion in 1993, equivalent to approximately 0.5% of European output.[3] Employment in the telecoms equipment sector in Europe accounts for approximately 0.3% of total European employment.

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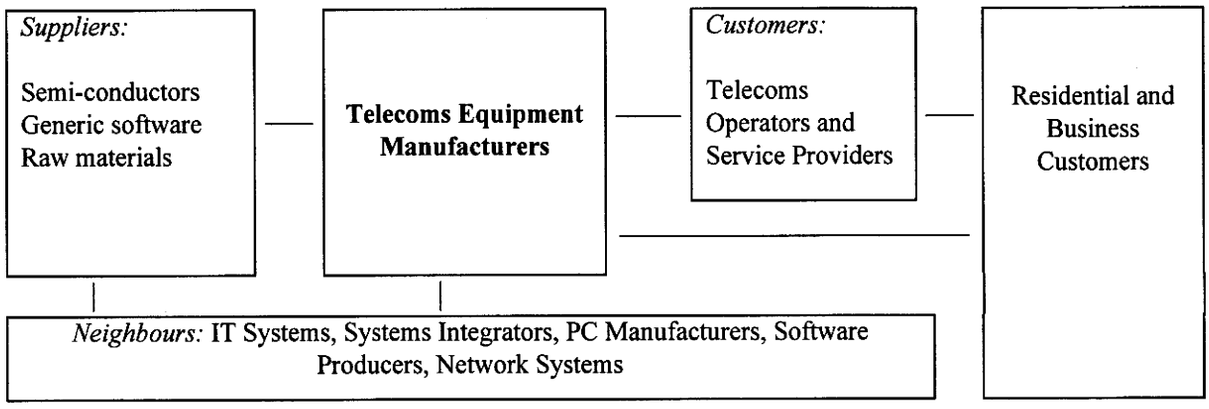
1 These categories correspond with NACE category 344 (and SIC 366). Appendix B2.1 provides more detail on sector definition.

2 Sources: Eurostat [1995], OECD and US Dept. of Commerce. In general, Eurostat figures have been given preference in this study.

3 Source: Eurostat [1995] and Elsevier [1995].

Figure 2.2. A simple value chain for telecoms equipment manufacturers



The European telecoms equipment sector has traditionally been strongly divided along national lines, although the cross-border ownership of equipment manufacturers by large players (notably Alcatel and Siemens) provided some linkage between national markets. In each national market the public telecoms operator has traditionally operated a monopoly for most categories of telecoms service, and has had a close, long-term relationship with a small number of generally indigenous equipment suppliers. For these reasons, the telecoms equipment market has always been expected to be an important focus for single market measures.[4]

The approach taken in this study is essentially qualitative, but quantitative analyses and illustrations have been included wherever possible. A purely quantitative approach is not sustainable because of the requirement to make subjective assumptions concerning the role of single market measures, which are just one factor among many which are driving change within the sector. The study has been 'hypothesis-driven'; a set of initial hypotheses were made which have been tested and changed as the study proceeded. None of the hypotheses proved to be testable with a level of analytical rigour that allowed firm conclusions to be offered, but several key hypotheses resulted in what we believe to be 'reasonable assertions', notably in the area of price trends. In other instances, notably the impact on competitiveness, we arrived at indicative results which are dependent on subjective assessments. Appendix B discusses these issues further.

The report is organized to match the structure defined by the Commission for all studies being undertaken in this work programme:

Chapter 3 identifies and describes the legal and administrative measures taken to create a single market for telecoms equipment.

Chapter 4 describes the impacts of single market measures on the telecoms equipment sector in ten defined areas (market access, production costs, cross-border sales and marketing, scale and scope effects, foreign direct investment, sourcing patterns and upstream/downstream

[4] See Cecchini [1988].

linkages, competition and market concentration, productivity and competitiveness, employment and price effects).

Chapter 5 describes the impact of single market measures on business strategies in the telecoms equipment sector.

Appendix A describes the case studies undertaken as part of the study, and Appendix B describes aspects of the methodology in more detail than is provided in the main report, as well as discussing the constraints on the study.

3. Legal and administrative measures taken to complete the single market

The single market programme has contained a very substantial and complex programme of legislation and other measures, with the specific objective of creating a harmonized and open market for telecoms equipment, through far-reaching reform of the EU sector.

This chapter describes the legal and administrative measures that are encompassed by the single market programme in the telecoms equipment sector.[5] Section 3.1 summarizes the telecoms-specific measures that have been introduced to remove obstacles to cross-border trade in equipment. Section 3.2 summarizes the 'horizontal' measures (i.e. measures not specific to telecoms equipment) that have had an impact on the telecoms equipment sector. Section 3.3 focuses on the remaining obstacles to open and harmonized markets. Section 3.4 provides a fuller description of individual areas of the single market programme, covering the rationale for individual families of measures, and commenting on their success or failure in practice.

3.1. Elimination of obstacles to cross-border trade in telecoms equipment

In order to obtain a full picture of the Commission and Council measures that are relevant to the development of the single market in telecoms equipment, it is necessary to include some measures that are not explicitly focused on the development of the single market, and measures that are not directly applicable to the telecoms equipment market, but which are having effects on the telecoms services market that are feeding back to the equipment market.

The tabulation of measures given below covers all these categories.

3.1.1. Assessment of the impact of liberalization measures on the costs for telecoms equipment manufacturers of supplying products to clients in other Member States

The main effect of single market measures in the telecoms equipment market has been to remove prohibitions rather than reduce costs. The majority of telecoms equipment is sold to telecoms operators as part of large contracts,[6] and for this equipment the additional unit costs of cross-border sales are relatively low, except where tax or tariff costs are incurred.

However, for equipment that is not purchased by telecoms operators, the additional costs of cross-border selling can be significant. Many terminal equipment and private networking equipment products fall into this category. The major source of concern in this area has been the cost of obtaining national equipment approvals,[7] which can add several percentage points to equipment unit costs if the volumes of sales are low. This is a particular problem for smaller manufacturers selling relatively low volumes of equipment. Single market measures

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[5] Chapter 3 is structured to conform to the guidelines provided to each study team to ensure a common contents list for all reports.

[6] In 1994, approximately 80% of telecoms equipment sold in Europe was purchased by telecoms operators, either for their own use or for selling on to end users.

[7] See for example OECD [1990], p. 26.

have, in general, been reasonably successful in reducing the costs and delays that characterized Member State approvals regimes, although implementation by many Member States has taken longer than necessary, and there are still areas in many Member States where further implementation action is required.

Reductions in the costs and delays associated with equipment approvals have been particularly important for the viability and growth of smaller equipment manufacturers. Although there are still only a relatively small number of such firms in Europe, the development and growth of small producers is important for the health and competitiveness of the sector.[8]

3.1.2. Evaluation of the success of legislative and administrative actions in eliminating barriers to trade

Before the single market programme the main barriers to trade in telecoms equipment were:

(i) opaque procurement practices among telecoms operators (the main customers for equipment) which were driven by national industrial policy concerns rather than commercial factors;
(ii) administrative restrictions and prohibitions which denied technical approvals for equipment (particularly terminal equipment), or charged high prices for granting approvals, or took many months to consider applications for approvals;
(iii) restriction of the rights to sell, lease, install and maintain terminal equipment to the public telecoms operator, and the maintenance of the public telecoms operator's monopoly rights as a network operator and service provider;
(iv) technical incompatibilities between networks, which made the transfer of equipment between national markets unfeasible.

All of these barriers have been addressed by the single market programme:

(i) **Opaque procurement practices.** Most EU TO procurement is now covered by legislation that prohibits many of the former practices and provides rights of redress to the victims of discriminatory procurement decisions. This legislation is comprehensive, clear and potent. However, it is particularly difficult to break existing customer/supplier relationships where the product or service is complex, customized and of high value. The relationships between Public Telecoms Operators (PTOs) and their traditional suppliers are being broken, but this is due to the new pressures exerted on PTOs in a commercial and liberalized services market. The single market measures aimed at ensuring open procurement are undoubtedly necessary and important, but it is fortunate that other forces are also acting to open up equipment markets.
(ii) **Approvals** are now quicker and cheaper to obtain in all Member States, and less open to restrictive abuses, although differences in implementation do still exist (see Appendix A2 for examples).
(iii) **TO monopsony and monopoly rights** have either been removed (such as statutory control over the retailing of terminal equipment, and the right to offer non-reserved services) or a timetable exists for their removal (reserved services and infrastructure).

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[8] See Appendix A2 for a case study illustrating the impact of approvals costs on a small manufacturer.

(iv) **Technical incompatibilities** between networks have been steadily reduced, although the legacy of unharmonized networks will persist for many years. In some areas, such as mobile telephony and ISDN, the level of technical harmonization is now very high.

In summary, the single market programme has succeeded in removing many barriers to EU trade, and is succeeding in addressing the remaining barriers with visible progress and a timetable for completion.

3.1.3. Assessment of the functioning of single market measures in practice

Initial progress on the practical implementation of many specific measures was slow, and remains slow in some sub-sectors of a number of countries. On balance, however, the rate of progress has been at the high end of most observers' expectations, given the strength of the vested interests which oppose the opening of markets, and the social and political pain of restructuring that must be undergone as changes are implemented. The acceleration of reform following the 1993 Telecoms Services Review Resolution has been particularly marked, and in 1995 there is now almost universal acceptance of the benefits and importance of completing the reform process in the shortest possible time.

There has been relatively little direct confrontation and enforcement, in either the telecoms equipment market or the services market. Persuasion has been more subtle and has had a lower profile. A more aggressive approach might have accelerated individual steps in the process, but may well have proved counter-productive in the longer term. There are several specific areas where, with the benefit of hindsight, a more assertive approach might have been beneficial (e.g. some aspects of approvals, the interpretation of the 1992 ONP Leased Lines Directive, intervention in the accounting rate régime, and acceleration of standards which threatened the PTOs).

Proponents of more rapid reform criticized many single market measures for their lack of precision. However, many of these measures would have been politically unacceptable in Europe at the time of drafting, if they had attempted to define more precisely the transitions which they initiated. With hindsight, it is clear that maintaining the momentum and direction of the single market programme was more valuable and important than the precise specification of, for example, a 'closed user group' or a 'cost-oriented tariff'.[9] The virtuous circle of reform has been created as a result (see Figure 3.1, below).

In summary, single market measures in the telecoms equipment sector (and the relevant service sector measures) are now, in general, functioning effectively, and their effectiveness is improving at a rapid rate. Progress was initially slow in many areas, which frustrated many participants in the sector, but the momentum of reform has now built up, and a truly integrated EU telecoms equipment market is within sight.

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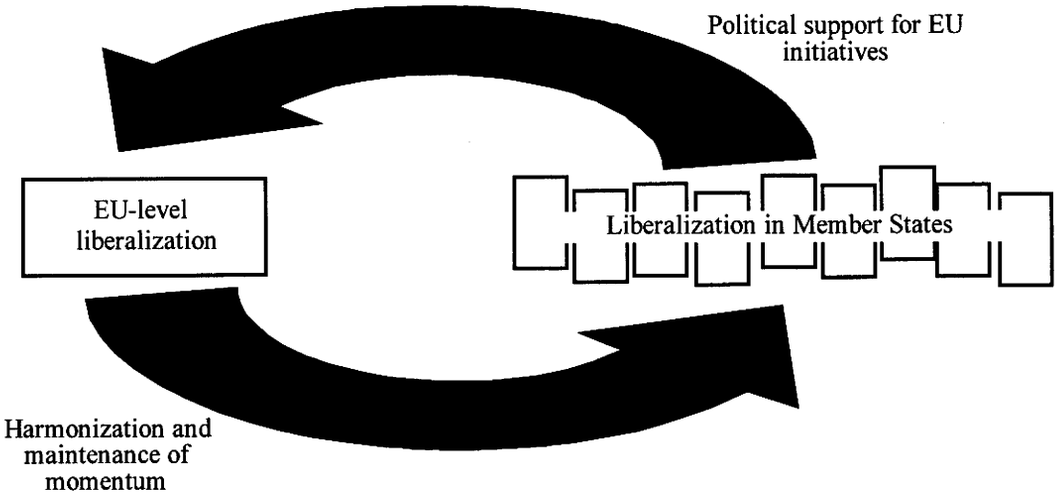
[9] See Carpentier et al. [1992] and Ungerer and Costello [1988].

Figure 3.1. The virtuous circle of EU-level and national reform of the European telecoms sector



3.1.4. Differentiation of equipment categories

The product segmentation for this study was introduced in Chapter 2. In legislative matters, the main sub-categories of measures are fixed infrastructure, fixed voice telephony services, fixed datacomms (and other value-added services), mobile telecoms, wireless spectrum issues and satellite communications.

3.1.5. Differentiation between the changes experienced by companies of different sizes

The telecoms equipment and services sectors are dominated by very large corporations, although there has been some growth in activity among smaller companies in recent years. Single market measures in this field have inevitably concentrated on the behaviour of large organizations. As a consequence, there are many areas where more could have been done at an earlier stage to support the participation of smaller organizations in the single market (e.g. the design of approvals processes, access to standards formation activities and research programmes, harmonization of procurement procedures, and the creation of information resources). Such measures are increasingly apparent in more recent directives and resolutions, and the importance of SMEs in the European economy is now clearly recognized (in the Delors White Paper,[10] for example). However, a great deal has been achieved for the benefit of smaller producers, and the prospects for further improvement are good.

3.1.6. The environmental impact of changes to companies' operations

In general, telecoms equipment manufacturing is environmentally benign. It has an environmentally positive impact, since the telecoms services sector has the potential of significantly reducing our impact on the environment by reducing the need for travel and the transportation of goods.

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[10] EC [1993].

Table 3.1 lists the measures included in the single market programme that are specific to the telecoms services and equipment sectors. Green Paper and COM documents are included for completeness even though they have no direct impact until translated into legislative proposals; they do, however, have a particular importance in the single market programme for telecoms equipment and services, due to the sensitivity of many of the proposals. It is necessary to be aware of the timing and content of these documents to have a full understanding of the single market programme in this sector.

3.2. Implementation of horizontal measures with an impact on the specific sector

3.2.1. Indirect barriers to cross-border trade

The most important indirect barriers to cross-border trade in telecoms equipment have been sector-specific (the purchasing behaviour of PTOs, restrictive equipment approvals procedures, compatibility issues, etc. as summarized in 3.1.2 above). The generic barriers (which were applicable to all manufactured goods requiring physical shipment across EU international borders) are of secondary importance.

3.2.2. Assessment of the mechanism used in horizontal single market measures relevant to telecoms equipment

See Section 3.1 above. Most of the horizontal measures have a direct relationship with specific telecoms measures and, as one would expect, the specific measures have a more precise and significant impact on the sector.

The telecoms services market, which is a particularly important determinant of the development of the equipment market, is subject to special exemptions from many aspects of EU legislation. The established PTOs have special rights to operate as monopolies that would not be tolerated in most other sectors.[11] The steady erosion of these special rights sets the pace for many other developments in the services and equipment sectors, but the industry operates on a long horizon, so many decisions are based on legislative changes that will not come into force for many years. These 'anticipation effects' are particularly important for the dynamics of the telecoms equipment sector.

The main obstacle to the creation of an open single market in telecoms equipment has been the close, protected relationships between national PTOs and their national equipment suppliers. As well as deploying direct measures to break open these relationships, measures to increase the commercial pressure on PTOs have been put in place, and the indirect effect of these measures on the PTO/manufacturer relationships has been very strong and relatively quick.The steady increase in the harmonization of EU national legal and administrative systems has benefited all businesses, including telecoms equipment manufacturers. ECTEL, in its response to the DRI survey of trade associations (DRI, 1995), noted that 'measures concerning the free movement of capital and company law particularly affect multinational companies, which dominate the [telecoms equipment] industry'.

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[11] The special position of PTOs in EU legislation has not been restricted to the preservation of their 'special and exclusive rights' in respect of services – for example, PTOs (together with other utilities) were excluded from the general reform of public procurement legislation until the introduction of the 1990 Procurement Directive.

3.3. Remaining legal or administrative obstacles and/or shortcomings

3.3.1. Remaining obstacles preventing companies from engaging in cross-border transactions

Legislation is either in place, or planned against a firm timetable, to eliminate all the legal and administrative barriers to cross-border transactions in EU telecoms equipment. All the necessary 'direct' measures in the telecoms equipment sector have been enacted; the timetabled measures are those within the telecoms services sector (indirect measures).

Although the necessary direct legislative changes have all been achieved, there are a large number of obstacles of cost, bureaucracy and lack of transparency that are still in place in many Member States, although explicit or implicit timetables exist for their removal. It should be noted that these obstacles do not result only from the late or imperfect translation of EU legislation into national codes; another significant factor is the weak and slow implementation and enforcement of some national legislation. The backlog of implementation actions for areas such as type approvals and standards development is substantial, and will take some years to be worked through, delaying the realization of the benefits of reform. It should be noted, however, that the overall pace of change has, in general, been relatively rapid, given the strength of vested interests that have been ranged against the implementation of reforms.

The outstanding obstacles to a harmonized and open market are concentrated in the area of terminals equipment, where progress on the reform of approvals procedures has been slowest. ECTEL, in its response to the DRI survey of trade associations [DRI, 1995], noted that 'some barriers to trade still exist within the EU, notably different national regulations on terminal equipment'. The development of 'one-stop' approvals based on common EU standards has been particularly problematic. This area requires continuing administrative attention rather than legislative action.

There are a number of non-legislative and non-administrative obstacles to the complete integration of the EU telecoms equipment market, concerning language, business culture, social patterns and the nature of demand for telecoms products and services. These obstacles do not have a major impact on large transactions between equipment manufacturers and telecoms operators, but they do affect the integration of the market for business and residential terminal equipment. Clearly, as legal and administrative obstacles are removed, these underlying market delineations will become the limiting constraint for the rate of market integration in these parts of the terminals market.

3.3.2. The impact of remaining obstacles on the reorganization of functions and activities

The remaining legal and administrative obstacles are not a significant constraint for the rate of reorganization and restructuring in the telecoms equipment sector. The remaining implementation obstacles (such as the backlog of standards development and the residual patchy approvals obstacles) are a more significant constraint to some aspects of sectoral restructuring, such as the development of smaller producers. However, in general, good progress is now being made in these areas.

The non-legislative and non-administrative obstacles to integration (discussed in 3.3.1 above) will become the limiting constraint for the integration of the telecoms equipment market, even though specific legislation (such as the 1990 Procurement Directive) is in place to counter any

discrimination against cross-border sales efforts. The continuing propensity of many PTOs to continue to buy a significant proportion of their switching and transmission equipment from their traditional suppliers is an example of behaviour that is hard to change overnight through legislation. This phenomenon is influenced by cultural and political factors as well as technical and operational constraints, and will take some years to disappear. It could not be eliminated overnight even by draconian and intrusive procurement legislation.

3.4. Survey of single market measures relevant to telecoms equipment

3.4.1. Summary

In the last decade there has been a gradual shift in the balance of power between the major players in the European telecoms industry. Through the opening up of the single market, telecoms equipment manufacturers are able to sell to a much broader customer base than previously. Furthermore, as the market for equipment has grown through the introduction of new services, new entrants have come into the market, and this has intensified competition in the industry. From the individual manufacturer's perspective, this period of transition has been both challenging and painful: the sector has seen increasing restructuring activity and job losses as players have sought to reduce their cost base and fight for market share.

The process of change in the sector began with the 1987 Green Paper, which catalysed many of the significant developments in the industry. Although the focus of the Green Paper was the abolition of exclusive rights and the harmonization of the EU telecoms services sector, it also served to stimulate a broader transformation of the telecoms sector – the gradual replacement of the accepted model of telecoms provision as a government-owned monopoly by a model which requires competition in services and networks through liberalization and privatization. Liberalization of the EU telecoms sector can be directly linked to the 1987 Green Paper, whereas the privatization of telecoms operators has only an indirect linkage. Many national governments have taken the view that private ownership of their national telecoms operator will be more appropriate in the liberalizing telecoms sector, and have thus embarked on privatization programmes.

The liberalization of supply and standardization of equipment has opened up the broader EU market to a wider range of telecoms equipment manufacturers. Furthermore, the formation of EU-wide standards, such as GSM, has helped manufacturers producing for the EU to compete in the global marketplace. Similarly, liberalization of services, and more recently infrastructure, has created new market opportunities such as mobile communications.

The increasing openness of the EU marketplace has encouraged competition from new entrants, particularly from US companies (in network equipment), and from Japanese and other Far Eastern companies (in terminal equipment). Some of these new entrants come from outside the telecoms sector – e.g. some are from the PC and consumer electronics industries. These new market players are used to shorter product development times and product lifecycles, and are keen to emphasize customer responsiveness.

The telecoms equipment manufacturers are also affected by the upheavals facing the TOs. As competition for services increases and privatization continues, radical changes are being wrought in the ways the TOs operate. The major TO players have begun to seek strategic alliances to secure their position in the global telecoms market. For example, France Telecom and Deutsche Telekom have announced an alliance to attack the European and global services

Table 3.1. Specific measures for telecoms equipment and telecoms services

	Date	Reference
The development of the common market for telecoms services and equipment	6/87	Green Paper COM(87) 290
Equipment-related measures		
Commission Directive on competition in the market for telecommunications terminals equipment	*5/88*	*Terminal Equipment Directive 88/301/EEC*
Council Directive on the approximation of the laws of the Member States concerning telecommunications terminal equipment, including the mutual recognition of their conformity	*4/91*	*Second phase Terminal Equipment Directive (Mutual Regognition of Type Approvals) 91/263/EEC*
Services measures		
Commission Directive on competition in the markets for telecommunications services	6/90	Services Directive 90/388/EEC
Communication by the Commission: 1992 review of the situation in the telecoms services sector	10/92	SEC(92) 1048
Council Resolution on the review of the situation in the telecommunications sector and the need for further development in that market	6/93	Telecoms Services Review Resolution
Open network provision measures		
Council Directive on the establishment of the single market for telecoms services through the implementation of open network provision	6/90	ONP Framework Directive 90/387/EEC
Council Directive on the application of open network provision to leased lines	6/92	ONP Leased Lines Directive 92/44/EEC
Council Recommendation on the application of open network provision to PSDS	6/92	92/382/EEC
Council Recommendation on the application of open network provision to ISDN	6/92	92/383/EEC
Proposal for a Council Directive on the application of open network provision to voice telephony	8/92	COM(92) 247 Resubmitted as COM(94) 689
Integrated digital services network measures		
Council Resolution concerning co-ordination of ISDN	7/89	89/C196/4
Council Resolution for ISDN as a Europe-wide telecoms infrastructure	6/92	92/C158/1
Council proposal for guidelines for the development of ISDN as a trans-European network	9/93	COM(93) 347 final

Table 3.1. Specific measures for telecoms equipment and telecoms services (continued)

	Date	Reference
Mobile services measures		
Council Recommendation for co-ordination of GSM	6/87	87/371/EEC
Council Directive on reservation of frequencies for GSM	6/87	87/372/EEC
Council Resolution on radio frequencies with regard to pan-European services	6/90	90/C166/2
Council Recommendation for co-ordination of ERMES	10/90	90/543/EEC
Council Directive on reservation of frequencies for ERMES	10/90	90/544/EEC
Council Directive on reservation of frequencies for DECT	6/91	91/287/EEC
Council Recommendation for co-ordination of DECT	6/91	91/288/EEC
A common approach in the field of mobile and personal communications in the EU	4/94	Green Paper COM(94) 145
Satellite measures		
Common approach to the field of satellite communications in the EU	11/90	Green Paper COM(90) 490
Council Resolution on satellite communication services and equipment	*12/91*	*Satellite Resolution*
Council Directive on satellite terminal equipment, including the mutual recognition of their conformity	*10/93*	*Satellite Terminal Equipment Dirrective 93/97/EEC*
Proposal for a Council Directive on satellite licensing	7/93	COM(93) 652
Proposal for a Council communication on satellite personal communications	4/93	COM(93) 171
Commission Directive on the liberalization of satellite services and terminals	10/94	94/46/EC
Cable TV measures		
A common approach to the liberalization of telecommunications infrastructure and cable television networks (Parts I and II)	11/94, 1/95	COM(94) 682
Competition rules		
Guidelines on the application of EC competition rules in the telecommunications sector	6/91	Competition Guidelines 91/C233/2
Procurement measures		
Council Directive on procurement procedures of entities operating in the water, energy, transport and telecommunications sector	*9/90*	*Procurement Directive 90/531/EEC*

Note: Measures that have a direct impact on the telecoms equipment sector are shown in italic type.

market. These changes to the TOs are forcing changes in the way manufacturers deal with their customers.

The European Commission has played a positive role as an agent for change in the telecoms sector. The remainder of this chapter considers the role of the European Commission and the key legislative measures that have been introduced to drive change in the telecoms industry.[12]

3.4.2. The role of the European Commission

The objectives of the EU's telecoms policy measures have been to:

(a) promote an advanced European telecoms infrastructure,
(b) stimulate the EU-wide market for services and equipment,
(c) contribute to the competitiveness of European industry and services.

The blueprint for these objectives was first set out in the 1987 Green Paper, with two main policy goals – liberalization and harmonization. The Green Paper represented a turning point in European telecoms. It articulated what was needed in the telecoms field in order to achieve a single market. In addition to the Green Paper, the earlier 1985 White Paper, which called for the removal of physical, technical and fiscal barriers to trade, has also had a role to play in setting the stage for change in the telecoms equipment sector. The White Paper set out many of the broader 'horizontal' objectives for change, including liberalization, by the mutual recognition of products and changes in procurement, and harmonization in the field of company law and taxation.

Subsequent to the 1985 White Paper and 1987 Green Paper, a number of measures and initiatives have been taken by the EU to implement directly and indirectly the principles of liberalization and harmonization of telecoms services and equipment. In addition to direct measures taken by the European Commission in the telecoms sector, a number of other horizontal measures – including areas such as procurement, intellectual property rights, taxation, standardization, data protection, data communication and business co-operation – have had a significant impact in shaping competition in the sector.

The remainder of this chapter discusses the relevant telecoms measures and horizontal measures in more detail, beginning with the 1985 White Paper and 1987 Green Paper which set the stage for change.

3.4.3. Setting the stage for change

The 1985 White Paper

The 1985 White Paper aimed to bring about liberalization and harmonization across the EU by addressing the broader 'horizontal' barriers to integration of business and communities.

The White Paper set out the blueprint for three broad EU objectives:

(a) the elimination of physical barriers,

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[12] See also Strivens & Martin [1993] and Interconnect Communications [1994] for concise summaries of the chronology and substance of EU telecoms measures.

(b) the elimination of technical barriers,
(c) the elimination of fiscal barriers.

The objective of the White Paper was to enable the free movement of goods and services across national boundaries in the EU. The White Paper called for change in a number of areas, of which the following are the most relevant to the telecoms equipment industry:

(a) **The abolition of national and regional import quotas:** except in the case where a lifting of the restriction would cause a serious threat to the Member State's balance of payments.
(b) **Simplification of frontier controls:** including reducing duplication of controls and sampling of goods for statistical records, and the elimination of customs documents.
(c) **Mutual recognition of goods:** a product lawfully manufactured and marketed in one Member State should be able to be sold freely in other Member States. This should allow manufacturers to achieve economies of scale by enabling them to produce for a continental market rather than disparate national markets.
(d) **Strengthening of the public procurement directives:** including re-examining the thresholds for tendering, and recognizing the need to extend existing procurement directives to the water, energy, transport and telecoms sectors.
(e) **A common market for services:** to ensure that trade in services becomes as open as trade in physical goods, by opening up the market. This included the markets for new technologies and services, which encompasses telecoms-related activities in the field of information services.
(f) **Creation of suitable conditions for industrial co-operation:** by removing legal, fiscal and administrative hurdles.
(g) **Establishing an EU-wide trade mark:** as part of a longer-term goal to harmonize the differences in intellectual property laws.
(h) **Re-inforcement of rules for state aid** with respect to competition policy.

These actions have been built on through subsequent Directives, some of which have been adapted specifically to the telecoms sector. Almost all of these Directives have had some form of direct or indirect impact on the telecoms sector. The most important measures are regulations and Directives in the areas of standardization, procurement, competition, data protection, data communication networks, taxation and business co-operation.

The 1987 Green Paper

The growing importance of telecoms to the EU macro-economy necessitated the development of a coherent EU policy for the telecoms sector. At the time of the Green Paper, the telecoms market was dominated by state-owned monopoly operators and 'national champion' equipment suppliers which conformed to locally set standards. The aims of the Green Paper were to liberalize and harmonize the market for telecoms services and equipment, by breaking down the monopolies and establishing equivalent trading conditions across the EU. Barriers to entry would be lowered, establishing true, EU-wide competition.

The Commission's objectives were to be accomplished by setting out a process in the Green Paper to tackle three main areas:

(a) the liberalization of services,
(b) opening up national borders in the terminal equipment market,

(c) providing open access to the telecoms infrastructure.

To meet these objectives, the Green Paper called for five core changes to the competitive environment in the EU:

(a) a clear separation of regulatory and operational management of the TOs, including licensing, control of type approvals etc., and general surveillance of network usage;
(b) the establishment of EU-wide technical standards to create EU-wide interoperability;
(c) the application of competition rules;
(d) the creation of a transparent fiscal environment to identify areas where there was a predatory cross-subsidization of goods or services;
(e) the opening of the market for telecoms supplies and works;
(f) strict continuous review of providers to avoid abuse of dominant positions.

To create competition, the Green Paper also recognized the need for changes to the provision of services and equipment, and called for the following changes in these areas:

(a) **Removal of exclusive provision:** minimizing the rights to exclusive provision by the TOs to a limited number of basic services where it could be proved that this was essential for safeguarding public service goals.[13] Unrestricted provision of all other services, including value-added services, was to be implemented.
(b) **Provision of service:** standards, frequencies and tariff principles were to be set out clearly to provide a common agreement under which competitive service providers could offer services over the network.
(c) **Provision of terminal equipment:** unrestricted provision of terminal equipment was to be allowed subject to type approval requirements.

The 1987 Green Paper excluded consideration of mobile and satellite communications. In November 1990, the European Commission issued a Green Paper on Satellite Communications, and in April 1994 it produced a Green Paper on Mobile and Personal Communications, which aimed to extend the principles of liberalization and harmonization to these fields.

The 1987 Green Paper has been implemented through a number of measures directed at the following aspects of the telecoms sector:

(a) the Terminal Equipment Directives,
(b) establishment of a Standards Institute (ETSI),
(c) the Services Directive,
(d) various Open Network Provision Directives,
(e) Integrated Services Digital Network Commitment,
(f) Mobile and Personal Communications Green Paper, recommendations and directives,
(g) Satellite Communications Green Paper, recommendations and directives,
(h) the Guidelines on the Application of EC Competition Rules for Telecoms,
(i) the Procurement Directive.

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[13] In the 1987 Green Paper this meant voice telephony, but there are now moves to open up voice telephony to competition.

3.4.4. Telecoms measures

Competition in the market for terminal equipment

The Green Paper asserted that users should be given a free choice between the types of equipment available, so that they could benefit from technological advances. To enable this would require the supply of equipment to be extended, breaking the monopolies of the TOs in this area without compromising the integrity of the network. To prevent compromising the network, the Green Paper recognized the need for mutual recognition of equipment type approvals developed at the national level, with the long-term aim of establishing pan-European standards and a one-stop Europe-wide type approval process.

Two key directives have been introduced to address these issues: the 1988 Terminal Equipment Directive and the 1991 Mutual Recognition of Type Approvals Directive.

The Terminal Equipment Directive. The introduction of the 1988 Terminal Equipment Directive has had a far-reaching impact on the market for the provision of terminal equipment. The directive aimed to abolish monopoly rights on the provision of terminal equipment and open up the market for provision, subject to some limited safeguards relating to technical standards and the use of qualified personnel.

The key provisions of the directive were to impose the following obligations on the Member States:

(a) Abolition of monopoly rights by withdrawal of all exclusive and most special rights related to the importation, marketing, connection, bringing into service of telecoms terminal equipment and/or maintenance of this equipment.
(b) Submission to the EC of a list of all technical specifications and type-approval procedures related to terminal equipment.
(c) Access to new Network Termination Points for users, and publication of their technical interfaces.
(d) Draft technical specifications and type-approval procedures related to additional telephone sets, PABXs, modems, telex and data transmission terminals, mobile phones, and receive-only satellite stations not connected to the public network.
(e) Establishment of an independent body responsible for drawing up specifications related to type-approval procedures, monitoring of their application and granting of type approval.

The directive has been implemented by all the Member States, and a fully competitive terminal equipment market has, at least as far as the legal and regulatory principles for the telecoms sector are concerned, been established throughout the EU. Since the enactment of this directive into Member State law there has been a proliferation of telephone and fax equipment available in electrical retail outlets and office equipment channels. Furthermore, it is now possible to purchase a telephone handset for less than the annual rental cost from a TO five years ago.

The traditional TOs are still very important players in the market for terminal equipment, even though there has been a significant shift of power in this market away from the TOs to other distributors.

Subsequent to this directive, the 1991 Mutual Recognition of Type Approval Directive continued the process of liberalizing and harmonizing the market for terminal equipment.

Mutual Recognition of Type Approval Directives. The Directive on the approximation of the laws of the Member States concerning telecommunications terminal equipment included the mutual recognition of their conformity (91/263/EEC).[14] The directive introduced a procedure to avoid multiple testing, by stating that if the equipment has been approved for connection in any one Member State then no further approval is required for the equipment to be sold in other EU markets. The directive also specified the need to develop Common Technical Regulations (CTRs) where possible, to enable a single market for equipment.

The key provisions of this directive were to oblige the Member States to:

(a) ensure that equipment remains on the market as long as it complies with the directive, and is connected only if it is in accordance with the manufacturer's declaration (i.e. all terminal equipment is subject to EU type examination, the manufacturer's declaration of conformity to type, and production quality assurance or a full manufacturer's EU declaration of conformity);
(b) ensure the removal of impediments to placement on the market, and free circulation and use, of terminal equipment which complies with national standards and CTRs;
(c) designate independent bodies to carry out the certification, product checks and associated surveillance tasks, and inform the EC of these bodies and test laboratories.

The process of establishing CTRs has been cumbersome, although some progress has been made on this front by the formation of bilateral arrangements (e.g. an agreement exists between France, Germany, the Netherlands and the UK).

Establishment of ETSI. The 1987 Green Paper proposed the establishment of ETSI as the basis for setting standards across Europe, and the organization was set up in April 1988.

ETSI has played a key role in producing drafts of CTR mandatory standards. CTRs are now available for GSM, DECT, 2Mbit/s unstructured leased lines and Euro-ISDN. Further CTRs are in the pipeline for ERMES, DECT, VSATs and Euro-ISDN.

In many cases, ETSI has had difficulty meeting deadlines and target dates for the development of CTRs. This is primarily because the CTR standards affect national implementations already in place in individual Member States, and do not allow for national 'interpretation'. Consequently, it has been easier for ETSI to gain agreement on standards for new networks such as GSM, than on standards for existing public switched networks. As 80% of terminal equipment is for the existing networks, it will still be many years before a fully integrated single market is achieved through the use of CTRs.

The creation of bilateral agreements ahead of the production of ETSI standards is not ideal, but not necessarily a symptom of failure. It indicates that there is pressure from a subset of Member States to make progress on standards formation. This phenomenon would be a greater concern if the bilateral agreements represented 'rival camps' advocating incompatible specifications. In fact, the agreements represent a desire to accelerate progress rather than to

[14] This Directive was adopted in 1991 and replaced an earlier Directive issued in 1986 (86/361/EEC).

steer the specification towards the vested interests of one group. The bilateral agreements reached to date are not a subversion of ETSI or a threat to the ultimate early harmonization of EU network specifications.

Competition in the market for telecoms services

Competition for telecoms services was established through an initial directive, the 1990 Services Directive, and a subsequent Telecoms Services Review in 1992. The directive (and its various amendments) have had a major impact on the whole of the EU telecoms sector, not just the operators. The existing and forthcoming re-regulation of services and the resulting growth in new entrants are creating greater variety of demand for equipment supply, and increasing the emphasis on lower equipment prices.

The Services Directive. The Services Directive was issued in June 1990, and represented a significant step towards the liberalization of services across Europe. The directive is a legal instrument, considered to be sufficiently precise and clear to be directly applicable to all EU Member States, whether or not it has been transposed into national legislation. The legal implication of this is that the directive can be invoked before national courts by any natural or legal person.

The Directive makes it clear there should be unrestricted provision to any applicant of capacity on the public network both within and between Member States, subject to fair conditions of access and prohibitions on the 'simple resale' of capacity.

The key provisions of the Services Directive are as follows:

(a) The liberalization of all telecoms services except public voice telephony, which would be reviewed in 1992. This was to be accomplished by withdrawing special or exclusive rights for the supply of these services, and by making conditions for access to the networks objective and non-discriminatory.
(b) The separation of regulation and operational functions, preventing the regulator from being involved as a commercial actor in the market. The regulatory body will be obliged to oversee an independent body for the granting of operational licences, control of type approval and mandatory specifications, allocation of frequencies and surveillance of usage.
(c) The continued exclusive provision, or special rights, for TOs in the provision of network infrastructure.

The Telecoms Services Review. In 1992 the Commission issued a Communication, 'Review of the Situation of the Telecommunication Services Sector' (SEC(92) 1048 final). This laid out four options for debate on the development of telecoms in the EU up to the end of the decade. After extensive consultation with the operators, the decision was eventually made to aim for full liberalization of voice telephony, set out in the Telecoms Services Review Resolution in June 1993. An agreement was also made to study the future deregulation of infrastructure.

The liberalization of voice telephony is to be implemented from 1 January 1998, with a derogation until 2003 for countries with less advanced networks. However, some countries are taking this further (e.g. France), and are pushing ahead with the independent introduction of competition in infrastructure; furthermore, countries like Sweden and Finland are already

fully liberalized. The moves by these countries will put enormous pressure on the peripheral countries of the EU to respond more quickly.

Open Network Provision

The Green Paper recognized that an open and harmonized market for telecoms services would need to define in detail the conditions of access to the public network, and that common principles needed to be developed regarding the conditions under which TOs must make the infrastructure available to users and competitive service providers.

The conditions for establishing open network provision were first set out in the ONP Framework Directive, and subsequently in further directives covering specific areas (including leased lines, PSDS, ISDN and voice telephony).

ONP Framework Directive. Adopted on the same day as the 1990 Services Directive, the 1990 ONP Framework Directive aimed to define the conditions for harmonizing open access to the network infrastructure, and to act as a platform for the content of subsequent specific ONP measures. In particular, the conditions for use of the network should comply with three basic principles: they should be objective, transparent and non-discriminatory.

The key objectives set out in the ONP Framework Directive are:

(a) to establish a minimum level of harmonization across Europe to enable the offering of pan-European telecoms services, e.g. the number of leased lines across the EU;
(b) to establish a level playing field between TOs by mimicking the effect of market forces and obliging TOs to behave as if in a competitive environment, despite their monopoly on infrastructure and voice telephony. In principle this means:
    (i) obliging NRAs to ensure that there is no discrimination between users offering competitive services,
    (ii) limiting the number of restrictions on the access to and usage of the public network, and publication of any such restrictions which remain,
    (iii) obliging tariffs to be 'oriented' by costs, and the setting up of cost accounting,
    (iv) enabling users to have access to a quick and inexpensive conciliation procedure when dissatisfied with the application of the directive.

Application of ONP to leased lines. The Directive on leased lines was adopted in June 1992 on the basis of the ONP Framework Directive. The directive is of great importance to new entrants which, except in the UK, cannot legally self-provide their own fixed networks.

The main provisions of the directive include the publication of information on leased lines (e.g. technical characteristics, tariffs, usage conditions, connection conditions, etc.) and the provision of a minimum set of leased lines.

The ONP Leased Lines Directive is seen by many as a clarification of the 1990 Services Directive, by going further in imposing conditions of non-discrimination upon the dominant TOs.

Application of ONP to ISDN and PSDS (Packet-Switched Data Services). Despite the emphasis on ISDN, the Council has been unable to bring forward any mandatory requirements on PSDS or ISDN at this time (as far as we are aware). Recommendations for harmonized

services and minimum service offerings have been published (92/382/EEC and 92/383/EEC), but they are not binding on Member States, and some Member States will enjoy extended implementation periods.

Application of ONP to voice telephony. In 1992 the Council issued a directive on the application of ONP to voice telephony. Subsequent to this directive, a common position has been reached both with respect to voice telephony and the public switched telecommunications network (PSTN) in general. The directive only included mobile networks in so far as it set out the terms by which fixed network operators must allow mobile operators interconnection to the PSTN.

The directive provides for the following:

(a) users are to have a basic right to be connected to the public network, use any approved terminal equipment and to use the network for voice telephony and other services;
(b) publication of up-to-date information on the conditions of access to and use of the PSTN, as well as set targets for the supply and quality of service. It also includes some expected voice service features, e.g. calling-line identification;
(c) tariffs set for the use of the PSTN are to be cost-oriented, transparent and unbundled;
(d) pre-payment cards are to be usable throughout the EU.

When considering the impact of the ONP series of directives, and assessing their success (or otherwise), it is important to understand their position in the overall single market programme for telecoms. A superficial assessment would lead to the conclusion that the goals of ONP have not been achieved, that incumbent operators have found it relatively easy to comply with the letter of ONP measures but suppress the spirit of ONP initiatives, and that many of the expectations of new entrants, users and commentators have not been matched. However, this superficial assessment is inadequate.

The 1990 Services Directive (with the 1993 Telecoms Services Review) has for many years been intended as the main thrust of the single market programme for telecoms reform, with the ONP directives as important but subsidiary measures.

The role of the ONP directives has been to confront specific current issues in the sector, to create a focused debate on important but detailed aspects of reform, and to develop expectations of change by demonstrating a serious intent to harmonize and liberalize the sector. The ONP directives have been a more complex and, in many ways more frustrating package of measures than the Services Directive and its associated measures, but they have served their primary purposes (as identified above). It is true that many of the specific ONP measures have run into difficulties, some of which could have been reduced by more forceful drafting or application of the directives (assuming that political approval could have been maintained for such modifications), but these 'lost battles' have been part of a successful overall campaign.

It should be noted, however, that an effective ONP régime will need to be in place before 1 January 1998 if the full benefits of service and infrastructure liberalization are to be achieved. The details of a 'post-1998' ONP régime will, however, be rather different from those drafted for the environment of the early 1990s.

Creation of an Integrated Services Digital Network (ISDN)

The Commission foresaw the need to encourage the move to full integration of voice and data services over a digital network, which would make it possible to provide sound, text, image and video services. By making these services compatible across Europe, the indigenous telecoms manufacturers would be in a strong position to gain a share of world markets.

In 1989 and 1992 the Council issued resolutions calling for the TOs to develop a harmonized and compatible ISDN infrastructure able to carry all foreseeable narrowband services, and standardize the interfaces between terminal equipment and ISDN (resolutions 189/C196/4 and 92/C158/1). A pan-European standard (Euro-ISDN) has been set as a high priority for ETSI, and all EU public network operators have signed a Memorandum of Understanding confirming their agreement to implement the new Euro-ISDN.

Progress on the creation of the Euro-ISDN has been made, but it has taken several years for the core standards to be established, and many non-core aspects, such as higher-speed aggregated channel implementations, D channel usage and 'subnetting' are not yet fully deployed. In recent years, a significant legacy of non-Euro-ISDN equipment and applications has accumulated, and it will take many years for these legacy systems to be replaced with fully compatible ISDN systems.

In addition to the progress on ISDN, the Council issued a resolution concerning trans-European networks (resolution 90/C). The resolution stated that special priority should be given to the development and interconnection of trans-European networks, including but not limited to telecoms.

Creation of competition in mobile telecoms

The creation of competition in mobile telecoms is probably the area where the Commission has had most success. The mobile market has evolved significantly over the last decade, and has therefore been open to EC influence from an early stage in its development.

Early measures taken by the Commission centre on three areas:

(a) the allocation of radio frequency,
(b) the provision of (new) mobile services (GSM, DECT, etc.),
(c) ONP provision.

A Green Paper on a common approach in the field of mobile and personal communications was issued in April 1994.

Allocation of radio frequency. Recent technological developments in mobile radio, satellite and broadcasting have led to a rapidly growing demand for radio frequency allocation. The availability and allocation of radio frequencies is seen by the Commission as an essential element for the establishment of the single market for radiocommunications equipment and radiocommunications-based services.

The objectives and principles guiding the EU's policy in the field of radiocommunications were set out in a resolution in June 1990 (90/C166/2), and were to:

(a) strengthen co-operation in the field of radio frequency co-ordination to ensure sufficient and timely availability of frequency spectrum for new services, while taking into account the demands and requirements for existing services;
(b) promote the efficient use of frequency spectrum by balancing service requirements with industrial developments and the development of standards;
(c) develop common European positions on international frequency harmonization, in particular with regard to the ITU;
(d) reform radio frequency planning co-ordination mechanisms within the framework of the CEPT, and through the establishment of the ERC.

The ERC has changed its rules, to enable it to produce binding decisions, rather than mere recommendations. Members of the CEPT are asked to write to the ERC within two months of any decision being passed in order to confirm their compliance.

Prior to, and following, the resolution, the EU has taken a number of actions to develop the sector. These include:

(a) Directive 87/372/EEC in June 1987, reserving frequency bands for the introduction of GSM cellular communications;
(b) Directive 90/544/EEC in October 1990, reserving frequency bands for a pan-European public radiopaging service;
(c) Directive 91/287/EEC in June 1991 on frequency bands for the co-ordinated introduction of DECT;
(d) adoption of a proposal for a Council resolution to assign common frequency bands for a Terrestrial Flight Telecommunications System (TFTS) (COM(92) 314 final);
(e) a proposal for a Council resolution to implement measures on radio frequencies (including securing the required frequencies), achieve EU-wide markets in order to allow economies of scale for the introduction of new equipment, and ensure a common EU position at the WARC to safeguard the EU's interest in the international arena (COM(90) 171 final).

Provision of new mobile services – GSM, DECT, etc. In June 1987, the Council issued a recommendation calling for TOs to co-ordinate the introduction of GSM, and setting out a timetable for roll-out of the service. The recommendation included a detailed annex containing systems specifications and details of the architecture, the signalling conventions to be used, and tariff considerations. The Council saw its role as promoting a co-ordinated policy for the introduction of pan-European mobile services. The aim was partly to achieve the benefits of a Europe-wide service, but also to try to develop a stronger indigenous manufacturing industry within the EU, particularly for terminal equipment (which, for analogue services, had been dominated by non-EU manufacturers). The TOs subsequently signed a Memorandum of Understanding agreeing that where terminal equipment was tested and approved in any one of four countries (Denmark, France, Germany and the UK), then the other Member States would accept the results.

Although not all Member States have fully implemented the service, primarily due to lack of demand, in broad terms the introduction of GSM as an EU-wide telecoms service has been a notable success.

Subsequent initiatives, similar to the approach on GSM, have been taken by the Commission for ERMES (European Radio Messaging System) and DECT (Digital European Cordless Telecommunications). In both cases, the Council called for a common specification to be drawn up, in conjunction with ETSI, and indicated that the existing systems would evolve to the pan-European system.

ONP and mobile communications. The Commission's direct involvement in this area has been relatively limited so far. A number of recommendations have been put forward from a study carried out on behalf of the Commission by PA Consulting Group. The recommendations are in four parts: technical standards, interconnection and access arrangements, usage and supply conditions, and tariff principles.

The study recommends that, where possible, only a minimum set of standards should be defined, and that most standards should remain voluntary, but published. In particular, standards should not be imposed on analogue services, on the grounds that any requirement to make an investment in harmonizing the analogue network could delay investment in GSM.

The study also recommends that the TOs provide primary-rate access more widely in their networks, in order to provide convenient and open access to various types of mobile operator, including mobile data services. The principles for access to the fixed network contained in Directive 95/62/EC on the application of ONP to voice telephony are deemed to be broadly suitable for governing access to mobile networks. ONP measures for mobile-mobile network interconnection were deemed unnecessary.

Competition in satellite communications

A Green Paper was issued in 1990, setting out the Commission's vision for European satellite communications, as an extension of the existing EU telecoms policy. The paper aimed to build on earlier communications by the Commission with respect to the EU's involvement in space programmes. The paper was subsequently endorsed in the 1991 Satellite Resolution.

The Green Paper and the subsequent resolution proposed five major changes to the regulatory environment:

(a) full liberalization of the earth segment, including both receive-only and transmit/receive terminals. This would mean the abolition of exclusive and special rights, but terminals would still be subject to type-approval procedures where they are to be connected to the PSTN;
(b) equitable, unrestricted access to space segment capacity, subject to licensing procedures to safeguard any exclusive or special rights;
(c) full commercial freedom for space segment providers, i.e. the capability to market capacity directly to users and other service providers;
(d) other measures to promote harmonization of the provision and use of Europe-wide services, including measures to promote mutual recognition of licensing and type-approval procedures, frequency co-ordination, and the co-ordination of services transmitted to and from countries outside the EU;
(e) separation in all Member States of the regulatory and operational functions in the field of satellite communications.

A number of measures have been introduced to facilitate implementation, including:

(a) the 1993 Satellite Terminal Equipment Directive (similar in direction to the 1991 Terminal Equipment Directive for telecoms, including the development of appropriate CTRs);
(b) the 1993 Satellite Licensing Directive proposal (calling for the mutual recognition of licences for the provision of satellite services across Member States);
(c) the 1993 Satellite Personal Communications (SPC) proposal (setting out requirements for the use of LEOs and GEOs in SPC systems).

In particular, the Commission sees the existing regulatory régimes as a potential stumbling block for SPC providers seeking quasi-global coverage. The Commission is concerned that this may result in the imposition in Europe of standards and modes of operating established in the USA (which is further ahead in the licensing process), and that these may not serve Europe's best interests. The need for early consideration of the appropriate regulatory régime for SPCs has therefore been stressed by the Commission.

Application of competition rules to the telecoms sector

The 1987 Green Paper set out the need to review the compatibility of the telecoms industry with EU competition rules. There was particular concern to ensure that the TOs did not cross-subsidize operations, or continue inappropriate and anti-competitive integrated relationships with manufacturers.

Competition guidelines for the telecoms sector were subsequently issued in 1991. These guidelines set out a wide range of types of contracts and contract terms which the EC considers might be caught by Article 85 of the EC Treaty (on anti-competitive agreements and practices), and identifies practices which it considers may constitute an abuse of power under Article 86 (abuse of power by a dominant company).

In particular, the guidelines describe the application of competition rules to all undertakings in the sector, including those to which special or exclusive rights have been granted (i.e. TOs, value-added service providers and equipment manufacturers). Exemptions can only be obtained when the Commission is of the view that the arrangement brings economic benefits which outweigh the restrictions of competition.

The main provisions of the competition rules under Article 85 prohibit the following agreements:

(a) direct or indirect fixing of purchase or selling prices;
(b) limitation or control of production, markets or technical development and investment;
(c) discrimination against any trading parties for similar transactions.

In the telecoms sector, the Commission has identified three areas where typical agreements in the sector may be in infringement of Article 85:

(a) agreements between TOs on the use of network infrastructure and other reserved services (e.g. conditions for the provision of facilities, choice of telecoms routes, technical standards for services provided);
(b) agreements between TOs and/or others on non-reserved services and terminal equipment (e.g. one-stop shopping of services, refusal to provide facilities, or restriction of usage to third-party suppliers);

(c) agreements on research and development (e.g. joint marketing and distribution following on from R&D).

R&D agreements are those in which the grounds for exemption from the application of Article 85 are most likely to apply, since the Commission recognizes the need for significant levels of investment to drive technological research. An example of this was the proposition by GEC and Siemens jointly to acquire Plessey. The aim of the purchase was to enable the companies to engage in joint R&D and work towards the creation of common systems in the future. Because of the importance of these companies in their respective national markets and of Siemens across the EU in public and private switching, the purchase of Plessey was considered to be a restriction of competition. However, because the expenditure required for developing these telecoms products met the conditions for exemption, and the level of competition in this sector globally, the Commission allowed the purchase to go ahead.

The main provisions under Article 86 are that no anti-competitive or abusive activity may be undertaken by a dominant power within the Member States which may affect trade in or between the Member States. Dominance has not been defined in terms of market share, and the European Court of Justice has confirmed that companies with less than a 50% share may still be considered to have a dominant position. It is also possible for undertakings to hold a dominant position collectively (e.g. in the case of predatory pricing).

The primary abuse likely to arise under Article 86 would be a TO taking advantage of its monopoly in reserved services and extending its power into non-reserved markets. However, cross-subsidization of services and abuse of purchasing position are two further potential areas for abuse which could have an impact on the equipment sector. By preventing cross-subsidization, the TOs are steadily having to become more cost-conscious on a service-by-service basis. On the other hand, the TOs are prevented from demanding excessively favourable prices or other trading conditions from their suppliers, or insisting on the granting of a licence to the TO of the IPR or technical details of the product, or any exclusive rights to distribute the product.

Although the guidelines provide some assistance to users and independent service providers on areas in which the practices of the dominant operators may be challenged, they provide little guidance to the dominant operators on the acceptable scope of terms and conditions that may be imposed. However, as time passes, and the volume of precedent increases, this lack of clarity is reducing in importance.

EU-level competition rules were implemented after the consolidation of the EU telecoms equipment industry which took place in the 1980s, and so the competition rules were never tested against these major transactions. It is, of course, interesting to speculate on the rulings that would have been made if these transactions had been assessed against the current criteria. The effectiveness of the existing measures appears to be adequate for policing and guiding the post-consolidation telecoms equipment industry. There is an increasingly clear understanding in the sector of the criteria that would lead to a referral, and a willingness among industry players to take soundings on the likely reaction to possible acquisitions and joint ventures. It seems unlikely that the telecoms equipment sector will become a particular source of problems for EU competition rules.

Application of procurement laws to the telecoms sector

The procurement rules aim to increase the effectiveness of the single market by preventing public authorities and utilities from awarding their purchase contracts to national suppliers in preference to other EU suppliers. The rules require government authorities to award their purchase contracts on a competitive tendering basis, provided the contracts are worth more than a certain threshold value. The rules were first extended to the telecoms sector in the 1990 Procurement Directive, and subsequently to the area of services contracts in the 1993 Services Directive.

The directives do not apply to contracts awarded for purposes other than the provision or operation of a public telecoms network or public telecoms service. The contracts must be advertised in the *Official Journal*, and can be restricted to certain suppliers, provided they have been selected on a fair and non-discriminatory basis. The directives make important provisions for the award of contracts to EU suppliers in preference to non-EU suppliers. A TO may legitimately chose to discriminate against a tender where 50% of the total value of the products (including software) originates from outside the EU.

As indicated in Chapter 4, the primary driver of change in the procurement practices of EU TOs is their desire to obtain the best equipment at the best price. If the Procurement Directive were the only measure in place with which to change procurement behaviour, then it would undoubtedly have been more widely and severely tested. Given that the directive needed to strike a balance between, on one extreme, intrusive and bureaucratic involvement with the detail of every contract, and on the other extreme, acquiescence to the perpetuation of opaque and non-commercial practices, the directive appears to have been positioned correctly. A slightly more intrusive drafting may have been more appropriate to the environment between 1990 and 1995, but the existing legislation is better matched to the market conditions over the period 1995 to 2000.

3.4.5. Other general horizontal measures

Standardization measures

The Commission has put in place a number of measures to encourage standardization of technical requirements, irrespective of sector, and thus prevent the erection of technical barriers to trade.

The first of these was issued in 1983, when the Council adopted a directive known as the Technical Standards Directive. The directive called for Member States to notify new draft standards for prior examination, to try to stem the erection of technical barriers between Member States. In the 1985 White Paper the Commission took this a step further, by stating that a product lawfully manufactured and marketed in one Member State should be sold freely throughout the EU. The Commission also recognized the need to address conformity to a set of standards, and in 1990 issued a Resolution setting out the methods by which manufacturers would conform to the standards. This included adoption of the CE mark, which indicated that goods were suitable for all Member States (although there have been some problems with the clarity of guidelines for the CE mark).

In addition to the basic standards directives, a special directive on the compatibility of equipment with electromagnetic devices was issued in 1989. Full implementation of this directive,

which has been delayed until 1996, requires that all electrical and electronic apparatus made, sold or imported by any Member State must not cause or be unduly susceptible to excessive electromagnetic interference. Compliance with the directive will require conformity assessment in a Member State.

One of the main burdens of the standards process on manufacturers has been the conflict between harmonization of standards and the development of intellectual property rights (through patents, etc.) to protect investments in R&D.

Consequently, ETSI has developed a policy for intellectual property rights (IPRs) to ensure that it does not impede the implementation of ETSI standards. The policy requires all members of ETSI to sign an undertaking which commits them to grant licences under essential IPRs, and procedures have been put in place to determine whether licences will be available if a standard is otherwise blocked by IPRs. The undertaking commits members to identify to ETSI, in good faith, any IPR which they own which may be considered essential to a standard, before the standard is adopted. In practice, however, implementation of the policy is very difficult. Many companies are unwilling to identify areas where IPR is an issue, because of the possible subsequent obligations to grant licences, and many are uncomfortable with the provisions of arbitration. Even where there is a clear obligation for a licence, the terms will be hard fought in the courts.

There is an inevitable conflict between the objectives of standardization (openness and ubiquity) and the objectives of the owners of intellectual property (protection of IPR, revenue maximization and control of use). This conflict is apparent in all important standards fora, whether institutionalized (e.g. ETSI, ITU-D, ANSI) or non-statutory (such as the ATM Forum or the Internet Engineering Task Force). The resolution of this conflict involves some compromise between the collective group and the specific interested parties. The extent of compromise depends on the balance of cost and benefit on either side. In the case of ETSI, the compromise appears to favour the owners of IPR, correctly reflecting the balance of power between the collective body and the specific manufacturers. This should not be seen as a failure of ETSI as it accurately reflects their collective best interests. It is not easy to envisage any actions that could materially improve the power of ETSI relative to the owners of IPR without deterring participation in EU telecoms standards formation.

Table 3.2. General measures relevant to telecoms equipment and telecoms services

	Date	Reference
Completing the single market	6/85	White Paper COM(85) 310
Standardization and IPR measures		
Council Directive on procedure for provision of information for technical standards and regulations	3/83	Technical Standards Directive 83/189/EEC
Council Decision on standards for IT and telecoms	12/86	87/95/EEC
Council Directive on electromagnetic compatibility	5/89	89/336/EEC
Council Resolution on global approach to conformity assessment	90	90/C10/1
Council Decision on global approach for testing and certification	12/90	90/683/EEC
Green Paper on standards	92	92/C173/1
Council Regulation on Community trade mark	12/93	EC 40/94
Council Directive and Decision on approximation of the trade mark laws of Member States	12/88, 12/91	89/104/EEC and 92/10/EEC
Data protection measures		
Proposal for a Council Directive on data protection and privacy in public digital telecoms networks	9/90	COM(90) 314
Amended proposal for a Council Directive on data protection	10/92	COM(92) 422
Data communication network measures		
Proposal for a Council Decision on a series of guidelines on data communication networks between administrations, including the IDA programme	3/93	COM(93) 69
Proposal for a Council Regulation on the general rules for granting Community aid in the field of trans-European networks	3/94	COM(94) 62
Taxation measures		
Council Regulation on administrative co-operation in the field of indirect taxation	1/92	EEC 218/92
Council Directives on the uniform basis of assessment for VAT	2/94	94/4/EC and 94/5/EC
Convention on elimination of double taxation	8/90	90/436/EEC
Council Directive on a common system for taxation of mergers, divisions, transfers of assets and exchanges of shares	7/90	90/434/EEC
Business co-operation measures		
Commission proposal for a 10th Directive on cross-border mergers of public limited companies	1/85	COM(84) 727

Impact of data protection measures

The Commission has put forward a number of proposals designed to facilitate the free movement of data while protecting the privacy of the individual. This is particularly important in the context of the development of open networks. The measures require that for protection to be applied, appropriate technical measures need to be taken. The data processor will be required to compensate the subject of the data for any damage caused, unless it can be proved that the necessary security measures had been taken.

A specific proposal was endorsed in 1995 relating to data privacy in the context of public digital telecoms networks. The purpose of the proposal is to ensure that subscribers have the fundamental right to inspect data concerning themselves, and request rectification of inaccurate data. Furthermore, it upholds the right of the calling party to remain anonymous. This would mean ensuring that subscribers linked to a digital exchange are able to prevent identification of their telephone number on the display of the number called, or the recording of their number in a storage facility on the terminal device called.

Impact of EU research programmes

The EU has initiated, funded and administered a substantial portfolio of research and development activities with direct relevance to the telecoms equipment sector. These activities have been funded under the four EU Framework Programmes listed in Table 3.3.

Table 3.3. EU Framework Programmes, 1984 to 1998

	Dates	Total budget (ECU billion)
First Framework Programme	1984 to 1987	3.8
Second Framework Programme	1987 to 1991	5.4
Third Framework Programme	1990 to 1994	5.7
Fourth Framework Programme	1994 to 1998	12.3

Source: DG XIII, European Commission.

The relevant individual R&D Programmes have been:

(a) **RACE**, which concentrated on fundamental R&D in advanced communications technology. The Programme funded a wide range of pre-competitive research and development projects that were run by pan-European consortia of commercial, public sector and academic organizations. Participants shared the costs of each project with EU funding covering 50% of costs on average. The Programme ran in two phases from 1987 to 1995 and involved all of the main European telecoms equipment manufacturers (Alcatel, Ericsson, Matra, Philips and Siemens) as well as most of the PTOs. The transition from the RACE Programme to the successor ACTS Programme occurred in 1995.

(b) **ESPRIT II** (1987 to 1992), which aimed to develop basic technologies for the European IT industry. It worked on the basis of 'contracted research with cost sharing', which meant that participants in the projects had to bear a substantial part of the project costs – usually 50%. Many ESPRIT projects were directly relevant to telecoms equipment.

(c) Unlike RACE and ESPRIT (which concerned basic and pre-competitive research), **EUREKA** and **COST** sponsored projects were nearer to full commercial status. One such project was JESSI (Joint European Submicron Silicon), which focused on the development of 64Mbit/s memories and their applications. JESSI was launched in 1986. It had a budget of around ECU 3.5 billion, and involved 19 European countries and the Commission.

(d) The **TELEMATICS Programme** was concerned with the use of information and communications technologies in applications for the industrial, education, transport and health sectors.

Telecoms equipment manufacturers were well represented as participants in R&D activities undertaken with the support of the EU Framework Programmes, for example constituting 396 of the 842 project participants in RACE; they also took leadership in 53 out of the 92 RACE projects. Table 3.5 shows the participation of the leading European equipment manufacturers in the RACE Programme.

ECTEL, in its response to the DRI survey of trade associations [DRI 1995], noted the importance of single market measures 'promoting innovation', such as the Framework Programmes, in its assessment of the relevance of the single market programme.

Table 3.4. Budgets of European R&D programmes in telecoms and information technologies (million ECU)

	1987-91	1990-94
Information technologies (ESPRIT)	1,600	1,339
Telecoms (RACE)	550	484
New services of common interest	125	106
Total	2,275	1,929

Source: DG XIII, European Commission, Telecommunications in Transition (SAGE Publications, 1994).

Table 3.5. Participation of the main European equipment manufacturers in RACE

Company	Participation (number of projects)	Project leadership (number of projects)
Alcatel	70	15
Philips	30	4
Thomson	23	3
Ericsson	19	3
Bosch Telekom	15	1
GEC	15	0
Siemens	14	1
Nortel/STC	13	3
GEC/Plessey	11	3
Matra	10	1

Source: Telecommunications in Transition (SAGE Publications, 1994).

4. The impact of the single market on the performance of the telecoms equipment sector

4.1. Drivers of change and impacts of change

4.1.1. Drivers of change in the European telecoms equipment sector

The telecoms equipment sector has been undergoing profound technical and structural changes since the early 1980s.[15] The main driver of change has been technology. Two key technologies reached a level of maturity in the 1980s that enabled their use in commercial telecoms products:

(a) Digital integrated circuits achieved levels of functionality and reliability that made it feasible for them to be used in telecoms switches, telecoms transmission equipment and telecoms terminals. The new generation of equipment was much more powerful than earlier equipment (in terms of capacity and functionality), much cheaper to manufacture, and had considerably lower full-life costs.[16]

(b) Optical-fibre transmission systems developed into an affordable, reliable solution for high-capacity transmission requirements. The economics of transporting large volumes of telecoms traffic were radically altered as telecoms operators began to introduce optical-fibre systems in their core networks.

These two developments acted as a catalyst for the whole telecoms equipment industry. The rate of technical change has continued to accelerate since the early 1980s, and has led to rapid innovation in a wide range of fields. For example, integrated circuit technology enabled significant advances in real-time signal processing which were essential for the development of mobile wireless communications systems, one of the most striking technical advances in any field in recent times; and the availability of integrated circuits and associated software has driven the rapid development of transmission protocols such as X.25, SNA, TCP/IP, frame relay, SMDS and ATM. The attributes of these protocols (and their role in manufacturers' product strategies) have been an important determinant of sectoral development.

Given this rate of technological change, it was inevitable that the former stability of the telecoms services and equipment sectors would be disrupted. The cost structures and economic arguments which had previously been used to justify high levels of state involvement and restrictive regulation were dramatically altered. It became clear that a more liberal regulatory environment could be introduced to stimulate the levels of innovation and efficiency which were now necessary.

Figure 4.1 illustrates the main drivers of change in the European telecoms equipment sector which were initiated by the technological acceleration of the early 1980s.

In the early 1980s, it was clear to telecoms equipment manufacturers that technology change would have a significant impact on future equipment cost structures and scale economics, and

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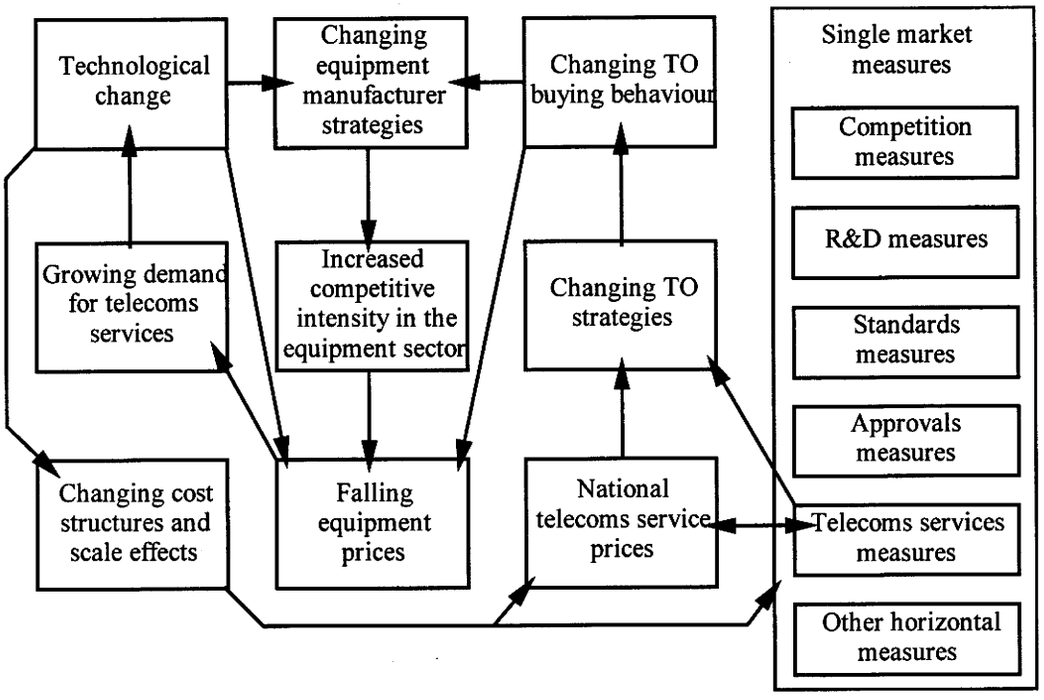
[15] Foreman-Peck and Müller [1988] and others.

[16] Full-life costs include maintenance, operations, consumables, premises and upgrade costs.

important implications for the structure of the equipment industry. The fixed costs of developing and preparing to manufacture a new telecoms equipment product would remain high, but the variable costs of manufacturing the new equipment would fall significantly. The costs of developing a new generation of switch is now estimated to be over ECU 1 billion.[17] The attractions of larger production volumes were therefore significantly increased, and equipment manufacturers entered a period of merger and consolidation in the 1980s in an attempt to access these scale economies. Individual national markets in Europe were not (and are still not) large enough to deliver the maximum scale economies for a number of equipment types (such as switching systems), so the largest manufacturers focused on developing their cross-border operations to gain access to other European markets.

Figure 4.1. Causality diagram for major drivers of change in the European telecoms equipment sector



The major European equipment manufacturers thus became much more ambitious and internationally oriented in the 1980s. This, combined with changes in the telecoms services sector, led to a step change in the competitive environment in most national equipment markets. Operators recognized that they needed to widen their purchasing base if they were to acquire new telecoms products in a timely and affordable manner, and so many former equipment oligopolies and monopolies were diluted in the mid and late 1980s (illustrated in Table 4.1 below), and the diversification of suppliers has continued into the 1990s in most national markets. Technical developments, such as the introduction of mobile communications, synchronous transmission systems and broadband services, have provided equipment suppliers with the opportunities to gain a foothold in national markets.

[17] OECD [1991] and Dang Nguyen [1990].

Table 4.1 shows that several equipment manufacturers had already established themselves as 'multi-domestic' suppliers of switching equipment by 1987 (notably Alcatel, Siemens and Ericsson). In the period to 1995 the coverage of national markets increased, and the presence in the original markets was consolidated. Other manufacturers such as Nortel, Nokia and AT&T also expanded their market coverage. As a result, the average number of switching suppliers in the 12 markets shown increased from 2.5 in 1987 to 4 in 1995. Chapter 5 provides further discussion of the evolution of manufacturers' strategies.

Table 4.1. Public switching suppliers in 12 EU markets, 1987 and 1995

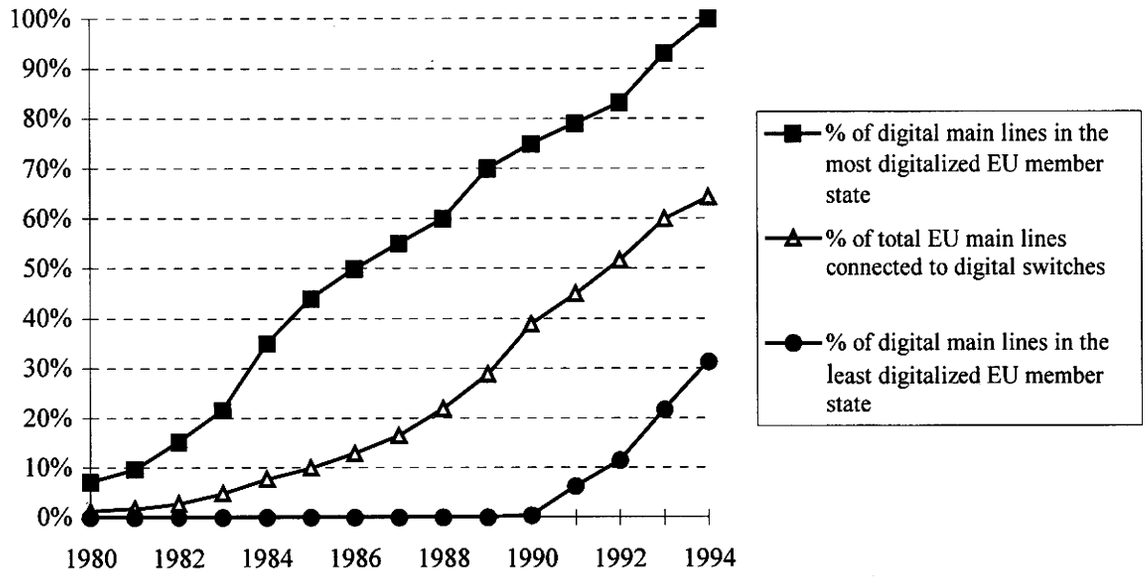
	1987				1995			
	Alcatel	**Siemens**	**Ericsson**	**Others**	**Alcatel**	**Siemens**	**Ericsson**	**Others**
Austria	✓	✓		✓	✓	✓		✓✓
Belgium	✓	✓			✓	✓	✓	✓
Denmark	✓		✓		✓		✓	✓
France	✓		✓		✓	✓	✓	
Germany	✓	✓			✓	✓	✓	✓✓
Ireland	✓		✓		✓		✓	✓✓
Italy	✓		✓	✓✓	✓		✓	✓✓✓
Netherlands	✓		✓	✓	✓		✓	✓
Portugal	✓	✓			✓	✓		
Spain	✓		✓		✓	✓	✓	✓✓
Sweden			✓	✓		✓	✓	✓✓
UK			✓	✓✓		✓	✓	✓✓✓✓

Note: Includes public switching in public mobile networks.
Sources: INSEAD, Analysys.

The significant changes in national telecoms equipment market structures in the 1980s matched the growing investments made by the TOs as they began to replace their analogue switches with digital switches. Figure 4.2 shows the progress of digitalization of telecoms networks in the EU from 1980 to 1994. The peak year for digitalization was 1990, and total EU switching investment levels have declined in real terms since 1990. Most of the contracts necessary for completing digitalization have already been awarded. Once digitalization is completed, the scale of switching contracts in the EU will be substantially reduced, and will be much more skewed towards software rather than hardware sales.

As national administrations became increasingly aware of the need to re-regulate their telecoms sectors to match the new environment of technological change and opportunity, the pressure increased on telecoms operators to optimize their equipment procurement so that they could face future competitive challenges on a sound basis, with world-class equipment purchased at reasonable prices. Although network competition was only introduced in the UK and Sweden during the 1980s, all European operators began to plan on the basis of future liberalization occurring in the unspecified medium term, and this translated into a more assertive and cost-conscious procurement policy (although at a different pace in each country). This change in TO behaviour is the second main driver of change for the European telecoms equipment manufacturing sector (after technological change).

Figure 4.2. Digitalization of EU telecoms networks, 1980 to 1994



Source: ITU.

The gradual transformation of national political positions on telecoms regulation coincided with the most active period in the creation of the European single market. It is impossible to separate the impacts of changes in national telecoms agendas from the progress of single market measures in the telecoms sector. Mechanisms and precedents existed for the 'special treatment' of telecoms matters,[18] and even as late as 1992 it was quite conceivable that the single market programme could have left important parts of the sector relatively untouched (for example, rights to build telecoms infrastructure were not planned to be extended in the 1992 Communication on the Services Review). What actually occurred in the early 1990s was a positive feedback process: the benefits of sectoral reform became increasingly apparent to individual Member States, and the single market programme became the focal point for change, serving as a mechanism for ensuring that reform could be harmonized and synchronized. The momentum of EU-level reforms ensured that individual Member State administrations could maintain the pace of change at a national level.

In 1996 the timetable for re-regulation of telecoms in Europe is clear, secure and increasingly well developed at a detailed level. All European TOs are fully aware of the pressures that they will face in the new environment, and are looking to procure world-class equipment at competitive world market prices (see 4.2.6 below).

It should be noted that these changes in procurement practices are, to a great extent, being implemented in anticipation of single market measures. This is in contrast to many other sectors, where single market measures have not had an impact until the years following their implementation. The pre-emptive actions of players in the telecoms sector can be explained by the size of the players (TOs and equipment manufacturers) and by the asset intensity of the

[18] For example, the identification and preservation of the 'special and exclusive rights' of monopoly telecoms operators with respect to 'reserved services' in the 1990 Services Directive. See Chapter 3 for more detail.

sector. A common analogy is to compare telecoms operators with supertankers, which require a long lead time for decisions on direction and speed.

Figure 4.3 (below) illustrates the causal relationships driving change in the EU telecoms equipment sector. This figure is a more complex version of the simplified causality diagram in Figure 4.1 (above). Appendix B1 discusses these causalities in more detail.

The primary impact of the single market programme on the telecoms equipment sector is indirect, and arises from changes in the behaviour of the telecoms operators, faced with the introduction of competition in their traditional core markets. Figure 4.4 illustrates this distinction between direct and indirect impacts.

The indirect impacts include:

(a) Transformation of the procurement behaviour of TOs. This can be observed in the movement of EU equipment prices towards competitive world market prices. Most EU TOs are now demonstrating a willingness to procure from new and non-indigenous suppliers when the products on offer exceed the functionality of the indigenous offerings. TOs are also placing greater emphasis on international standards rather than national proprietary solutions (for example, in public and private switching, transmission and datacomms procurement).

(b) Erosion of national monopsonies and near-monopsonies for telecoms equipment. New entrants and new distribution strategies are reducing the dominance of the national TOs as purchasers and distributors of telecoms equipment.

Figure 4.3. Detailed causality diagram for drivers of change in the European telecoms equipment sector

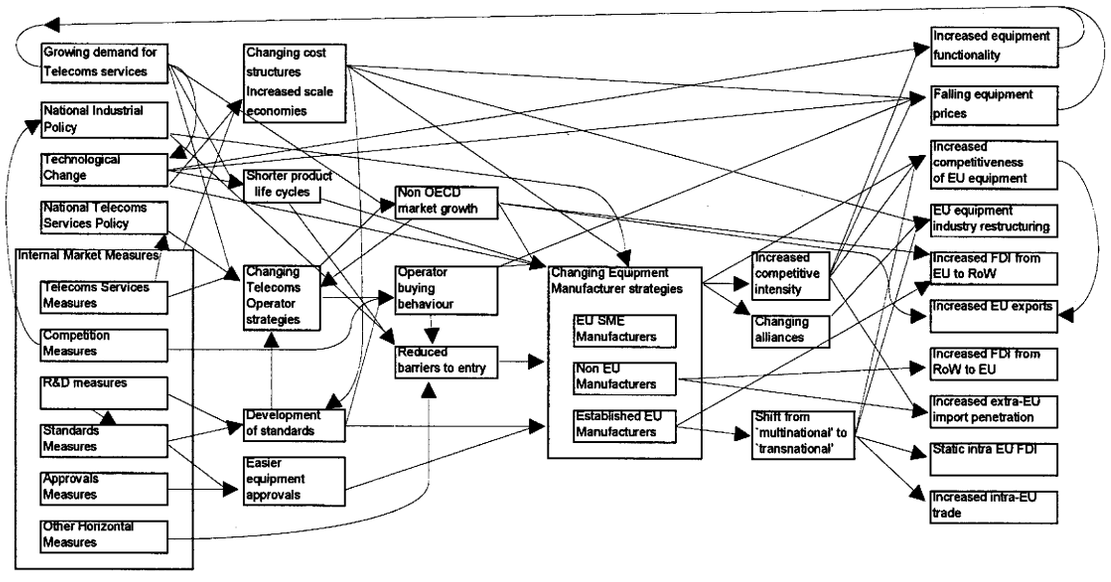
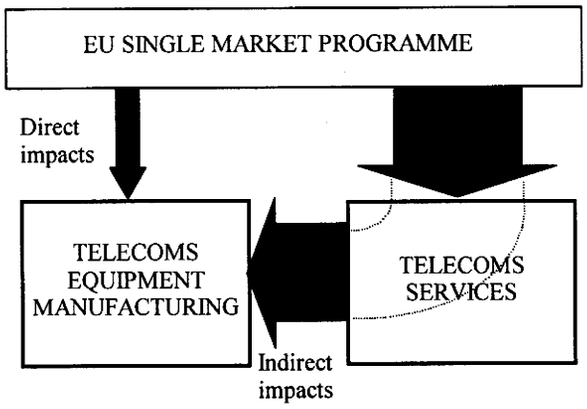


Figure 4.4. The direct and indirect impacts of the EU single market programme on telecoms equipment manufacturing



The direct impacts include:

(a) Removal of national equipment market restrictions, such as restrictions on sales and distribution channels, obstacles to equipment approvals and onerous conditions for the installation and maintenance of equipment.
(b) Assistance to the processes of standards formation and development (via ETSI, R&D programmes and direct measures).
(c) Greater harmonization of radio spectrum planning and usage, including the targeting of frequencies for specific applications, and the harmonization of Member State positions for a clearer EU voice in the wider international context of frequency reservation and allocation.
(d) Stimulation of pan-EU research and development, through the creation, funding and administration of large international research programmes in telecoms and related fields.

The indirect impacts of the single market programme are generic, and tend to affect broad areas of the equipment sector. In contrast, the direct impacts are specific, and tend to have a more localized effect within the equipment sector.

Table 4.2 below describes the role of the single market programme in the reforms of the telecoms equipment sectors in each of the EU Member States, illustrating the acceleration of liberalization in many Member States that followed the 1993 Council Resolution on Telecoms Services Review (6/93).

Table 4.2. The impacts of the single market programme on the telecoms equipment sector in each of the EU Member States

Member State	Comments on the impacts of the single market programme and national initiatives
Austria	Austria tracked EU legislation before its accession to the EU in 1995. EU liberalizing legislation is a key driver of Austrian telecoms sector policy, including policies relevant to telecoms equipment.
Belgium	Belgium was identified as having particularly high equipment price premiums in the mid-1980s (see 4.2.6 below). By 1995, these price premiums had reduced to be close to EU average levels. A significant proportion of the reduction in equipment price premiums in the Belgian market can be attributed to the single market programme. EU legislation has been a key driver of sectoral policy in Belgium, including policies relevant to telecoms equipment.
Denmark	Before 1994, EU legislation was the key driver of the pace of liberalization in Denmark, including policies relevant to telecoms equipment. Since 1994, the Danish liberalization programme has begun to run ahead of pan-EU requirements, developing a strong momentum of its own.
Finland	Finland has liberalized many areas of telecoms ahead of EU requirements, but EU legislation remains an important driver of sectoral policy in Finland, since Finland tracked EU legislation before its accession to the EU in 1995. Finnish equipment manufacturers have benefited substantially from the liberalization and harmonization of EU equipment and service markets.
France	EU legislation has been a key driver of sectoral policy in France, including policies relevant to telecoms equipment. The French market has moved in step with EU reforms and is now significantly more open and competitive than it was before the single market programme began. In some areas, such as satellite licensing, France has run ahead of EU requirements.
Germany	EU legislation has been a key driver of sectoral policy in Germany, including policies relevant to telecoms equipment. As the largest telecoms equipment market in Europe, the implementation of the single market programme in Germany has been of profound significance for the whole of the EU. In 1985, the German telecoms equipment market was one of the most restrictive and expensive in Europe. Over ten years this has changed very considerably, with significant progress on improved equipment approvals, reduced price premiums and a more open approach to equipment procurement by the dominant operator, Deutsche Telekom. The unification of Germany has led to a significant investment programme for telecoms equipment to upgrade networks in the eastern *Länder*. This investment programme has accelerated the rate of reform of the German equipment sector.
Greece	Greece has received a number of derogations to EU telecoms legislation because of the level of development of the sector. Nevertheless, EU legislation has still been the main driver of reform in the sector, including policies relevant to telecoms equipment. There are many single market programme benefits that have yet to be fully realized in the Greek market.
Ireland	Ireland has received a number of derogations to EU telecoms legislation because of the level of development of the sector in Ireland. Nevertheless, EU legislation has still been the main driver of reform in the sector, including policies relevant to telecoms equipment.
Italy	EU legislation has been a key driver of sectoral policy in Italy, including policies relevant to telecoms equipment.
Luxembourg	EU legislation has been a key driver of sectoral policy in Luxembourg, including policies relevant to telecoms equipment.
Netherlands	Before 1994, EU legislation was a key driver of the pace of liberalization, including policies relevant to telecoms equipment. Since 1994 the Netherlands liberalization programme has begun to run ahead of pan-EU requirements, developing a strong momentum of its own.

Member State	Comments on the impacts of the single market programme and national initiatives
Portugal	Before 1994, EU legislation was a major driver of Portuguese sectoral policy. In many areas, Portugal obtained derogations due to the level of development of its telecoms infrastructure. Since 1994, Portugal has planned to liberalize in advance of the timetables required by EU legislation, including reforms relevant to telecoms equipment. This acceleration has been assisted by the successful rationalization and privatization of the national telecoms operators.
Spain	Before 1994, EU legislation was a key driver of the pace of liberalization. Since 1994, the liberalization programme in Spain has begun to run ahead of EU requirements, with plans for a duopoly in 1997.
Sweden	The telecoms sector in Sweden has been amongst the most liberal in the world for several decades. The primary benefit of the EU single market programme to the sector in Sweden has been the harmonization of reforms with the rest of Europe, including policies relevant to telecoms equipment. Sweden tracked EU legislation for several years before its accession to the EU in 1995. Swedish telecoms equipment manufacturing has benefited considerably from the increasing openness of EU equipment markets.
UK	UK sectoral liberalization has run ahead of EU legislation since the introduction of a full service and infrastructure duopoly in 1984. Although this has reduced the directly attributable impacts of the single market programme in the UK, it should be noted that EU harmonization benefits have been important, and the pan-EU liberalization programme has encouraged continuing reform in the UK (such as the recent liberalization of international services and infrastructures). Overseas manufacturers control almost all of the remaining UK equipment manufacturing base, which has received little protection during the years of liberalization. In contrast to the problems of the traditional large UK manufacturers, the UK has a relatively dynamic SME sector in telecoms equipment manufacturing, although this is still small in terms of market share.

4.1.2. Description of the 'Antimonde'

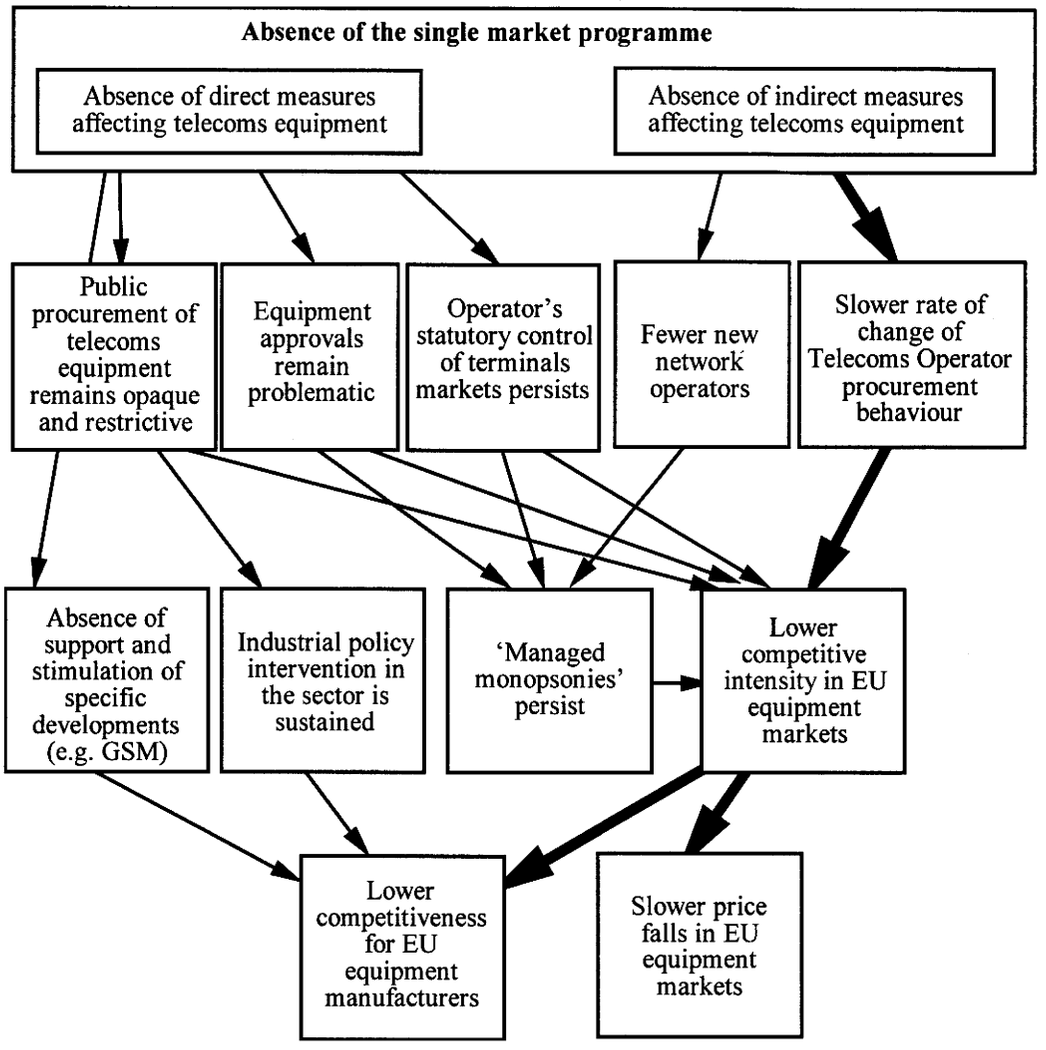
This section describes the main features of an 'Antimonde' in which the single market programme has not been implemented, and draws comparisons with the current state of the EU telecoms equipment sector. It provides a summary of the arguments presented in more detail in Section 4.2 (below).

Figure 4.5. shows the major differences between the Antimonde and the actual course of events, dividing the effects between 'direct' effects on the telecoms equipment sector and 'indirect' effects caused by the impact of measures in the telecoms services sector.

As Figure 4.5 indicates, the major difference between the actual environment and the Antimonde is caused by the absence of measures which have indirect effects on the equipment sector. In the absence of single market measures driving change in the telecoms services sector it is plausible to envisage an Antimonde with the following characteristics:

(a) **Slower rates of change of TO procurement behaviour**, and **fewer network operators**. Even by 1996 there are no clear timetables for the liberalization of reserved services (including voice services) or network infrastructure in most of the EU Member States (France, Germany, Italy, Spain, Belgium, Austria, Portugal, Ireland, Greece and Luxembourg). Several of these states have not yet liberalized non-reserved services effectively. The liberalization timetables in Denmark and the Netherlands are not co-ordinated or harmonized. Sweden, Finland and the UK have liberalized infrastructure

Figure 4.5. Schematic diagram for the Antimonde



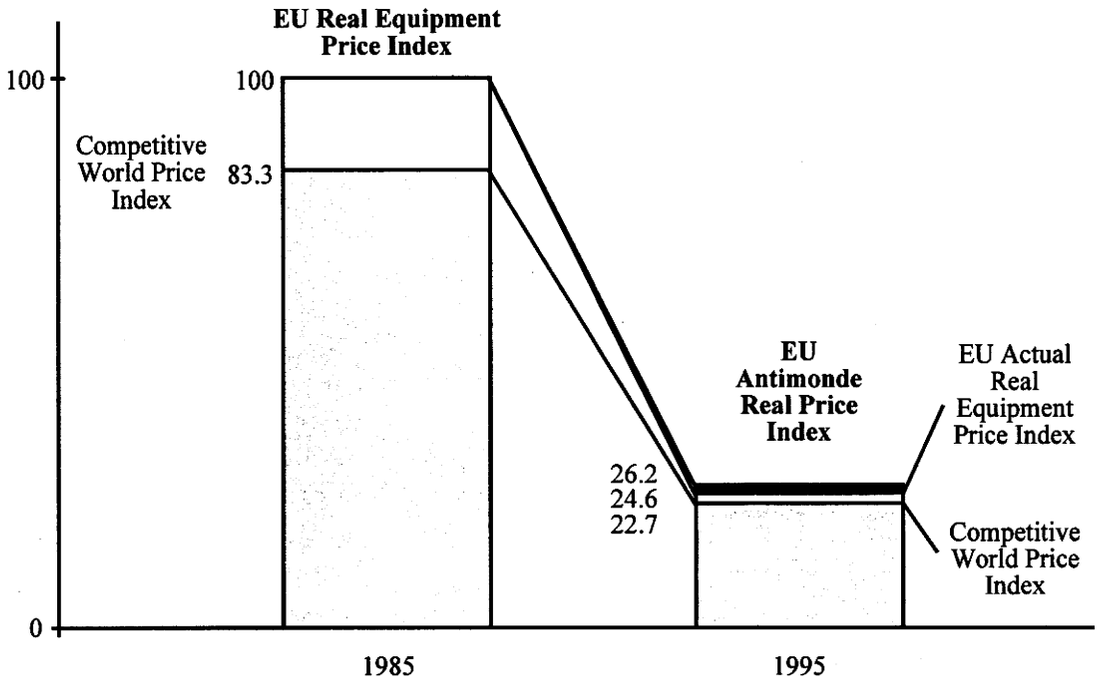
Note: Heavy arrows emphasize the strongest effects.

and services, but all Member States plan to continue to restrict entry into international reserved services and infrastructure.

The overall pace of re-regulation is slow, and re-regulation initiatives are fragmented. There is relatively little prospect of the dominant EU PTOs facing effective competition in their most profitable core businesses, and so their focus on reforming procurement policies is not great.

The overall gap between EU equipment prices and the competitive world price (see 4.2.6) has narrowed from 20% in 1985 to 15% by 1995, due to a certain amount of increased competition in the equipment markets of each Member State. The close relationships which still exist between the PTOs and their traditional domestic suppliers have prevented a more significant reduction in this price premium. The difference

Figure 4.6. The impact of the single market programme on EU telecoms equipment prices



between actual price trends and Antimonde price trends is shown graphically in Figure 4.6.

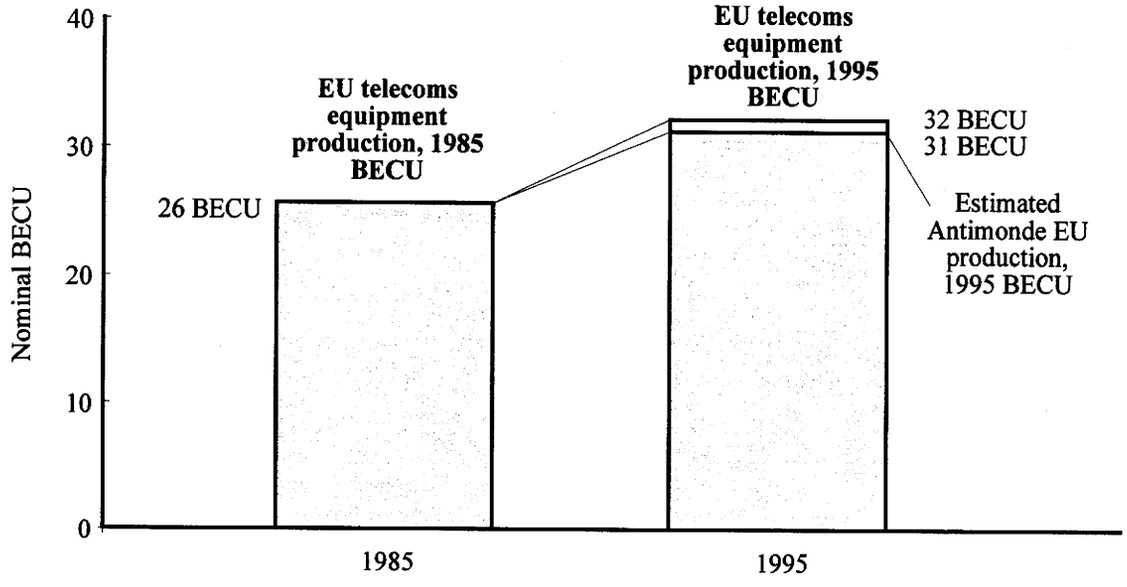
The slower rate of change of telecoms operators' procurement behaviour, combined with other persistent obstacles to trade and market entry, have protected the incumbent manufacturers from competitive threat and allowed them to maintain their market shares and margins without significant difficulty. Levels of competitive intensity in EU equipment markets have therefore not increased significantly since the mid-1980s.

(b) The low levels of competitive intensity in European equipment markets have meant that the multi-domestic strategies of the large equipment suppliers have continued. The inefficiencies of these organizational structures are more than offset by the benefits of maintaining close relationships in each national market with the PTO and the national administration, and supporting these relationships with investments in a local production capability and a local workforce.

The lack of incentives to rationalize these multidomestic structures and replace them with transnational production systems denies the main EU manufacturers access to the full economies of scale that could be achieved, and undermines their competitiveness in the global marketplace. As a result, EU manufacturers' share of the non-EU equipment markets is reduced, most notably in the rapidly growing non-OECD markets, where competition on equipment price and functionality is particularly intense.

Figure 4.7 (below) illustrates the difference between actual EU manufacturers' production and Antimonde production.

Figure 4.7. The impact of the single market programme on EU telecoms equipment production



In the absence of single market measures which have had a direct effect on the telecoms equipment sector, it is plausible to envisage an Antimonde with the following characteristics:

(a) **Public procurement remains opaque and restrictive.** There are no legislative problems for those operators and governments which wish to maintain restrictive and preferential relationships with local equipment producers. The reduced pressure on operators in the Antimonde to reform procurement practices (in the absence of clear timetables for services liberalization) means that many operators fall into this category.

(b) **Absence of support and stimulation for specific developments.** The GSM standard for mobile communications is struggling to compete with US-originated D-AMPS and CDMA standards. A major setback occurred in 1991, when several Member States decided to allocate 900MHz spectrum to relieve congestion in analogue mobile networks rather than to reserve it for GSM. This reduced the confidence of a number of EU equipment manufacturers in the prospects for GSM. One leading manufacturer split its mobile equipment development activity between GSM and a joint venture with a US CDMA proponent. Several Member States decided to license only one GSM operator, either because of frequency shortages or industrial policy concerns.

Production schedules for GSM network systems and handsets were cut back, and the failure to reach expected production volumes resulted in equipment prices remaining high during the early 1990s. A number of Asian and Central European operators rejected GSM systems on the basis of price, choosing US solutions or enhanced European analogue systems instead. None of the US PCS operators selected the GSM standard.

(c) **Equipment approvals remain problematic.** In the Antimonde, European markets are still fragmented by technical incompatibilities and restrictive equipment approvals

procedures. The costs of developing products which can be offered in each EU market have therefore remained high. Smaller manufacturers have tended to restrict their sales and distribution efforts to a small subset of EU national markets. Larger manufacturers can carry the costs of pan-European operations, but are unable to access many of the economies of scale which would come from offering a common product across the whole of the EU. The restricted activities of smaller manufacturers and the inefficiencies imposed on larger manufacturers have limited the increase in competitive intensity in Europe. Although lower competitive intensity has limited the threats to market shares, market prices and manufacturers' margins in their home markets, it has had a negative impact on the competitiveness of EU manufacturers in global markets.

(d) **Operators' statutory control of terminals markets persists**. In the Antimonde, several European states retain the telecoms operator's monopoly over the distribution and sale of handsets, fax machines, private switching and other categories of terminal equipment. This control of the route to market preserves the operator's position of a monopsonist in the terminals market. When combined with the absence of public procurement reform and the continuing obstacles to equipment approvals, this results in the suppression of competition, innovation and price reduction in many European terminals markets.

It should be noted that some progress towards European telecoms liberalization is made in the Antimonde. As indicated above, liberalization at national level proceeds in some Member States, notably the UK, Sweden, Finland, Denmark and the Netherlands. In the mobile communications sector several Member States license competing operators in the Antimonde, and most national markets also proceed with the liberalization of data services.

Figure 4.8. The virtuous circle of national and EU-level reforms in the telecoms sector

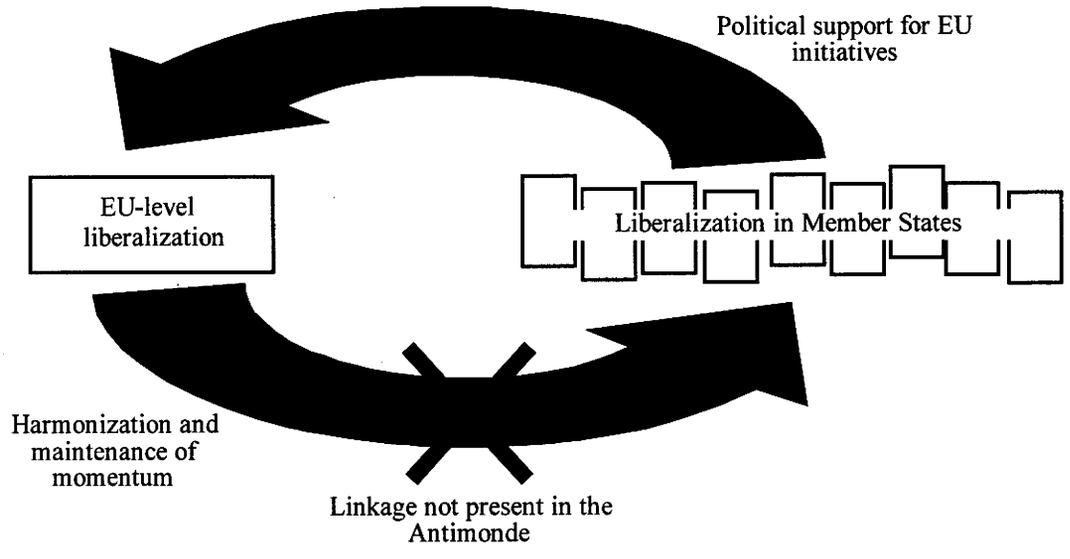


Figure 4.8 illustrates how the Antimonde breaks the virtuous circle of reforms. Much of the

acceptance of reforms that can be seen in the actual environment at national level in the mid-1990s can be attributed to the momentum created by the single market programme at EU level.

In summary, there are several striking differences between the actual condition of EU telecoms manufacturing in 1996 and the Antimonde. In the absence of the single market programme EU telecoms equipment would be more expensive, and EU manufacturers would be less competitive in global terms. It is reasonable to ascribe significant credit for these differences to the single market programme, although the manufacturers themselves should, of course, be given credit for their responses to the opportunities and challenges created by the single market.

4.2. Assessment of specific single market impacts

This section addresses each of the eleven categories of single market impact specified in the brief for the study:

(a) upstream and downstream linkage effects (4.2.1),
(b) competitiveness and productivity effects (4.2.2),
(c) scale and scope effects (4.2.3),
(d) market access effects (4.2.4),
(e) direct production costs effects (4.2.5),
(f) evolution of final prices (4.2.6),
(g) competition and concentration effects (4.2.7),
(h) cross-border sales and marketing effects (4.2.8),
(i) FDI and location effects (4.2.9),
(j) employment effects (4.2.10),
(k) effects on consumers (4.2.11).

Table 4.3 illustrates the grouping of these eleven categories into 'primary impacts' and 'impacts on observable parameters'. The primary impacts are the causes of the changes in the observable parameters. The major linkages are summarized in Table 4.4.

Table 4.3. Eleven categories for assessing the impact of single market measures

Primary impacts	Level of impact	Impacts on observable parameters	Level of impact
Upstream/downstream linkage effects (4.2.1)	High	Evolution of final prices (4.2.6)	High
Competitiveness and productivity effects (4.2.2)	Moderate	Competition and concentration effects (4.2.7)	Moderate
Scale and scope effects (4.2.3)	Moderate	Cross-border sales and marketing effects (4.2.8)	Low
Market access effects (4.2.4)	Moderate	FDI and location effects (4.2.9)	Low
Direct production cost effects (4.2.5)	Low	Employment effects (4.2.10)	Low
		Effects on consumers (4.2.11)	Moderate

Table 4.4. Major relationships between primary effects and impacts on observable parameters

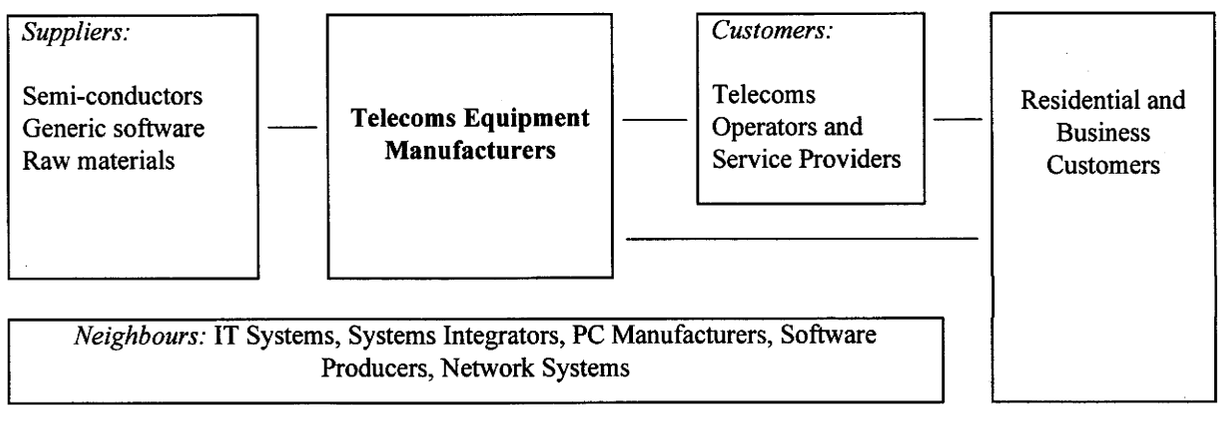
Observable parameters / *Primary effects*	Evolution of final prices (4.2.6)	Competition and concentration effects (4.2.7)	Cross-border sales and marketing effects (4.2.8)	FDI and location effects (4.2.9)	Employment effects (4.2.10)	Effects on consumers (4.2.11)
Upstream/ downstream linkage effects (4.2.1)	↑	↑	↑	-	↑	↑
Competitiveness and productivity effects (4.2.2)	↑	↑	↑	-	↑	
Scale and scope effects (4.2.3)	↑	↑	↑	-	-	↑
Market access effects (4.2.4)	↑	-	↑	↑	-	
Direct production cost effects (4.2.5)	↑	-	-	-	-	

Note: Dark arrows indicate a strong linkage, lighter arrows indicate a weaker linkage.

4.2.1. Upstream and downstream linkage effects

This section assesses the impact of the single market programme on the value chain linkages of the telecoms equipment industry. Figure 4.9 illustrates the main 'upstream' and 'downstream' linkages for the telecoms equipment sector.

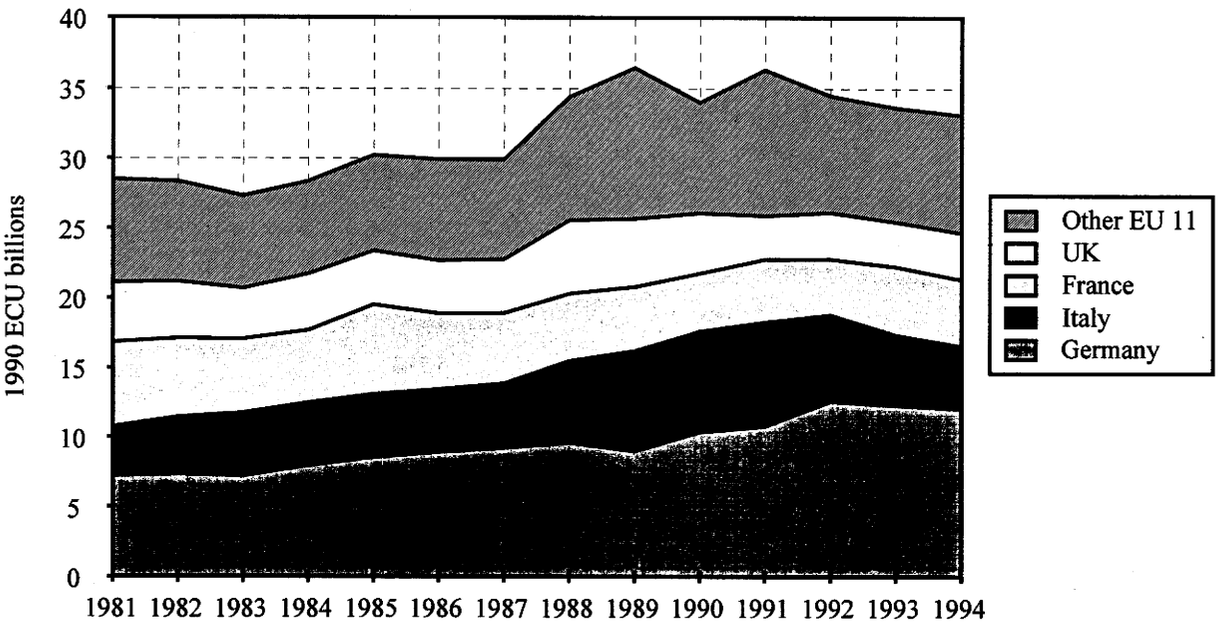
Figure 4.9. A simple value chain for telecoms equipment manufacturers



Telecoms operators purchase around 80% of the output of the telecoms equipment manufacturers. Correspondingly, telecoms equipment represents a large proportion of the capital expenditure of the TOs. In the EU, four operators account for over 70% of all TO capital expenditure (Deutsche Telekom, France Telecom, Telecom Italia and BT), and the ten

largest operators accounted for over 90% of European TO capital expenditure in 1994. In a market with such a concentrated demand side, the impact on equipment manufacturers of changes in the purchasing behaviour of TOs is very high. Figure 4.10 (below) illustrates the variation of TO capital expenditure since 1981 in real terms, showing that real capital expenditure has risen at a rate of only 1.2% compounded annually over the period.

Figure 4.10. Capital expenditure by EU telecoms operators, 1981 to 1994, in 1990 ECU billion



Sources: ITU, OECD, Eurostat exchange rates and deflators.

The single market programme has had three major effects on the value chain linkages of the telecoms equipment manufacturers:

(a) **Transformation of the procurement behaviour of TOs.** Moves towards the creation of a competitive EU single market for telecoms services have focused the attention of European TOs onto their equipment procurement activities. As a consequence, there has been a steady reduction in the gap between EU equipment prices and competitive world market prices (see 4.2.6 below). The willingness to procure equipment from new and non-indigenous suppliers has steadily increased. Operators have placed a greater emphasis on procuring equipment which is compatible with international standards rather than national proprietary solutions.

Public Telecommunications Operators, the main consumers of European telecoms equipment:

(i) will no longer pay artificially high prices as a subsidy to national manufacturers;
(ii) are prepared to play suppliers off against each other in order to drive down prices;
(iii) will generally not buy equipment from national suppliers that is not state-of-the-art;
(iv) will deal with any reputable and capable supplier, regardless of its size or origins;
(v) require equipment to be delivered on time, and ready to use;

(vi) prefer to procure complete solutions (systems) rather than 'boxes';
(vii) require future-proof systems rather than obscure proprietary systems;
(viii) wish to avoid many of the development costs which they formerly shared with manufacturers.

A survey of EU telecoms equipment trade associations confirmed these conclusions, finding that 'traditional close relationships between national equipment suppliers and national service providers are loosening'.[19]

This changed approach to procurement has proceeded in parallel with the implementation of public procurement measures which forbid many former practices such as closed tendering and explicit patronage of national manufacturers. However, these public procurement measures cannot be said to have caused the change in procurement practices – TOs now buy on a more commercial basis because their own environment has become more commercially orientated.

(b) **Erosion of national monopsonies and near-monopsonies for telecoms equipment.** New entrants and new distribution strategies are reducing the dominance of the national TOs as purchasers and distributors of telecoms equipment. The increased openness of the demand side of the equipment market increases the opportunities for foreign entrants and for SME entrants (both foreign and indigenous). These changes have been made possible because of a combination of direct single market measures to remove restrictions on market access (see 4.2.4 below), and the indirect effect of single market measures on the telecoms services market. The re-regulation of the sector encourages new entrants – initially in non-reserved services (1990), then in non-reserved infrastructure (1996) and, in 1998, in reserved services and infrastructure. Analysys [1996] estimates that new entrants will account for around 20% of equipment purchases in Europe by the early years of the next decade, although it should be noted that most of these new entrants are partly owned and controlled by other TOs.

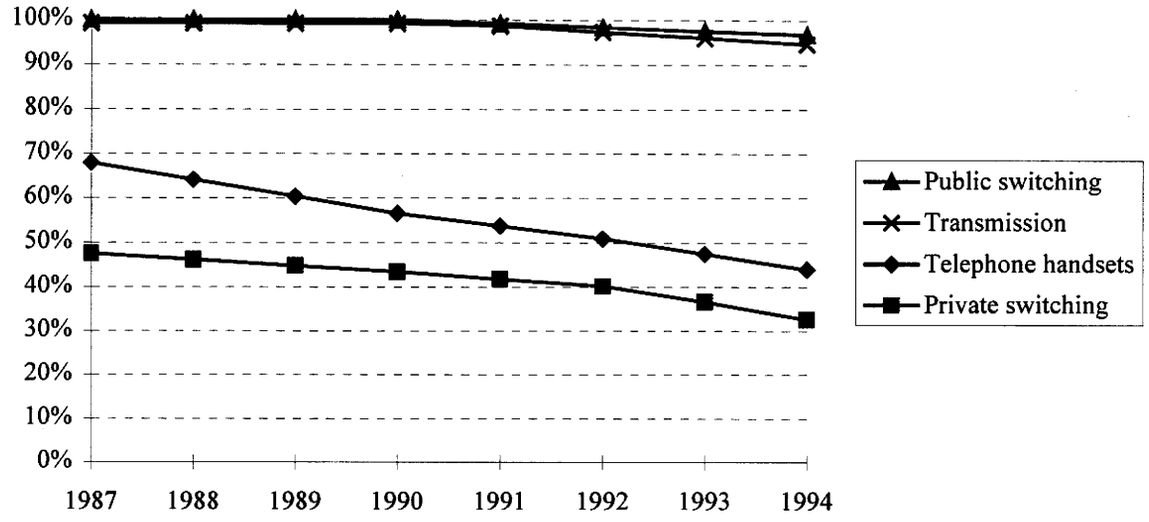
Figure 4.11 illustrates the reduction over time of the share of total telecoms equipment procurement that is purchased by the TOs. TOs' dominance of the value chain for terminal equipment (such as private switching, handsets and fax machines) is reducing, but their strength as distributors and retailers is based on good fundamental positioning, and they will remain the most attractive channel for terminal equipment, except where this is prohibited by regulations.

(c) **Reduced levels of state intervention to aid or protect indigenous equipment manufacturers.** EU competition policy now prevents many of the former interventionist practices which characterized national industrial policies in the telecoms equipment sector in the 1980s and earlier. However, the main reason for the reduced level of intervention is a realization among national administrations that the benefits of these policies do not justify harming the performance of the national TO (by

[19] DRI [1995], p. 155.

maintaining artificially high equipment prices or preventing the TO from having access to the full range of equipment available on the global market).[20]

Figure 4.11. Average PTO share of purchased telecoms equipment for the five largest EU national markets, 1987 to 1994



Sources: MZA and Analysys.

These three categories of change have had a significant effect on telecoms equipment manufacturers:

(a) The increased competitive intensity in national equipment markets has led to an acceleration of equipment price reductions (see 4.2.6 below) and consequent pressure on margins for many manufacturers (see 4.2.7 below).
(b) The opportunities have increased for those manufacturers which have been able to achieve and maintain competitiveness, through the control of costs and through product innovation (see 4.2.2 below).
(c) Manufacturers have embarked on significant strategic initiatives, in order to restructure themselves for the new market conditions (see Chapter 5 below).

It should be noted, however, that none of the larger manufacturers has yet suffered a serious loss of market share to new entrants in the most established switching and transmission segments (see 4.2.7 below); their strategy has been to defend their market share by absorbing price reductions. This strategy has been successful in the traditional activities of public switching and transmission equipment, but it has been less successful in ensuring a share of the market in growth areas such as mobile networks and terminal equipment.

In contrast to the significant impact which the single market has had on the telecoms equipment industry's relationships with its customers, the impact on 'upstream linkages' has been very small, even though the relationship between telecoms equipment manufacturing and key component manufacturing (notably integrated circuits) is extremely important for the development of both activities:

[20] See Neven [1994] for an interesting analysis of patterns of state aid.

(a) **Integrated circuits**. The single market programme has not yet had a significant effect on Europe's weak position in commodity or custom integrated circuits. The health of the European telecoms equipment sector has, however, been a significant boost to Europe's custom integrated circuit sector, by driving demand and product development. Several of Europe's telecoms equipment manufacturers are also active in integrated circuits, notably Siemens.[21]

(b) **Software**. Again, the telecoms equipment sector has provided significant support for Europe's generally undersized software sector, but the single market programme has not materially affected equipment manufacturers' relationships with their software suppliers. It should be noted that a high proportion of the software in all categories of telecoms equipment is generated in-house by the manufacturers themselves.

(c) **Cable**. The single market programme does not appear to have materially affected the relationships between the telecoms equipment manufacturers and their suppliers of metallic cable and wire or fibre-optic cable. Again, many manufacturers are fully integrated into these areas of production (e.g. Alcatel and Siemens).

(d) **Electronics subassemblies**. No material single market programme effects have been identified in this area.

(e) **Wireless subassemblies**. No material single market programme effects have been identified in this area.

(f) **Production and test equipment**. No material single market programme effects have been identified in this area.

(g) **Satellites**. The liberalization of the European satellite services market has not yet brought any observable improvement in the position of the European space systems manufacturers, who continue to face formidable US competition. Again, many telecoms equipment manufacturers are also integrated with satellite manufacturing (e.g. Alcatel, Matra, Bosch and GEC).[22]

This study has thus not established any strong causal links between the single market programme and the relationships between equipment manufacturers and their suppliers.

The Antimonde for upstream and downstream linkages

In the absence of key single market measures, the rate of change in the procurement strategies of most European TOs would have been much slower. Without the prospect of full competition on the horizon, the pressure on TOs to reform their procurement practices would be less intense. Some Member States would undoubtedly have pressed forward with re-regulation of telecoms services in the absence of pan-EU reforms (see 4.1.1 above), but this kind of fragmented and patchy reform process would have had much less impact on the telecoms equipment market than has actually been seen in the EU. The implications of this slower rate of transition are lower competitive intensity (see 4.2.2 below) and slower price falls (see 4.2.6 below).

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[21] See Zysman and Borrus [1994] for an assessment of the linkages between the telecoms equipment and electronic components sectors.

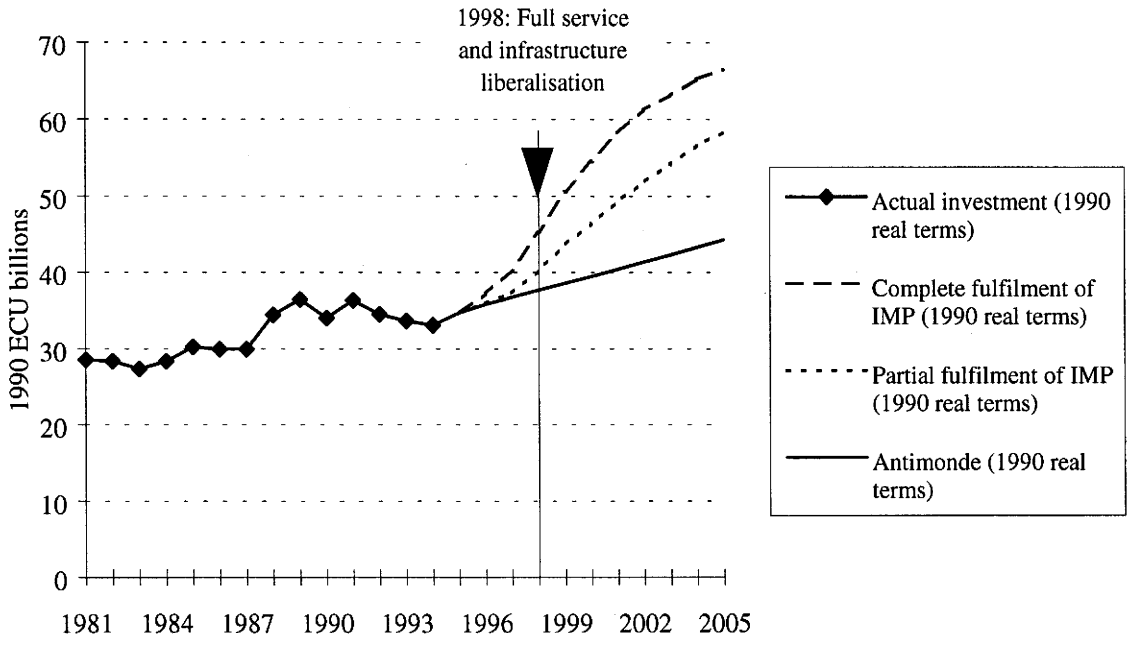
[22] See Analysys [1993], KPMG [1994] and Neven, Roller and Waverman [1993] for further treatment of satellite sectors.

It is not possible to conclude with any certainty whether the value of demand for telecoms equipment from telecoms operators in the Antimonde would have been higher or lower than the trend illustrated in Figure 4.10 (above). The persistence of higher prices in the Antimonde would compensate for reductions in the volumes of equipment purchased, and so it is probable that total expenditure on telecoms equipment by telecoms operators would have been similar to the historical trend. Analysys [1992] predicted only small differences in TO capital expenditure for 1994 between a full implementation of the single market programme and a suspension of the single market programme.

However, the levels of TO capital expenditure in the Antimonde are expected to diverge considerably in coming years. Analysys [1992] predicted that TO capital expenditures in a scenario of continued single market programme implementation will be 50% higher than in the Antimonde. Analysys [1996] predicts that TO capital expenditure will be between 30% and 50% higher than in the Antimonde, depending on the degree of development of the single market programme from 1996 onwards. These predictions are illustrated in Figure 4.12 below.

Real growth in TO capital expenditure as an impact of the single market programme will have a strongly positive impact on equipment manufacturers, provided that they have the products and prices which enable them to capture a significant share of this expenditure. It should be noted that much of this incremental demand is expected to be for equipment which is not currently classified as telecoms equipment (see Appendix B2.1), such as routers, hubs and servers. These are all areas where traditional telecoms equipment manufacturers (European and non-European) are weak, and struggling to compete.

Figure 4.12. EU telecoms operators' capital expenditure, 1981 to 1994 and projected 1995 to 2005, all in 1990 ECU billion



Note: IMP refers to Internal (Single) Market Programme.
Sources: Historical data from ITU (adjusted), projections from Analysys [1996] based on Analysys [1992].

Conversely, in the Antimonde, equipment manufacturers would continue to face relatively flat EU equipment markets, with lower levels of demand-side innovation and an increasingly poor platform from which to project products into global markets.

Summary

In summary, the single market programme has had a significant impact on the telecoms equipment sector, by altering the demand side of the European equipment market. The primary effect of the changes which have occurred has been to speed up the rate of equipment price falls in Europe (an issue which is addressed in 4.2.6 below). Other studies indicate that the single market programme may be the enabler of significant growth in demand for equipment in the future, which would be potentially beneficial to EU equipment manufacturers.

4.2.2. Competitiveness and productivity effects

This sub-section addresses the impact of the single market programme on the competitiveness and productivity of the EU telecoms equipment manufacturing sector. The impacts on competitiveness are considered first, followed by the impacts on productivity. Appendix B1.3 provides a more thorough description of the various approaches taken to assess competitiveness, and Appendix B1.4 addresses productivity assessment.

Single market measures have contributed to the global competitiveness of European telecoms equipment manufacturers in two ways:

(a) by increasing the competitive intensity of the domestic markets of European manufacturers, and accelerating the development of a large integrated pan-European market;
(b) through specific contributions to individual developments, such as GSM and ISDN, which have improved the competitive positions of European manufacturers.

ECTEL, in its response to the DRI survey of trade associations [DRI, 1995] noted that 'the increased competition within the EU brought about by single market measures has increased the global competitiveness of the EU industry'.

The single market programme has increased the competitive intensity of European equipment markets by altering the procurement behaviour of the dominant customers of telecoms equipment manufacturers, the national TOs (see 4.2.1 above), by accelerating the breakdown of the managed national monopsonies of the TOs (4.2.1), and by removing most of the artificial restrictions on market access (4.2.4). The most important of these effects is the first, the change to TO procurement behaviour.

In the new environment, European equipment manufacturers are required to increase their focus on controlling costs, improve their product development performance (in terms of speed and direction) and upgrade their sales, marketing and product support processes. Progress in these areas is having a positive impact on the competitiveness of EU manufacturers in global terms. It should be noted that most manufacturers are inclined to play down the importance of single market measures (and other exogenous factors) in contributing to these changes; understandably, they prefer to emphasize endogenous corporate drivers for change.

A similar difference of views exists over the importance of several of the specific single market measures which have contributed to the competitiveness of EU manufacturers in particular areas:[23]

(a) **Measures to improve the harmonization of radio spectrum in the EU.** This study concludes that measures to rationalize and harmonize pan-European spectrum assignment have made an important contribution to the success of the GSM standard in European and world-wide mobile communications markets (see Appendix A3). On this basis, it is reasonable to attribute to the single market programme some share of the credit for the huge improvement in EU competitiveness which is resulting from the success of GSM, although it should be noted that the success of GSM has depended on a large number of fortunate and timely inputs from TOs, equipment manufacturers, national administrations and other bodies. Delay or failure in any of a number of activities could have undermined the achievement of objectives for GSM.

(b) **Assistance in standards formation.** Single market measures were important in establishing mechanisms for European standards formation (notably ETSI). However, there are very mixed views within the industry on the effectiveness of these mechanisms. This study concludes that it is not possible to quantify the impact on EU competitiveness of measures to assist with standards formation, although it is acknowledged that there are many individual impacts in this area which are positive in qualitative terms (for example, work on the V.5 interface, work on standards for Intelligent Networks (IN), network management (TMN) and ISDN supplementary services).

(c) **Stimulation of pan-European R&D.** The many critics of RACE, ESPRIT and other R&D initiatives related to the single market programme tend to undervalue the benefits to EU integration that have occurred as a result of this work. These R&D programmes have created a significant number of effective working relationships between organizations and individuals across the EU, many of which have developed beyond their EU-assisted origins. This study concludes that the impact of such initiatives on the competitiveness of EU equipment manufacturers is positive, but not readily quantifiable.

Table 4.5 summarizes the contribution of the single market programme to the competitiveness of EU manufacturers in a number of illustrative equipment categories.

Evidence for the increasing competitiveness of EU equipment manufacturers can be found by examining the relevant indicators (although as Appendix B1.3 indicates, there are problems with all of these indicators of competitiveness):

(a) EU external exports and external trade balance in telecoms equipment are increasing steadily. Since 1988, EU external exports have grown at a compound rate of more than 12% per year (see Figure 4.13). This indicates that EU manufacturers are able to compete more effectively in world markets than was the case in the mid-1980s.

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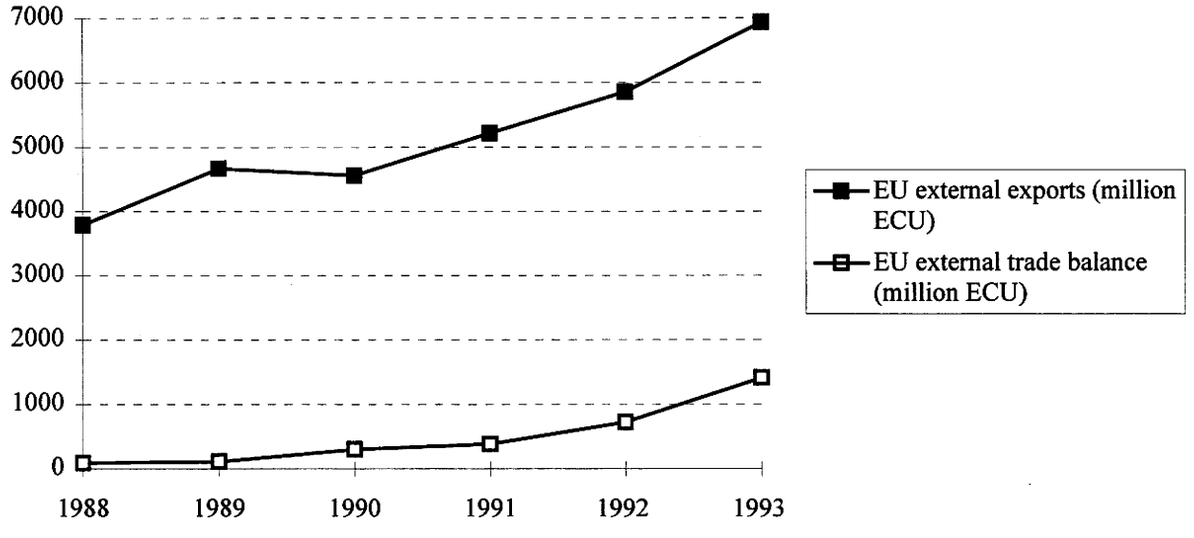
[23] For examples of sceptical views on the effectiveness of single market measures in the telecoms sector see trade press journals such as *Public Network Europe* (for example, October 1991, May 1992, November 1993, October 1994, October 1995 and the PNE 1995 Yearbook).

Table 4.5. The contribution of the single market programme to the competitiveness of EU manufacturers in a selection of equipment categories

Equipment category	Competitiveness of EU manufacturers	Contribution of the single market programme to competitiveness
Public switching	Good	Important indirect contribution
Transmission equipment	Good	Important indirect contribution
Mobile network systems	Very good	Important direct and indirect contribution
Mobile terminals	Very good	Important direct and indirect contribution
Datacomms equipment	Generally poor	Little impact
Fax terminals	Poor	Little impact

Figure 4.13. EU external exports and trade balance for telecoms equipment, 1988 to 1993 (million ECU)



Source: Panorama 95/96. Figures before 1988 are not on a comparable basis.

(b) EU equipment prices have fallen rapidly, and the price premium (relative to competitive world prices) has been significantly reduced since the mid-1980s (see 4.2.6 below). This indicates that EU manufacturers have had to become increasingly competitive in price terms in their domestic market and other European markets, and supports other evidence (from specific contracts) that EU manufacturers are able to price competitively in non-EU markets.

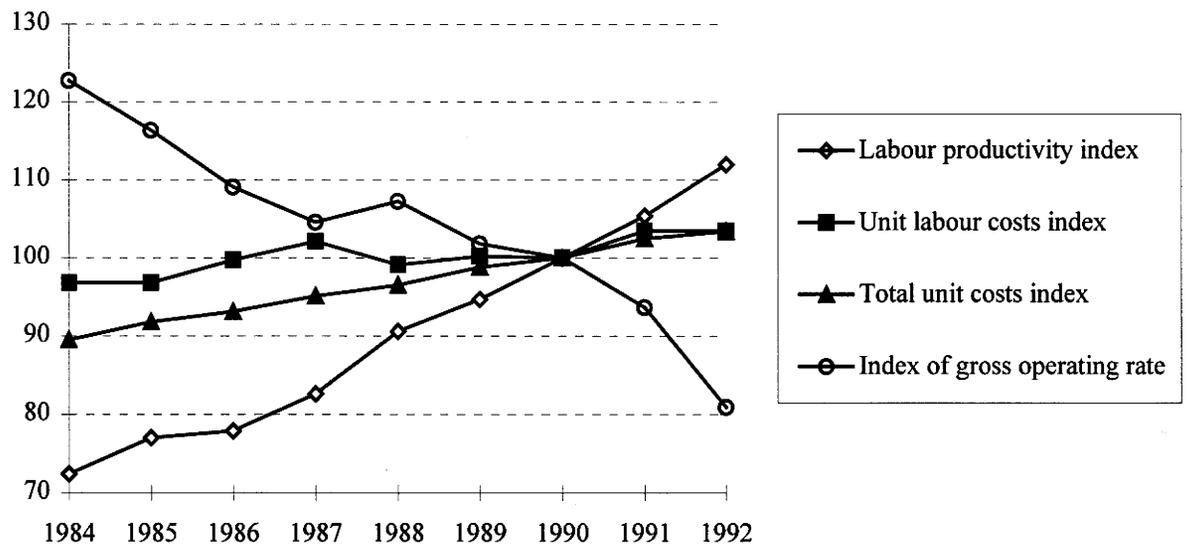
(c) EU equipment manufacturers are being reasonably successful in defending domestic market share, even though this is at the expense of reduced margins (see 4.2.7 below). This indicates that the competitiveness of their products and prices is improving. It should be noted that there are several equipment categories where the competitiveness of EU manufacturers is poor, and where EU markets are subject to significant import

penetration (for example, in wide-area datacomms equipment categories such as routers and hubs).

Although there is considerable evidence (and a reasonable consensus) that telecoms equipment is one of the few EU industrial sectors where the current level of global competitiveness is adequate, there is much less robust quantified evidence for the role of the single market programme as a contributor to this trend. However, an assessment of the qualitative causal arguments (see 4.1.2, 'Description of the Antimonde' above) leads this study to conclude that the single market programme has made a significant contribution to overall EU equipment manufacturer competitiveness. The consequences of this positive impact on competitiveness are assessed in 4.2.8 (below).

There are no strong, testable hypotheses linking the single market programme to changes in the productivity of EU equipment manufacturers.[24] Even though it appears that labour productivity has improved steadily in the sector over the past decade, there are counter-indicators for total cost productivity and the aggregate gross operating rates[25] (see Figures 4.14 and 4.15 below). The dramatic changes in equipment functionality, production cost structures and equipment prices (see 4.2.5 and 4.2.6 below) make it extremely difficult to interpret productivity statistics in the sector over the past decade.

Figure 4.14. Productivity and cost index trends for EU telecoms equipment manufacturing, 1984 to 1992 (1990=100)

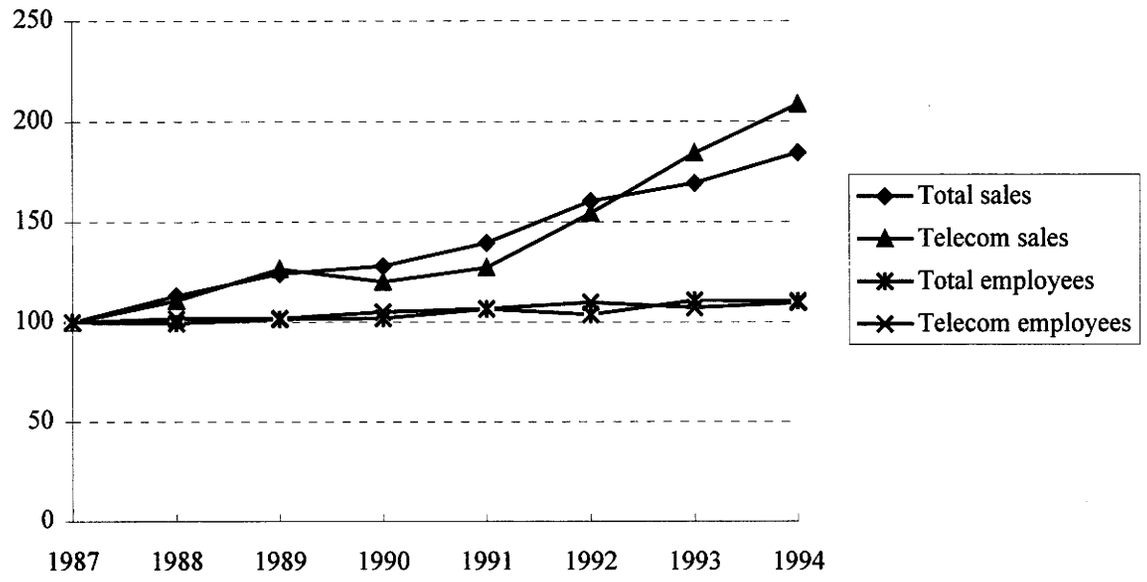


Source: Panorama 95/96 (DEBA).

[24] See Appendix B1.3.

[25] Although it is not a direct indicator of productivity, gross operating rate is included here because of the weakness of the available direct indicators. (In a more stable competitive environment, increasing productivity would tend to be accompanied by an increasing gross operating rate.)

Figure 4.15. Employee and sales trends for five large EU telecoms equipment manufacturers, 1987 to 1994 (1987=100)



Source: Annual Reports.

4.2.3. Scale and scope effects

This section addresses the impact of the single market programme on the economies of scale and scope that exist in telecoms, and its impact on the ability of EU manufacturers to gain access to these economies. The section is descriptive rather than analytical, due to the unfeasibility of disaggregating quantified single market effects from other effects in a way that could provide robust conclusions for the sector as a whole.[26]

There are increasingly significant underlying economies of scale for many categories of telecoms equipment, and the ability of manufacturers to gain access to these scale economies is clearly an important determinant of their competitive strength. The corporate strategies of equipment manufacturers in the 1980s and 1990s have been largely driven by the need to access economies of scale (see Chapter 5). Scale economies are increasing because of the following trends:

(a) **Increasing product development costs**. The increasing sophistication and complexity of telecommunications equipment continues to increase new product development costs, research costs and product improvement costs. Product development costs are fixed, and almost independent of production volumes, and therefore have a significant impact on the scale economies.

(b) **Increasing software content**. Software development costs are largely independent of production volumes and therefore increase the scale economies that are available. For a growing number of product categories, the software content accounts for almost all of the value-added. Examples include network management systems, intelligent network

[26] Appendix B2.5 describes the constraints for analysing the impact of the single market on economies of scale.

systems, billing and subscriber management systems, many transmission products and many datacomms products.

(c) **Increased content of customized integrated circuits**. The costs of designing and preparing to produce custom integrated circuits are largely independent of the ultimate volume of production (within certain bounds). Products with a high content of custom integrated circuits (such as switching systems, transmission systems, mobile terminals, many advanced terminals (e.g. set-top boxes, fast faxes, modems) and many datacomms products) demonstrate significant economies of scale. It should be noted, however, that the use of standardized integrated circuits (processors, memory, and converter chips) is increasing in some applications, for example in switching and transmission products. The costs of standardized integrated circuits relate much more closely to the volumes used.

(d) **Increased cost of production assets**. For some equipment categories, the cost of production equipment is significant, and thus affects the scale economics of the product. Examples include optical fibre production assets, printed circuit board production assets and displays production assets.

(e) **Increased learning-curve effects**. The variable costs of production for many complex products is observed to reduce as the cumulative volume of unit production increases. This is due to the accumulation of expertise in the characteristics of the product and the production system, and the translation of this expertise into reduced unit costs. The learning-curve effect can represent an increased benefit from higher volumes of production that is equivalent to a scale economy. It is expected (and anecdotally verified) that learning curve effects occur in the telecoms equipment sector (for example, in mobile handset production and the production of other advanced terminal products).

(f) **Reduced mechanical and electro-mechanical content**. The converse of increased value-added from software and integrated circuits is reduced value-added from mechanical and electromechanical components, which exhibit much lower scale economies.

The creation of an EU single market for telecoms equipment has had a beneficial effect on the ability of EU manufacturers to achieve levels of production that match the opportunity for scale effects. However, the impact of the single market programme is difficult to separate from the other drivers of scale and scope effects, and the attribution of benefits to the creation of a single market is therefore largely subjective. There are two mechanisms by which the single market programme has improved the opportunities for EU manufacturers to access scale economies:

(a) **Increasing market size**. The removal of restrictions on market access and harmonization of markets (see 4.2.4 below) effectively enlarges the market for an individual equipment product, and enables scale economies in product development, manufacturing and distribution to be accessed without incurring significant customization or replication costs.

(b) **Increasing manufacturers' confidence about the size of the market and their likely share**. In order to achieve scale economies it is (in general) necessary to anticipate future market size and invest in production systems that deliver the benefits of scale. The risks of such investments are reduced if the manufacturer is confident that the market for his product will develop in a predictable way. Standards play an important

role in increasing manufacturers' confidence in this respect (consider, for example, the impacts of ATM standards, GSM standards, G3 fax standards). The single market programme has contributed to standards development in the EU. Secondly, the manufacturers' perception of their own competitiveness is an important part of the decision to invest in 'high scale' production systems. The single market programme has contributed to the competitiveness of EU manufacturers in a variety of ways (see 4.2.2 above), and thus improved the likelihood of EU manufacturers deciding to invest in higher volume production systems, rather than forego scale benefits by planning for more modest volumes.

Table 4.6 summarizes the assessments of this study with respect to economies of scale and scope:

Table 4.6. Summary of scale and scope assessments for each equipment category

	Underlying potential for economies of scale	Underlying potential for economies of scope	Impact of the single market programme on EU manufacturers' ability to access economies of scale
Public switching	High, growing	Moderate, declining	Moderate
Transmission equipment	High, growing	Moderate, declining	Moderate
Terminal equipment	Moderate, growing	Low	High

Public switching equipment has high economies of scale that are continuing to grow as development costs increase and software content grows. European switch manufacturers' recognition in the early 1980s of the scale economics of digital switching systems led to the consolidation of EU switch manufacturers that took place over the remainder of that decade. The 'multi-domestic' production systems that resulted from this consolidation (see Chapter 5) were denied economies of scale in the production of switches (which remained fragmented on national lines) but gave access to economies of scale for the development of new products. It has taken many years, however, for these economies of scale to be realized. (As recently as 1989, Alcatel was manufacturing three distinct but overlapping lines of public switch for European markets.)

Public switching has reasonable economies of scope with transmission equipment, but decreasing economies of scope with respect to terminals. There is certainly no economy of scope with the non-telecoms activities of most of the large public switching manufacturers (e.g. power, transportation) and the apparent economies of scope with respect to defence electronics and space systems are not easy to realize in practice.

The single market programme has contributed to the environmental changes that are now enabling the large public switching manufacturers to move away from their multi-domestic strategies towards more rational and integrated systems of production. However, it is not possible to credit the single market programme with having a major impact on the ability of EU public switch manufacturers to access economies of scale.

Similar arguments apply to the production of **transmission equipment**. The transition from PDH to SDH transmission systems is reducing the linkages between transmission technologies and the services that are carried over the network, reducing the economies of scope in this area.

Terminal equipment generally exhibits lower scale economies because average product development costs are lower than for switching and transmission systems. However, advanced terminal equipment production has more significant scale effects (for example, in mobile handsets, video communications terminals, 'set-top boxes' and advanced fax terminals). Historically, the economies of scope for terminals manufacturers have been relatively low, and it remains to be seen whether economies of scope exist between, for example, terminals and desktop computing manufacturing (IBM, Compaq), terminals and software development (Microsoft and Oracle), or terminals and integrated circuit production (Intel).[27]

The single market has had a significant impact on the ability of terminals equipment manufacturers to access the economies of scale that are available. Two effects are apparent:

(a) Smaller terminals manufacturers are now able to sell into a reasonably harmonized EU market place, thus increasing their volumes without incurring the costs of addressing fragmented national markets (see case study in Appendix A.3 below). Previously these costs would have prevented such manufacturers from operating at a pan-European level. The sector level impact of this effect is very small because of the low share of smaller manufacturers, but this will change over time, and the harmonization and integration of EU markets are creating an environment in which future innovations from small manufacturers are more likely to be able to achieve viable scale in an acceptably short time period.

(b) The larger terminals manufacturers were not prevented from operating at a pan-European level by the costs of addressing fragmented markets, but the lack of technical harmonization between markets reduced the level of scale economies that were available. Full technical harmonization will not be achieved for some years in many parts of the terminals markets, because of legacy effects and legislative time-lags. However, the technical harmonization of many new products is being driven at a global level, and for these new products a reasonably integrated EU market is occurring from 'day one'. Examples of such products include IP routers and other IP terminals and devices, ATM products, GSM voice and data terminals and others.

It is probable that improved access to the available economies of scale have contributed to EU manufacturers' ability to sustain the equipment price falls that are described in Section 4.2.6 (below).

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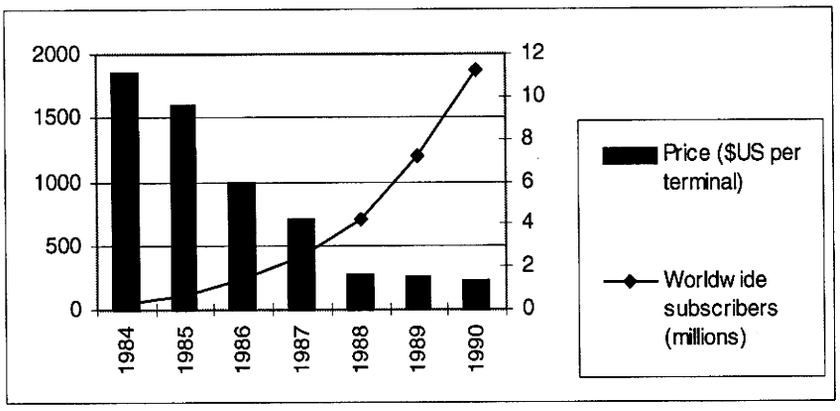
[27] *Note on economies of scope*: Although there are synergies between many activities in the telecoms equipment sector which could be described as economies of scope, this study offers no hypotheses that the single market programme has materially altered either the nature of these economies of scope or the ability of EU manufacturers to take advantage of these effects. For example, there is an apparent economy of scope between the production of digital switching systems and digital transmission systems. If the single market programme enabled a switching manufacturer and a transmission manufacturer to combine in some way which gave them access to these scope economies, this would register as a single market impact. However, we can find no material examples in the sector that follow this model.

The following exhibits are included to illustrate the extent of economies of scale in telecoms equipment, focusing on mobile terminals.

Figure 4.16 illustrates the decline in competitive world price for an analogue mobile terminal from 1984 to 1990, and the growth of subscribers over the period. Over a period where subscribers increased by a factor of 37, nominal terminal prices fell by 88%.

Figure 4.16. Competitive world market price for car telephones (unsubsidized retail market price, nominal US$, 1984 to 1990)



Sources: Mobile Communications International (1993) and ITU.

Table 4.7 illustrates the impact of expansion of the mobile handset market over the past five years for Ericsson and Nokia. The mobile handsets sector, as represented by the two leading mobile communications suppliers in Europe, has expanded rapidly during the first half of the 1990s, in terms of both employees and sales. Over a five-year period, turnover has increased fourfold and employment has more than doubled in the handset manufacturing businesses of Ericsson and Nokia. Ericsson announced in October 1995 that a further 8,000 employees would be transferred to its mobile communications division to address the rising demand for mobile equipment. Ericsson and Nokia will have gained access to significant scale economies and learning curve benefits through their efforts to address a European and global market, and this effect has been materially aided by the EU single market programme.

Table 4.7. Ericsson and Nokia mobile handset sales and employees, 1989 to 1994

	1989	1990	1991	1992	1993	1994
Ericsson, handset business:						
Sales (million SKR)	3,441	3,932	4,419	6,434	11,051	14,580
Employees	10,142	12,084	12,340	12,979	16,486	20,938
Sales per employee (000 SKR)	339	325	358	496	670	696
Nokia, handset business:						
Sales (million FIM)	-	1,004	1,275	1,857	3,410	5,672
Employees	-	3,500	3,160	4,223	7,554	-
Sales per employee (000 FIM)	-	287	403	440	451	-

Source: Annual reports.

In summary, the single market programme is having a positive effect on the ability of EU telecoms equipment manufacturers to access the scale and scope economies that are available. However, the impact of the single market in this area cannot be decoupled from the many other factors that are relevant, and the contribution of the single market in this area can only be assessed at a subjective and qualitative level.

4.2.4. Market access effects

Measures taken to improve market access

The single market programme has focused considerable attention on the removal of barriers which have prevented EU suppliers from gaining access to the other national markets of the EU. Table 4.8 identifies the areas where measures have been implemented that are directly relevant to the removal of such barriers to access in EU telecoms equipment markets.

The combined effect of these measures has been to remove the many procedural, legislative, technical and financial barriers to market access that existed in most EU national telecoms markets before the single market programme. (See Section 3.1 (above) for an assessment of these barriers, and 3.3 for an assessment of the remaining obstacles.)

However, even though the single market measures are successfully clearing away these obstacles, the impact of these changes on the sector had, by 1996, not been dramatic (see 4.2.7 and 4.2.8 below). It would be unreasonable to expect to observe dramatic shifts in market share or market structure in the five years since the first key measures were enacted, but it is also necessary to consider a number of factors which have obscured and reduce their impact on the sector.

Table 4.8. Single market measures of direct relevance to telecoms equipment market access

	Dates of key measures	Incorporation of key measures into Member States' national law
Public procurement measures	1990	1990-92
Terminal equipment measures	1988	1989-92
Measures to eliminate intra-EU trade tariffs	1980-92	1980-92
Measures to harmonize EU telecoms standards	ongoing	not applicable
Measures to harmonize EU electrical standards	1980 to present day	not applicable
Measures to harmonize national legal and fiscal environments	1980-ongoing	1980-ongoing

Factors obscuring and reducing the impact of improved access

The following factors have influenced developments in the network equipment sectors (e.g. switching and transmission):

(a) The major players in these sectors were sufficiently large and well resourced to overcome the former obstacles to market access by developing 'multi-domestic' manufacturing strategies (see Chapter 5 below). This has diminished the early impact of increased market access, although elimination of the requirement for multi-domestic manufacturing

is allowing these players to implement new strategies which are more commercially driven and more efficient.

(b) The relationships between a network operator and his major network equipment suppliers are particularly close, for a range of technical and operational reasons. Even in a fully competitive environment with common equipment standards, these relationships cannot be terminated or initiated without significant risks, costs and time-lags. Operators require a compelling technical or commercial reason before they will add a manufacturer to their supply base. Equipment from a newly selected supplier is generally phased in gradually, over many years, in order to reduce the risks. For these reasons, it will take many years for the impact of changes in market accessibility to be observed in market share data.

(c) It is relatively straightforward for an incumbent network equipment supplier to defend his market position by reducing equipment prices and improving the level of service he offers when competitive threats appear as a consequence of increased market access. The impact of this defensive strategy is seen in lower margins, which are increasingly undermining the financial performance of many national equipment manufacturers in the EU (including those which form part of multi-domestic organizations). However, the defensive strategies of the incumbents do delay the impact of market access measures on measurable parameters such as market share.[28]

(d) The overriding restrictions on access to national network equipment markets were not procedural, legislative, technical or financial, but were rooted in national industrial policy. Throughout Europe, the purchasing policies of the monopoly public TO were strongly influenced by the political objectives of protecting and promoting employment in the national equipment manufacturing sector, and maintaining capabilities in 'strategic' industries such as switching and transmission. The breakdown of these political barriers to access is having a far greater impact on the equipment manufacturing sector than the direct single market measures which removed the procedural, legislative, technical and financial barriers. This also makes it very difficult to identify separately the impacts of the direct single market measures.

The single market programme's improvement of market access is particularly important for the terminals equipment sector, where non-EU imports are much more significant than imports of switching or transmission equipment, and where most of the small and medium-sized EU telecoms equipment manufacturers are active. Although a qualitative assessment of the impacts of these changes indicates that the obstacles to access have been significantly reduced (see Section 3.1), the following factors have obscured and reduced the observable quantified impact of market access measures:

(a) The TOs have a strong position in the value chain for most terminal equipment in each national market. Although the legal barriers to market access have been removed, it is difficult to compete with a TO which controls the main distribution channels for equipment (including equipment rentals). Many terminal equipment manufacturers find it more straightforward to supply to the TO, rather than attempt to serve the market directly. This factor has obscured and reduced changes in market share and market structure caused by the single market measures to improve market access.

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[28] Market share loss is relatively easy to measure and could be more easily attributed to improved market access, whereas declining margins and profitability are part of a more complex set of causalities, and it is more difficult to disaggregate market access effects.

(b) Non-EU manufacturers have a very important role in many areas of the EU terminal equipment market (for example, they dominate the manufacture of fax machines, and are important component suppliers). The non-EU share of the terminal equipment market is estimated to be around 25%, excluding non-EU component supply.[29] A high proportion of non-EU terminal equipment is, however, supplied via EU intermediaries (such as TOs, agents and distributors) who still operate on a national basis, even though the same equipment is available across the EU. These features of the terminal equipment value chain have reduced the impact of single market accessibility measures.

(c) Even though smaller EU manufacturers are more active in the terminal equipment sector than in switching or transmission equipment, their share of the market is still negligible, so the benefits to individual firms of improved market access cannot be seen at aggregate levels (see also 4.2.5, Direct production cost effects).

The combined effect of these factors has been significantly to reduce the observable impacts that can be directly attributable to single market measures to remove barriers to market access. Sections 4.2.7and 4.2.8 below discuss the scale of these effects in quantified terms.

The Antimonde for market access

This subsection attempts to envisage a world where the measures identified in Table 4.8 (above) had not been enacted, and to compare this Antimonde with the current situation:

(a) In the absence of measures to reform public procurement, most TOs could, if they wished to, still procure equipment in an opaque and discriminatory manner from their national manufacturers. However, in the Antimonde, most TOs would still face growing competition in the services market, and also have to satisfy increasingly demanding (private) owners. They would be looking to purchase the best equipment at the best price, and would no longer have incentives to subsidize inefficient suppliers and accept uncompetitive equipment. On this basis, the Antimonde would still see a major upheaval in the purchasing behaviour of TOs.

(b) In Member States where industrial policy interventions were still an important factor in telecoms equipment purchasing, the 'multi-domestic' strategies of the leading equipment manufacturers would, in the Antimonde, survive for longer than would otherwise be the case. The painful transition from 'multi-domestic' to 'transnational' strategy could be delayed, although in the actual environment, these transitions are not yet close to completion, so the difference between the Antimonde and the current situation would not be significant.

(c) Without the introduction of measures to liberalize terminal equipment it would undoubtedly be more difficult to obtain approvals for equipment in many national markets, and the only route to market would be via the national TO. Many SMEs which are currently benefiting from cheaper, quicker and easier approvals for their equipment would have been deterred from their efforts in the Antimonde. However, in the actual current environment SMEs have yet to make a significant impact on the sector, and TOs still dominate the value chain for terminal equipment (even though their legal monopolies on distribution have been removed). In overall terms, therefore, the Antimonde would not be significantly different from the current situation.

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[29] *Source*: Estimate for 1992 based on Elsevier [1994] and European Information Technology Observatory [1995].

In summary, in an Antimonde where the telecoms equipment market access measures had not occurred, the structure and performance of the EU equipment sector would not be significantly different from the world as it really is today, although the inefficiencies resulting from the absence of these measures would be a justified target of criticism and concern.

Summary

Although there are many specific examples of improved market access which can be directly linked to single market measures (particularly in the area of equipment approvals), these do not yet amount to a measurable change in the structure of any subsector of the EU telecoms equipment market, or an attributable change in the performance of the sector.

This conclusion should not be interpreted as a failure of the identified measures. The main legal and administrative barriers to market access have been successfully removed, but the main driver of change in EU telecoms equipment markets is the transformation of purchasing behaviour among the national TOs, which have increasing freedom from many of the former industrial policy constraints and are facing the rigours of competition and private ownership (see 4.2.1 above). It is inevitable that, in the period under study, these fundamental changes should overshadow the direct impacts of single market measures designed to improve market access.

4.2.5. Direct production cost effects

This sub-section addresses the impact of single market measures on production costs, excluding cost changes which are due to scale or scope effects. Scale and scope effects are addressed in Section 4.2.3 above, and market access costs are addressed in Section 4.2.4.

Although a wide range of specific and horizontal measures in the single market programme have focused on matters relevant to production costs (see Table 4.9 below), and many of these measures have had a positive impact for small manufacturers, these measures have not had a measurable effect on actual production costs measured at a sectoral level, because of the domination of the sector by large firms.

The reasons for the low observable impact of the single market programme on telecoms equipment production costs are summarized below:

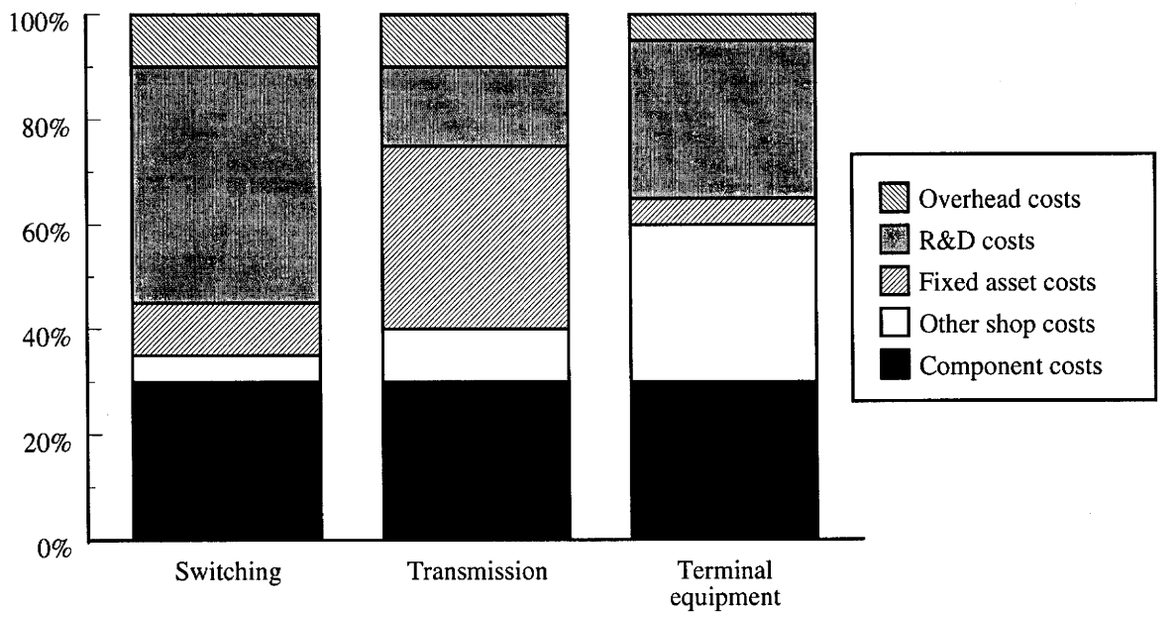
(a) The large European equipment manufacturers had already organized their production to avoid many of the costs imposed in the absence of the single market (such as tariff costs), and so single market measures have only a limited effect on such costs.
(b) Smaller manufacturers, which are more vulnerable to the imposition of additional costs, and which benefit most from the elimination of such costs, represent only a small portion of the telecoms equipment sector.
(c) The mix of production costs for telecoms equipment (see Figure 4.17 below) is not particularly well matched to the areas where single market measures would be expected to have the biggest impact. For example, the intra-EU trade in components is not particularly significant, so the elimination of internal tariffs and duties only has a limited impact (see also Table 4.10 below).

ECTEL, in its response to the DRI survey of trade associations [DRI, 1995], noted that 'the single market has not had a fundamental impact on costs'.

Table 4.9. Single market measures of direct relevance to telecoms equipment production costs

Measures	Date of measure	Incorporation into Member States' national law
Framework Programmes for R&D	1984-ongoing	not applicable
Measures to eliminate intra-EU trade tariffs	1980-92	1980-92
Measures to reduce EU tariffs on imported components and production equipment	ongoing	ongoing
Measures to improve labour mobility	1980-92	not applicable
Measures to harmonize EU telecoms standards	ongoing	not applicable
Measures to harmonize national legal and fiscal environments	1980-ongoing	1980-ongoing

Figure 4.17. Approximate breakdown of production costs for different equipment types



Source: Analysys estimates.

Table 4.10. The relative importance of the single market programme for specific categories of production cost

	Labour and materials costs	Fixed costs	R&D costs	Overhead costs
1 Increase of European competition	Low	Low	Low	Medium
2 EU R&D programmes	Low	Low	Medium	Low
3 European standardization	Medium	Medium	Medium	Medium
4 International market prices for components	High	High	Low	Low

The impact of single market measures on telecoms equipment production costs is also obscured by the major changes in telecoms equipment cost structures which have occurred in recent decades. Even if this study had expected to find significant production cost effects from the single market programme, these effects would have been difficult to observe against a background of such changes. The changes in production costs can be attributed to the following causes:

(a) Significant changes in the production cost mix, such as the increased importance of software, R&D and fixed asset costs for most equipment categories.
(b) Significantly increased economies of scale, caused by the nature of the changes in the production cost mix given in (a) above (see 4.2.3. above).
(c) Increased competitive intensity in the global telecoms equipment market (see 4.2.7 below), leading to shorter product life cycles and requiring shorter product development cycles. These changes alter the rate at which development costs must be recovered, and also exert strong pressure on manufacturers to reduce their up-front development costs.
(d) Several of the important areas of impact for single market measures are extremely difficult to observe in quantifiable terms. The impacts of pan-EU research programmes and assistance to standards formation are subtle and diffused, and are not amenable to credible quantitative analysis.

The initiation, funding and administration of pan-European R&D activities has made a significant contribution to breaking down the national boundaries dividing telecoms research and development in the EU. It is not feasible to quantify the impact of these initiatives on EU R&D effectiveness or costs, but on a qualitative basis the impact is assessed as positive.

Similarly, although the quantification of production cost savings for smaller equipment producers is difficult at the sectoral level, the benefits for individual small firms are apparent, and important. Appendix A2 provides a case study illustrating this observation, and also highlighting the costs of non-integration that remain as a burden for small producers. Although the actual level of savings will vary considerably depending on the size, products and target markets of each firm, the major categories of production cost savings for small firms arising from the impact of the single market programme are:

(a) cheaper, quicker and more predictable approvals processes;

(b) reduced costs of bureaucracy for cross-border sales (an effect of horizontal measures);
(c) technical harmonization, reducing the need to re-engineer products for different national markets.

Although there is significant scope for further cost reductions for small firms in each of these areas, the focus for activity should be acceleration of the implementation of existing single market measures, rather than the introduction of new measures.

4.2.6. Evolution of final prices

This subsection addresses the impact of the single market programme on telecoms equipment prices in the EU. Appendix B1.2 provides more details on the methodology used in this section.

EU telecoms equipment prices before the single market programme

In the mid-1980s, before the main elements of the single market programme had been established, it was generally accepted that European telecoms equipment prices were considerably higher than 'competitive world prices'[30] (prices in the US domestic telecoms equipment market were used as the benchmark for competitive world prices). Figure 4.18 illustrates one set of price premium estimates for 1985.

The key features of EU telecoms equipment pricing in the mid-1980s were as follows:

(a) Average EU equipment prices were estimated to be approximately 50% higher than 'competitive world prices' (US domestic telecoms equipment prices), with various caveats concerning the comparability of different prices.[31] Cecchini [1988] postulated that an average premium of 20% might be more accurate because of the caveats concerning equipment comparability and the arrangements for funding of research and development costs in the US market.
(b) Significant price differences existed between European national markets for each category of telecoms equipment, confirming that the European market was strongly partitioned into distinct national markets.

Telecoms equipment price information is not, in general, available in the public domain. The most reliable guide to industry prices is a synthesis of informed industry opinions and such contract information as is available. This was the approach used in the studies referenced above. However, it should be noted that this approach to price assessment cannot provide precise information, and should be treated with some caution.

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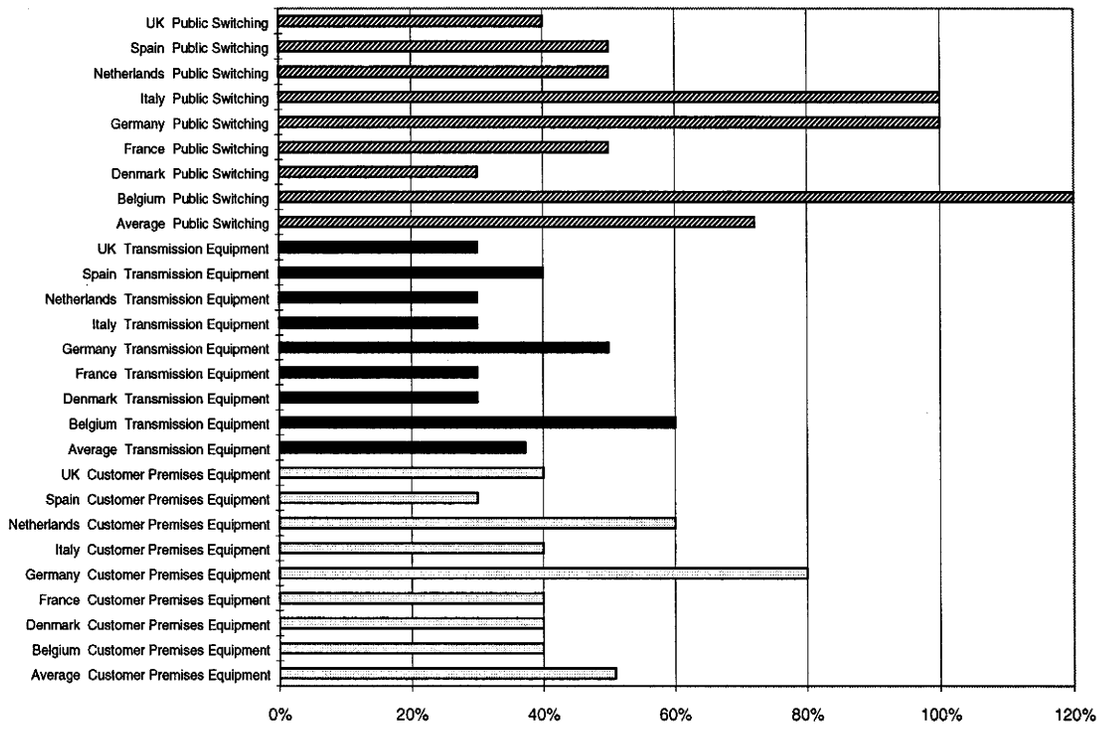
[30] INSEAD [1988] and Cecchini [1988].

[31] Equipment functionality varied significantly (but not consistently) between European and US markets; it was difficult to compare contract terms, and the inclusion of research and development costs in equipment prices was also treated differently in several markets.

Figure 4.18. Estimated EU telecoms equipment price premiums relative to competitive world prices, 1985



Source: INSEAD [1988].

World telecoms equipment price trends since the mid-1980s

Although prices in all telecoms equipment categories fell dramatically over the decade 1985 to 1995 it is necessary to examine price trends in equipment categories individually in order to understand the considerable increases in equipment functionality which have occurred in many areas:

(a) **Switching equipment.** Taking US domestic prices as the 'competitive world price', the median price per switched line of switching equipment has fallen from approximately ECU 420 (in 1995 terms, ECU 280 in 1985 terms) to approximately ECU 170 in 1995 (see Table 4.11). This corresponds to a compound reduction of 8.6% per year in real terms. The fall in per-line prices was compounded by a shift from smaller switches to larger switches over the period. Further complexity arises from the growth of concentrators and remote access units which feed traffic into larger centralized switches. The functionality of switches grew dramatically over the period, with a steady increase in the range of features which are included in the product specifications.

Table 4.11. Estimated change in competitive world switch prices (per line), 1985 to 1995 (1995 ECU)

	1985	1995	CAGR (real)
Maximum price per line	508	190	
Minimum price per line	373	150	
Median price per line	420	170	-8.6%

Sources: Analysys, Dataquest, Yankee Group (1987), industry contacts.

(b) **Transmission equipment.** The competitive world price per channel[32] of transmission equipment has fallen even more rapidly than the unit price of switching equipment (see Table 4.12). However, it should be noted that price per channel is not a particularly satisfactory measure for price comparisons because of the dramatic increase in transmission capacity that has been made possible by the combination of high-speed electronics and optical-fibre systems. Actual expenditure on a typical transmission equipment transaction has fallen at an estimated real compound rate of approximately 9% per year, with a dramatic increase in the capacity which is purchased. Lower, but still significant, rates of price reduction can be estimated for terrestrial microwave and satellite transmission systems.

Table 4.12. Estimated change in competitive world transmission prices, 1985 to 1995

	1985	1995	CAGR (real)
Typical system capacity (Mbit/s)	140	2,400	
Typical system capacity (channels)	1,900	30,000	32%
Typical world market price (nominal ECU)	250,000	150,000	-5%
Equivalent price per channel (nominal ECU)	132	5	-28%
Equivalent price per channel (1995 ECU)	196	5	-31%

Sources: Analysys, Nortel/STC, industry contacts.

(c) **Customer premises equipment.** The CPE market is too diverse, stratified and volatile for a robust summary analysis of competitive world price trends, but analysis of individual equipment types indicates that prices fell rapidly over the period 1985 to 1995. Price falls have been most marked for the more expensive equipment categories with the highest electronics and software content. Table 4.13 illustrates price falls for two such products.

[32] Originally the unit of transmission capacity was the 'voice channel', which has now been superseded by the '64kbit/s channel', even though a 64kbit/s channel can carry several voice channels.

Table 4.13. Illustrative change in competitive world prices for two terminal types, 1985 to 1995

	1985	1995	CAGR (real)
Fixed voice 'feature' terminal, indicative retail price (nominal ECU)	150	50	
Fixed voice 'feature' terminal, indicative retail price (1995 ECU)	224	50	-14%
Mobile voice terminal (TACS), indicative wholesale price (nominal ECU)	1,500	75	
Mobile voice terminal (TACS), indicative wholesale price (1995 ECU)	2,240	75	-29%

Sources: Analysys, MZA.

In addition to the traditional equipment categories, there are many important equipment types which did not exist in a recognizable form in the mid-1980s. Prices for digital mobile telecoms systems (handsets, base stations and management systems) are falling very sharply at the same time as significant functionality improvements are being achieved. New datacommunications products such as routers, hubs, modems and PC cards have followed a similar trajectory of falling world market prices and rapidly expanding functionality. Network management systems have emerged as a distinct product category, and, in common with most software-based products, have become steadily cheaper and more powerful.

In overall terms, the competitive world price for telecoms equipment is estimated to have fallen by approximately 40% in real terms between 1985 and 1995, although the functionality of the equipment that can be purchased for this reduced price is far greater than its 1985 forerunners.

EU telecoms equipment price trends since the mid-1980s

The price premiums which were observed in European telecoms equipment markets in the mid-1980s were substantially reduced in the ten-year period from 1985 to 1995. The price differentials between individual national markets within the EU have also been substantially reduced. Table 4.14 (below) tabulates the estimated changes in EU price premiums.

The caveats identified earlier in this subsection also apply to the price premiums quantified in the penultimate row of Table 4.14. In particular, the comparisons of competitive world price and EU prices is not on an exact 'like-for-like' basis, either in terms of equipment specifications or commercial terms and conditions. If Cecchini's conservative estimate of the 1985 premium (reducing from 50% to 20%) is applied to reduce the 1995 estimate from 20% to 8% (reduced in the same proportion), then the EU price premium has reduced by 12% in ten years.[33]

[33] See Appendix B1.2, step 3, for a discussion of the rationale for these adjustments.

It is also clear that only part of the convergence between EU prices and competitive world prices can be attributed to the effects of the single market programme (see the Antimonde section below).

Even given these caveats, it can be concluded that the purchasers of telecoms equipment are achieving significantly better prices in the mid-1990s than was the case in the mid-1980s, both in absolute terms and relative to competitive world market prices. Taking the conservative 12% reduction in EU price premium (above), and applying this to the 1993 EU equipment market of ECU 16.9 billion,[34] European purchasers are avoiding annual expenditure of approximately ECU 2.0 billion through the reduction in EU price premium.

Table 4.14. Estimated EU equipment price premiums, 1985 to 1995

	1985	1995	CAGR (real)
Public switching			
Competitive world price (1995 ECU)	420	170	-9%
EU maximum price (1995 ECU)	820	260	-11%
EU minimum price (1995 ECU)	450	170	-9%
EU median price (1995 ECU)	670	210	-11%
EU average price premium	60%	24%	
Transmission equipment			
Competitive world price per channel (1985=100)	100	2.4	-31%
EU maximum price per channel (index)	160	3.2	-32%
EU minimum price per channel (index)	130	2.4	-33%
EU median price per channel (index)	138	2.6	-33%
EU average price premium	38%	5%	
Customer premises equipment			
Competitive world price (1985=100)	100	39	-9%
EU maximum price (index)	180	58	-11%
EU minimum price (index)	130	40	-11%
EU median price (index)	152	49	-11%
EU average price premium	52%	25%	
Approximate overall average price premium	50%	20%	
'Corrected' price premium[1]	20%	8%	

Sources: INSEAD [1988], Analysys.

[1] See Chapter 7, footnote 15 of Cecchini [1988].

[2] 1995 figures were derived from an Analysys survey of industry contacts and synthesis of known contract terms. See Appendix B1.2 for a detailed description of the methodology used.

[34] Eurostat [1995].

The reasons for these improvements are discussed elsewhere in this report, but can be summarized as follows:

(a) Technological change (see 4.1 above).
(b) Demand-side changes (see 4.2.1 above). The single market programme has made a significant contribution to altering the purchasing behaviour of European TOs, and opening up alternative routes to market. This diagnosis is reinforced by the continuing high EU price premium for CPE (25%), the equipment category where telecoms operators' downward pressure on prices is *weakest*. (Because most of this equipment is ultimately purchased by end-users, the telecoms operators, as leading distributors of CPE, have little incentive to drive down prices.) The equipment categories where operators purchase for their own use (switching and transmission) have seen the greatest reductions in price premiums.
(c) Improved cost-competitiveness of equipment suppliers (see 4.2.2). This is a much less significant factor than (a) and (b) above.
(d) Scale effects (see 4.2.3). A large part of the opportunity for telecoms equipment price falls arises from the significant economies of scale available in the design and manufacture of current telecoms equipment.
(e) Increased market access (see 4.2.4). Although important in general terms, improved market access has been less significant than (a) and (b) above in reducing EU equipment prices.

Although there is no simple causality in the relationship between telecoms equipment prices and telecoms services prices, it is reassuring to observe that reductions in the real price of equipment are at least to some extent being reflected in the real price trend for telecoms services in the EU. For example, the average EU residential telephone bill fell by around one third in real terms over the period 1985 to 1995[35] (see 4.2.11, 'Effects on consumers', below).

The Antimonde for EU telecoms equipment prices

The most probable Antimonde for EU telecoms equipment prices (in the absence of key single market measures) would have the following features:

(a) The EU equipment price premium would have reduced from its 1985 level, but not by as much as can be seen in the actual out-turn. If the 1985 premium is taken to be 20%, then it is plausible that the 1995 EU Antimonde price premium would be 15%, a reduction of 5%. This means that EU purchasers would have foregone price reductions of approximately 7% in the Antimonde case (12% minus 5%). It should be noted that this apportionment of savings is entirely subjective, and has been made in the absence of any objective alternative approach.
(b) Price differentials between EU national markets would quite possibly have remained at their 1985 levels in the absence of the pan-European programme of re-regulation included within the single market programme. It is even possible that differentials would have actually widened in some cases, given the steep falls in competitive world market prices and the different approaches of Member States to policy in these areas in the mid-1980s.

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[35] See Analysys [1995].

It is conceivable that the overall average EU price premium may actually have increased in the Antimonde, given the rapid falls in competitive world prices and the state of most EU national industrial and telecoms policies in the mid-1980s. However, to propose such an Antimonde would probably be ascribing too much influence to the single market programme, and too little influence to the changes in national outlook which have occurred during the period (and which enabled the telecoms-related areas of the single market programme to proceed at the rate which has actually occurred in the 1990s).

Summary

The single market programme has, through a variety of mechanisms, helped to reduce the price premiums being paid for telecoms equipment in Europe. Over the period 1985 to 1995 the current annual benefit to customers of the reductions in EU price premium is estimated to be approximately ECU 3.5 billion. However, only a portion of these savings can be attributed to the single market programme.

In the absence of key single market measures the EU would have foregone a total average equipment price fall of approximately 7% (from 1985 to 1995, in real terms). This cumulative price reduction is equivalent to annual savings of around ECU 2.0 billion on equipment expenditure.

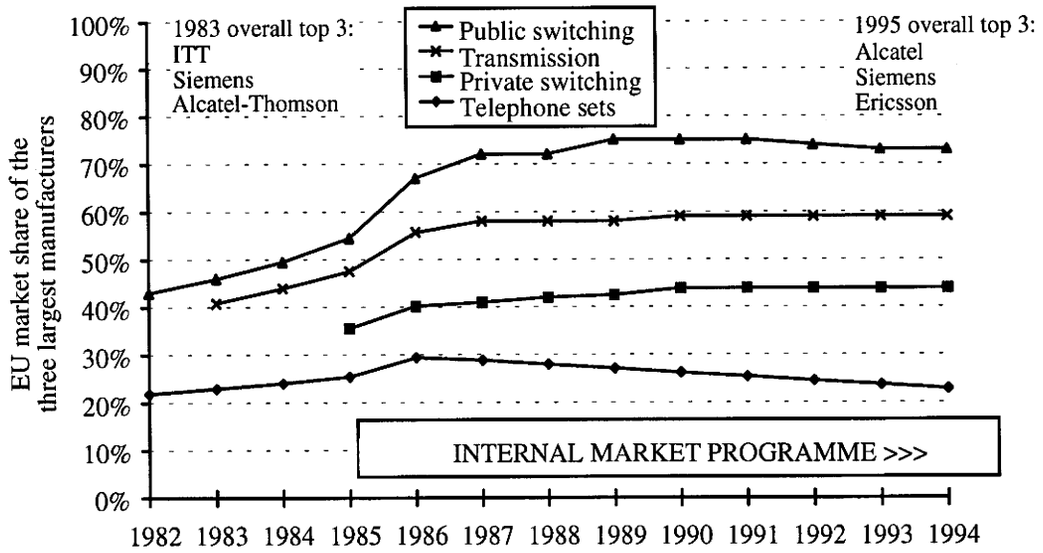
4.2.7. Competition and concentration effects

To assess competition and concentration effects the study has examined concentration ratios, market share changes, manufacturer profitability trends, import penetration trends and price effects. Price effects were discussed in the previous section.

Although analysis of price effects and overall qualitative assessments indicate that the competitive intensity of the EU telecoms market has increased significantly in recent years, this has not resulted in attributable changes to industry concentration measures or market shares. Profitability trends show that margins within the sector have fallen, but this is not a reliable indicator over the period under analysis because of the difficulty of correcting for the macro-economic cycle in the results of large manufacturers. Import penetrations have risen considerably over recent years (see 4.2.8 below), supporting the hypothesis of increased competitive intensity.

Figure 4.19. illustrates the consolidation of EU telecoms manufacturers during the 1980s, and the relatively stable C3 share for all categories except terminals since the end of the 1980s. Equivalent charts for EU national markets show a reduction in concentration (C1 and C2) during the 1980s as second and third suppliers were adopted by PTOs in a number of Member States for public switching and some categories of transmission equipment.

Figure 4.19. Illustration of concentration ratios for the EU telecoms equipment sector: C3 indicator for four equipment categories, 1982 to 1994



Sources: Analysys, Dataquest, ADL, Datapro.

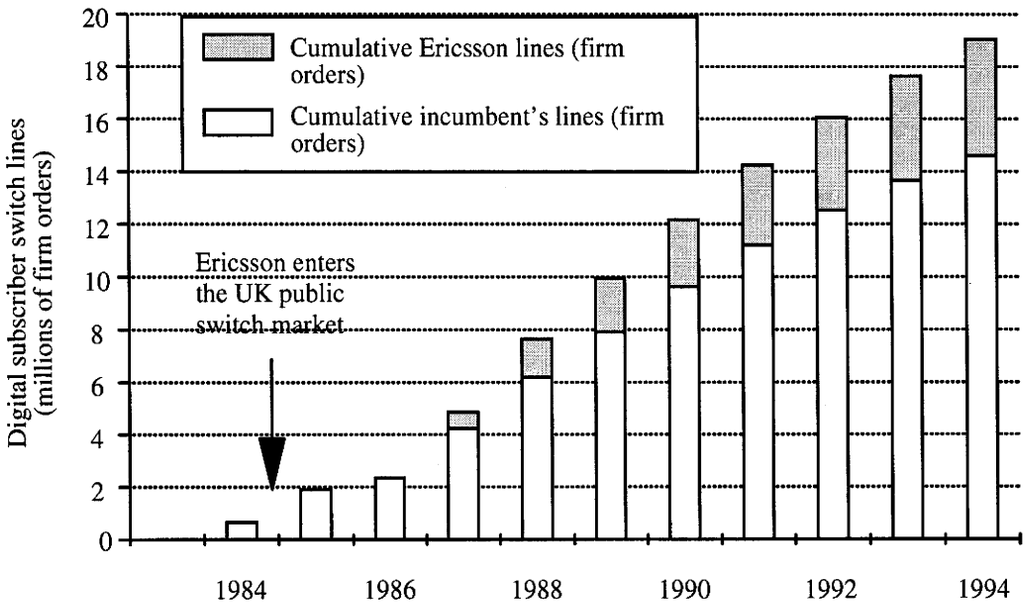
The absence of clear indications of changing patterns of market concentration since the end of the 1980s can be explained by a number of factors:

(a) The main structural changes in the EU sector occurred before the impact of the single market. Although the mechanism for this restructuring – the creation of large, multi-domestic operations – was costly and sub-optimal, the main effect on national and EU-level concentration ratios had already occurred by the time the single market programme began to be implemented.

(b) Organic shifts in market share (as opposed to shifts resulting from mergers or acquisitions) are particularly slow in the telecoms sector because of the huge installed asset base and the natural risk aversion of TOs. Figure 4.20 (below) illustrates the rate of market share growth of LME Ericsson in the UK public switching market. Even though Ericsson was actively encouraged in this strategy by BT, and had a highly competitive product, it has taken almost ten years to capture 25% of the cumulative orders for switching. This is one of the most rapid organic market share shifts in EU telecoms equipment – most penetration strategies have progressed much more slowly (e.g. Nortel or AT&T).

(c) Incumbent manufacturers have demonstrated that they are prepared to defend their market shares by cutting prices (see 4.2.6 above) rather than sacrifice market share in an attempt to defend margins. The role of potential new suppliers has often been as a negotiating lever for the TO to obtain better prices from its existing supplier. In such a scenario changes in market shares will clearly be smaller and slower.

Figure 4.20. LME Ericsson penetration of the UK public switching market, 1984 to 1994



Source: Analysys.

Tables 4.15 to 4.17 illustrate market share trends for a selection of other equipment categories.

Table 4.15. Market shares in the European facsimile market (%), 1989 to 1994

Manufacturer	1989	1990	1991	1992	1993	1994
Panasonic	N/A	13	13	17	16	13
Canon	N/A	20	20	14	14	8
Sagem	N/A	N/A	N/A	10	13	20
Ricoh	N/A	5	6	3	3	3
Philips	N/A	N/A	N/A	2	5	5
ITO	N/A	N/A	N/A	1	5	8
Samsung	N/A	N/A	N/A	2	3	4
Amstrad	N/A	3	3	2	2	2
Olivetti	N/A	N/A	N/A	2	2	3
Italtel	N/A	N/A	N/A	2	2	3
Siemens	N/A	N/A	N/A	1	3	1
Others	N/A	59	58	44	32	30

Source: MZA.

Table 4.16. Market shares in the European cordless handset market (%), 1989 to 1994

Manufacturer	1989	1990	1991	1992	1993	1994
Siemens	0	1	3	3	10	13
Alcatel	4	7	8	4	6	3
Philips	14	12	11	13	15	13
Bosch	0	0	0	1	2	0
Panasonic	6	6	8	12	9	8
Ascom	9	7	4	1	1	2
Hagenuk	11	13	17	12	7	7
Matra	18	16	16	14	12	12
Smaller Far Eastern suppliers	18	18	20	21	28	33
Others	20	20	13	20	11	9

Source: MZA.

Table 4.17. World market shares in mobile handsets (%), 1989 to 1994

Manufacturer	1989	1990	1991	1992	1993	1994
Alcatel	4	3	4	2	2	3
Ericsson	6	6	7	8	12	13
Motorola	29	27	24	24	27	29
NEC	23	17	11	10	9	7
Nokia	5	9	15	16	20	22
Panasonic	7	7	6	5	4	3
Philips	7	7	7	7	4	3
Siemens	5	5	11	15	14	14
Others	14	19	15	13	8	6

Sources: MZA and Brokers Report estimates.

In contrast to the facsimile market, none of the larger non-EU producers have succeeded in establishing control of the cordless handset market. The market leaders in terms of market share are European (Siemens and Philips). Philips' share of the market has remained constant, while, in contrast, Siemens' share has grown rapidly since 1989. The openness of the market to foreign competition is illustrated by the performance of Panasonic, which has achieved a market share not far below that of the leaders. Moreover, a group of small Far Eastern producers now accounts for a third of the market. The cordless handset market has all the attributes of an open, accessible and contestable market, with a high level of competitive intensity.

Table 4.18 (below) shows profitability ratios for the largest EU equipment manufacturers since 1985. The period can be divided into two phases. Profit margins for most manufacturers grew until approximately 1989. Profitability then declined, in some cases quite radically. Notable exceptions to this trend were Nokia and Ericsson, whose profit growth has been sustained by the successes of their mobile communications divisions.

Table 4.18. Profit ratios in the EU equipment industry (%), 1985 to 1994

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Alcatel Alsthom			5.7	7.0	8.6	9.7	10.6	9.1	8.5	5.7
Siemens		1.7	1.9	1.0	1.7	1.5	2.3	1.9	1.4	
Ericsson	5.1	7.3	6.7	8.6	11.5	12.5	5.0	3.7	5.6	7.9
Fujitsu	12.4	5.0	3.5	5.8	7.8	7.7	7.2			
Nokia	8.9	8.2	9.1	4.5	4.3	4.9	-0.6	1.6	6.2	11.9
Philips	5.1	5.8	4.6	4.3	4.0	4.1	5.5	4.2	5.0	
Italtel				17.5	19.2	16.7	14.9	14.4		
Ascom							3.3	0.7	-4.1	1.6
Matra Hachette	4.2	3.9	5.5	5.6	6.3	5.3	4.3	5.4		
Pirelli	6.3	6.3	6.2	5.5	5.5	4.6	2.2	3.4	3.7	4.4

Source: Annual reports.

By comparison, profit margins for large manufacturers from outside the EU showed more variable levels of performance (see Table 4.19). NEC and Northern Telecom had fluctuating profit margins over the past ten years; AT&T and Motorola have fared much better. Motorola has benefited from its strength in mobile communications.

Table 4.19. Profit ratios for leading non-EU equipment manufacturers (%), 1985 to 1994

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AT&T	5.7	1.6	7.1	-3.7	8.2	8.8	2.2	9.7	9.3	10.7
Motorola					9.4	8.9	7.8	8.6	11.4	12.9
NEC	6.2	5.0	2.4	2.6	4.3	5.0	3.6	1.4	-1.1	0.7
Northern Telecom	9.8	9.3	9.2	3.5	8.6	9.8	11.0	11.0	-11.0	4.7

Source: Annual reports.

The evidence on profit ratios in the industry suggests that competitive intensity in the EU equipment industry has increased. However, this evidence cannot be treated as conclusive because the fall in profitability experienced during the early 1990s coincided with the macro-economic downturn which affected most of the European economies in that period. It is also very difficult to disaggregate the profitability of specific activities within large integrated groups such as Alcatel and Siemens.

Import penetration into the EU has risen steadily since the mid-1980s. In 1985, imports accounted for 14% of the total EU market for telecoms equipment. By 1992, this figure had risen to 23% and was still increasing.[36] When these trends of increasing import penetration are considered in combination with simultaneous strong growth in EU external exports, it appears to confirm the conclusion that competitive intensity within EU markets has increased in recent years.

[36] Eurostat [1995] and OECD [1995].

The degree of import penetration varies greatly for different equipment types. Import penetration is far higher in the terminal equipment market segment than the switching or transmission segments. The terminal equipment segment has been particularly influenced by the strong growth in facsimile communication which occurred during the 1980s. Japanese manufacturers in particular demonstrated considerable competitive advantage in the production of facsimile equipment and were able to capture a large share of the EU market. (See also Figure 4.25 below.) Note that many data networking equipment categories where import penetration is extremely high (such as LAN equipment, hubs, routers, and servers) are not included in this analysis. Appendices B1.3 and B2.1 address this area further.

Antimonde

In the Antimonde, competition in EU equipment markets would be less intense, prices would have fallen more slowly, manufacturers' margins and profits would be higher, and the pace of restructuring and rationalization would be slower. The value of terminals imports would be lower, although EU terminals exports would also be reduced due to the lower competitiveness of EU manufacturers on price and product functionality. Asian producers would have slightly reduced market shares in EU terminals markets.

Antimonde market shares and concentration ratios in switching and transmission equipment would not differ significantly from the current actual environment.

Summary

In summary, indicators of the competitive intensity of EU telecoms equipment market either show that levels of competition are increasing (price, imports and profitability) or support no firm conclusion (concentration and market share trends).

The firm attribution of increasing competitive intensity to the single market programme cannot be supported by any robust, objective analytical evidence, but at a subjective level it is probable that the changes brought about by the single market programme have had a considerable positive impact.

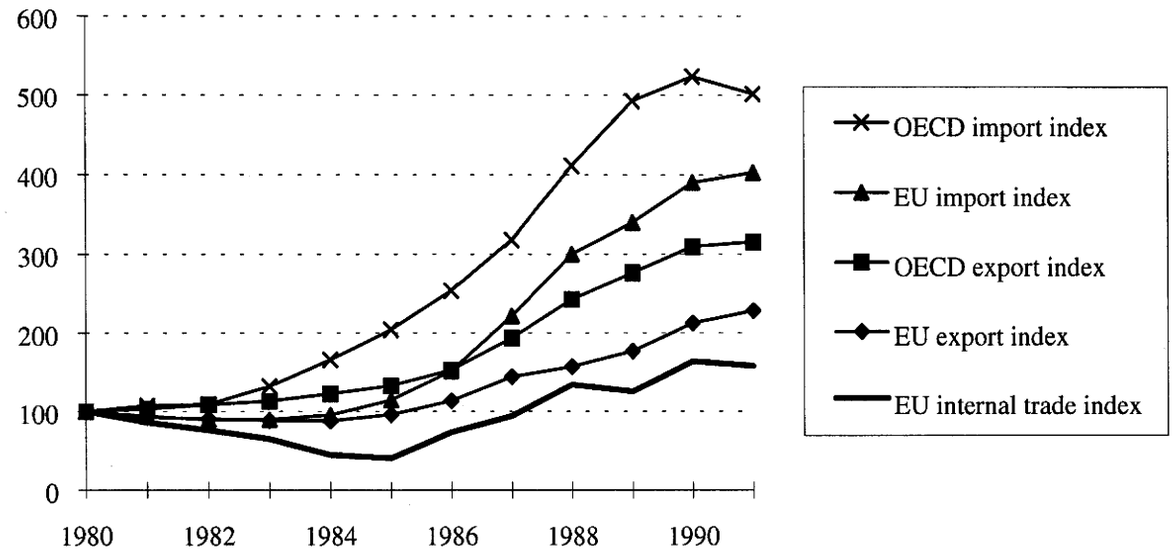
4.2.8. Cross-border sales and marketing effects

Although the single market programme has undoubtedly removed most of the artificial restrictions on cross-border sales and marketing, these changes have not yet had a measurable impact on EU internal trade statistics for telecoms equipment.

Figure 4.21 illustrates that EU internal trade in telecoms equipment has grown significantly since 1985, after declining between 1980 and 1985. However, the rate of growth over the period from 1985 has not exceeded the rate of growth of EU external exports, EU external imports or total OECD trade. Whilst it is plausible to suggest that internal trade would have grown even more slowly in an Antimonde (without key single market measures), it is impossible to test this hypothesis.

Trade statistics do not show any growth in intra-EU trade that is higher than the rate of growth for general trade in telecoms equipment.

Figure 4.21. Telecoms equipment import and export trends, EU and OECD indices (1980=100)



Sources: OECD and Panorama.

The lack of an observable and attributable impact on cross-border trade should not be interpreted as a failure of the single market programme in this area. There are robust explanations for the pattern of trade statistics:

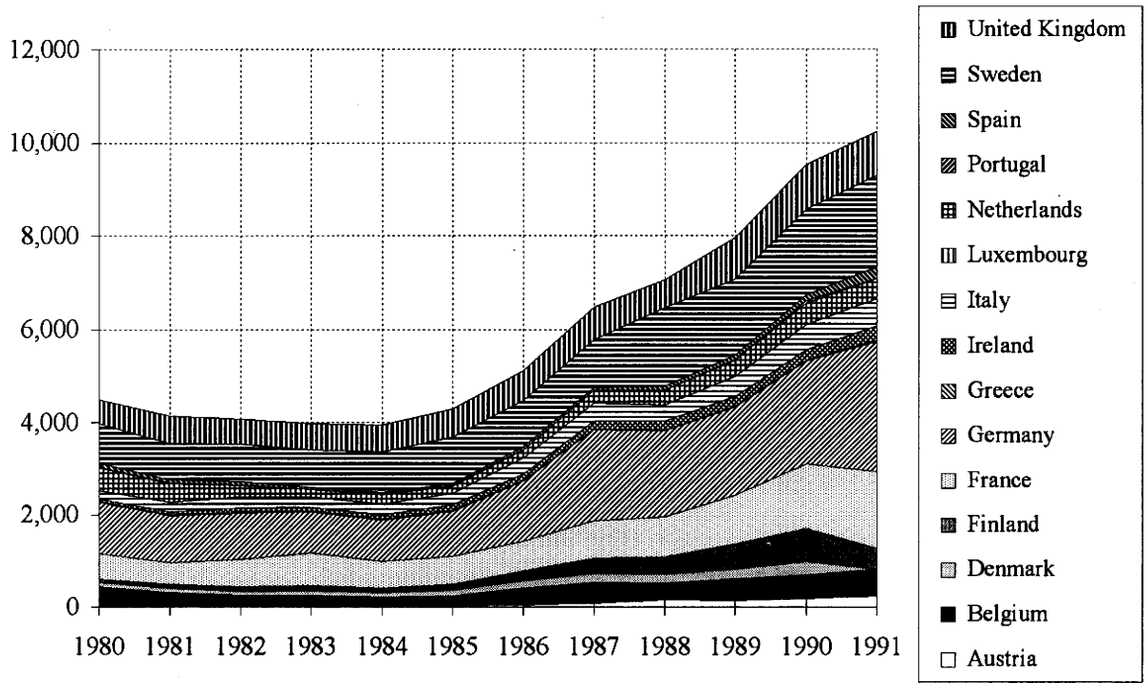
(a) The large European equipment manufacturers had already implemented their multi-domestic strategies before the enactment of key single market measures. This was a costly but effective means of circumventing the former restrictions on cross-border trade, and once the strategies were in place (the costs of which were largely sunk costs) there was little incentive to dismantle these structures as soon as the single market programme began to take effect. As a result, the large manufacturers did not begin to rationalize their multi-domestic structures until the mid-1990s, and the impact of these activities on internal EU telecoms equipment trade will not be seen until the late 1990s (see Chapter 5).

(b) It has undoubtedly become easier for smaller manufacturers to operate across EU borders than it was before key single market measures were implemented to eliminate artificial restrictions on cross-border activity. For example, the case study evidence of Diehl, a small ISDN PC card manufacturer (see Appendix A2) acknowledges the cost savings which were made possible by single market measures, thus making it economically feasible for the company to market its product in other EU countries. However, the market share of smaller manufacturers is still too low, and the removal of restrictions occurred too recently for such changes to be visible at sector level.

Figures 4.22 to 4.24 illustrate the marked differences in telecoms equipment import and export behaviour for EU Member States.

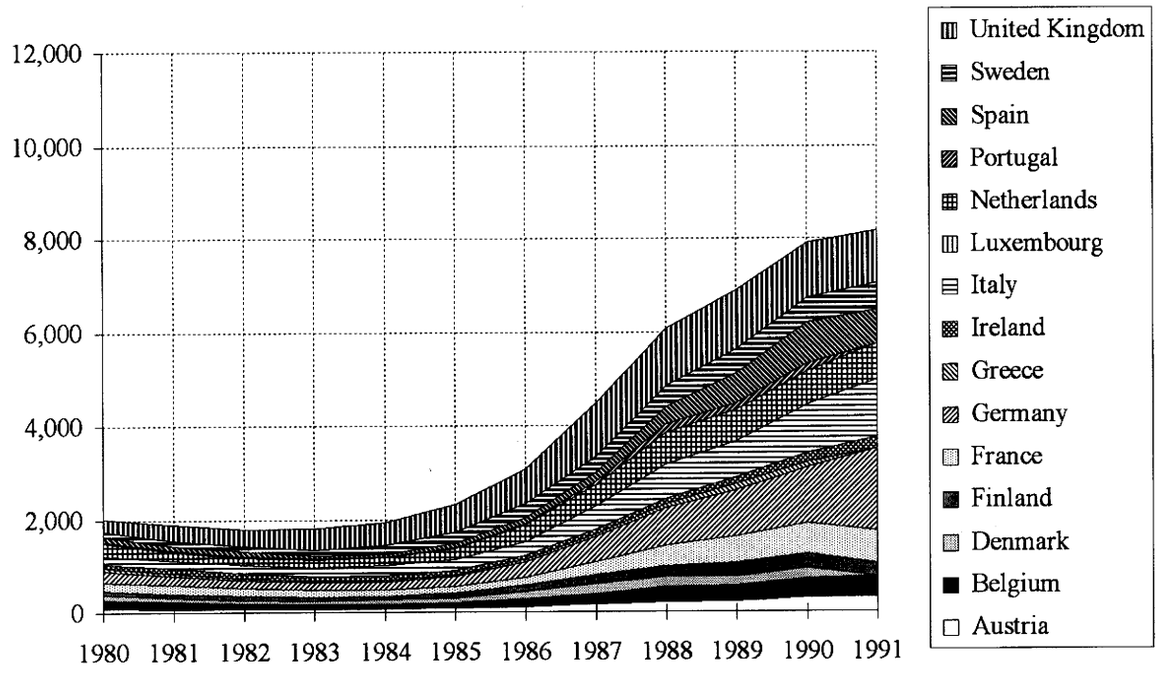
Although Europe has an overall trade surplus in telecoms equipment, several equipment categories have a long-standing trade deficit, notably mass-market business or residential terminal equipment such as handsets and facsimile machines. Figure 4.25 (below) illustrates this phenomenon, although it should be noted that these statistics for extra-EU trade broken down by equipment type are difficult to reconcile with national trade statistics. Other statistical sources in this area are either incomplete or do not distinguish between intra-EU and extra-EU trade.

Figure 4.22. Trend in EU telecoms equipment exports (million US$)



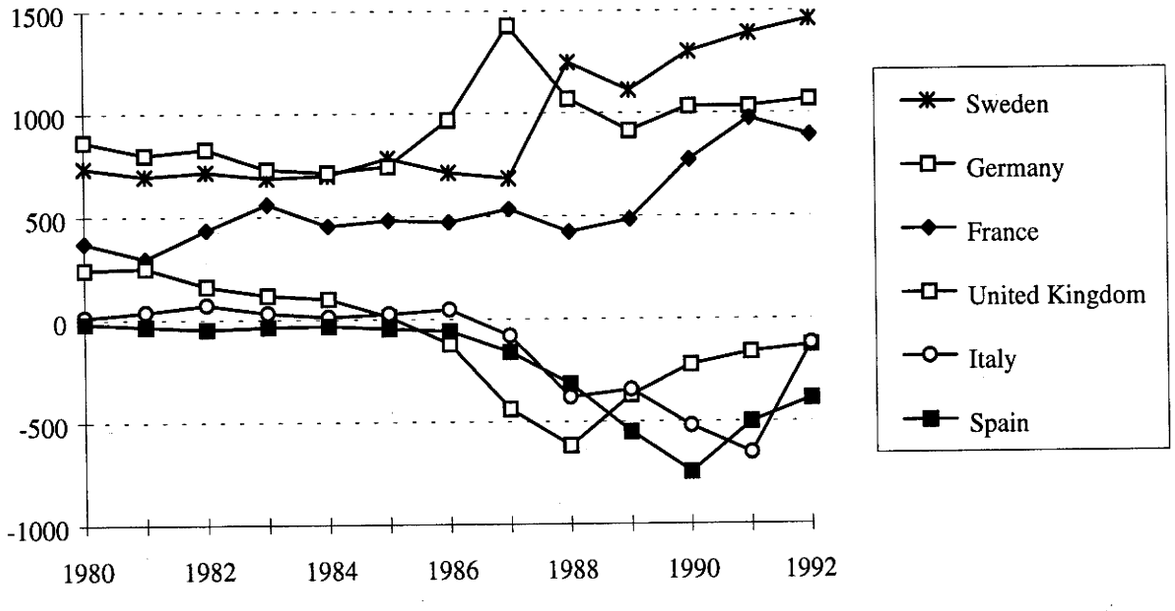
Source: OECD.

Figure 4.23. Trend in EU telecoms equipment imports (million US$)



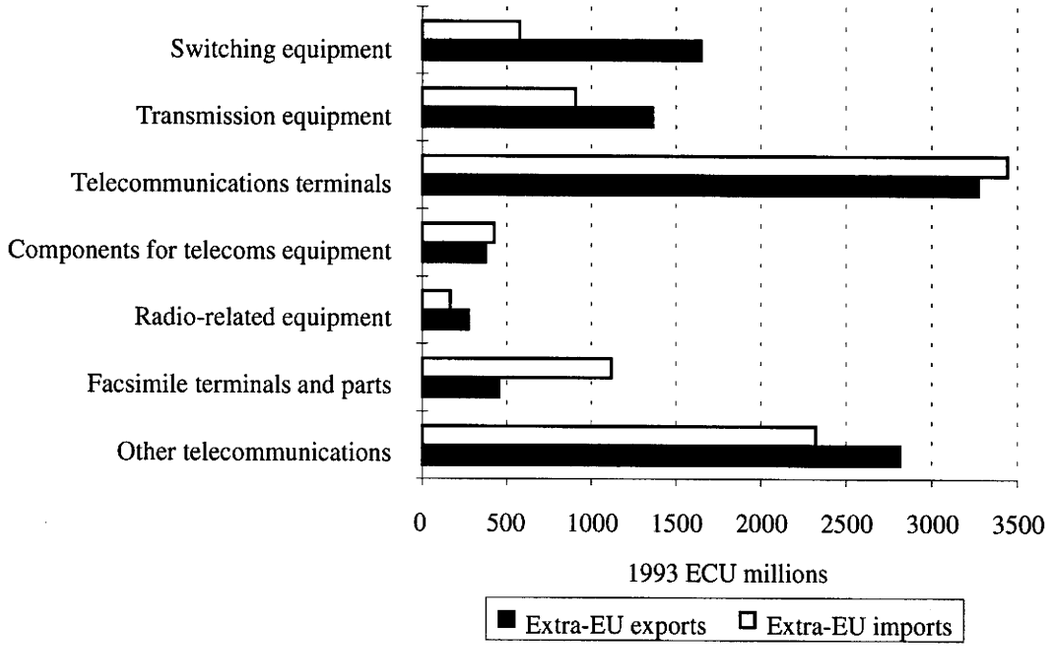
Source: OECD.

Figure 4.24. Telecoms equipment trade balances for six EU markets (million US$)



Source: OECD.

Figure 4.25. EU telecoms equipment trade balances for seven categories of equipment



Source: EC DGIII cited in Panorama 95.

Antimonde

In the absence of key measures and actions it seems reasonable to assert that EU telecoms equipment manufacturing would be less competitive than it is today (see 4.2.2, 4.2.6 and Appendix B1.3). EU manufacturers would be less successful exporters into markets outside the EU, and less able to defend domestic market shares against non-European imports. The global market share held by EU manufacturers would be below its current level.

Each percentage point of global market share is equivalent to approximately ECU 0.8 billion of sales, and from a subjective assessment of the magnitude of the impacts of the EU single market programme on the competitiveness of EU manufacturers, we believe that it is a reasonable assertion that current EU telecoms equipment production would be reduced by at least ECU 1 billion in the absence of the single market programme (equivalent to 14% of current EU external exports of telecoms equipment).

It is not tenable, however, to attribute any specific portion of current world market share entirely to single market measures – no contract could have been said to have been won or lost solely because of the impact of the single market programme on an EU manufacturer. Rather, the single market programme has assisted the development of several aspects of competitiveness.

Areas where we would expect EU world market share to be lower in the Antimonde include mobile handsets, base stations and switching (higher imports and lower exports), public switching (lower exports and lower production from investments outside the EU), ISDN terminal equipment and network equipment (lower exports), SDH transmission equipment and microwave transmission equipment (higher imports and lower exports) and telephone handsets (higher imports).

4.2.9. FDI and location effects

The single market has not yet had a direct material impact on the location of telecoms equipment production. However, this may change as the larger EU manufacturers rationalize and restructure, and dismantle their multi-domestic EU operations (see Chapter 5). ECTEL, in its response to the DRI survey of trade associations [DRI, 1995], noted that 'the creation of the single market has not significantly altered the locational distribution [of production]'.

Addressing the various categories of FDI individually:

(a) **Cross-border investments in Europe involving the largest manufacturers** (acquisitions, mergers and greenfield developments) were an important feature in the consolidation of the European telecoms equipment industry during the 1980s (see 4.2.7, Competition and concentration effects). The period saw important intra-EU transactions (e.g. Siemens/GPT, Alcatel/SEL), EU/EFTA transactions (e.g. the activities of Ericsson and Ascom), and investments from outside Europe (e.g. investments in Europe from Northern Telecom/STC, Fujitsu, Motorola, AT&T and IBM). Many of these cross-border transactions were necessitated by the absence of an EU single market, and were largely completed before the single market programme had made much impact on the telecoms equipment sector.

Most of the major cross-border investments by large players in recent years have been 'upstream' investments in new electronics and components production facilities, which fall outside the scope of this study. These investments have been made by EU manufacturers (notably Siemens), US manufacturers (e.g. Motorola and IBM) and Asian manufacturers (notably those from Japan, Korea and Taiwan). Although it is likely that the creation of a single market makes investment in EU production facilities more attractive to US and Asian manufacturers, there is no robust approach for estimating the extent to which these investments would have been reduced or cancelled in the Antimonde.

(b) **European manufacturers' investments outside Western Europe** accelerated at the end of the 1980s and the early 1990s (e.g. Siemens/Rolm and Alcatel in the USA and China). However, these initiatives were not primarily driven by the actual or anticipated effects of the EU single market programme, and can be explained by examining other commercial, technological and strategic drivers. Investments made in the USA by EU manufacturers have been driven by the need to achieve a sustainable share of a global market, or by the need to gain access to important technologies and products. Investments in the rest of the world are driven by the globalization of the telecoms equipment sector and the rapid growth of non-OECD equipment markets.

By the early 1990s, Siemens and Alcatel were both among the top 30 firms world-wide, when ranked by foreign assets.[37] It is possible that the effects of the single market programme have increased the ambitions and confidence of EU manufacturers when considering their global investment plans, although it would be difficult to quantify this effect relative to the situation in the Antimonde.

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[37] UNCTAD [1993].

(c) **Acquisitions of small EU manufacturers by North American manufacturers**. There is concern in some quarters that the best of the small start-up equipment manufacturers in the EU are being acquired by North American firms.[38] Many of these small EU firms are active in the important growth sector of data networking equipment, and many owe their early success partly to the reform of EU equipment markets under the single market programme. Given that they are few in number it is understandable that their acquisition by larger groups might raise concerns. However, the single market programme has not introduced any obstacles to continuing independence for these small firms, nor prevented EU manufacturers from making acquisitions themselves. Whether this phenomenon is beneficial or harmful to EU interests, it cannot be described as an impact of the single market programme, or seen as an area which should have been addressed by the single market programme.

(d) **Investments in North American operations by smaller EU manufacturers**. A number of smaller EU equipment manufacturers have preferred to expand from their domestic national market into the US market before entering other EU national markets. This is particularly noticeable in the important growth sector of data networking products.[39] The US network equipment market is more mature and advanced than any European national markets, and so represents a more attractive opportunity to many small but ambitious firms, despite the progress made towards creating a single market in Europe. Even with the removal of all administrative and legislative obstacles to pan-European operations, strong cultural and demand-related differences will persist in Europe for many years, and these will influence the strategies of many small producers of networking products. This phenomenon does not represent a failure of the single market programme.

Appendix B2.1 discusses the data constraints that prevent this study and others from undertaking a valid quantified analysis of telecoms equipment foreign direct investment flows.

In summary, the single market programme has not had a particularly significant direct impact on flows of foreign direct investment in the telecoms equipment sector.

4.2.10. Employment effects

Employment in the EU telecoms equipment manufacturing sector fell by one sixth from its peak in 1989 to 1994 (see Figure 4.26 below), and this trend is likely to be continued in the 1995 and 1996 statistics. The fall in employment since 1989 has been caused by reductions in workforce requirements throughout the sector (distributed across EU countries and across equipment categories). The fall in the period to 1994 does not include the effects of the overall restructuring and rationalization activities of the largest EU telecoms equipment manufacturers, which are still being planned and implemented (see Chapter 5).

The main drivers of the employment trend since 1989 have been:

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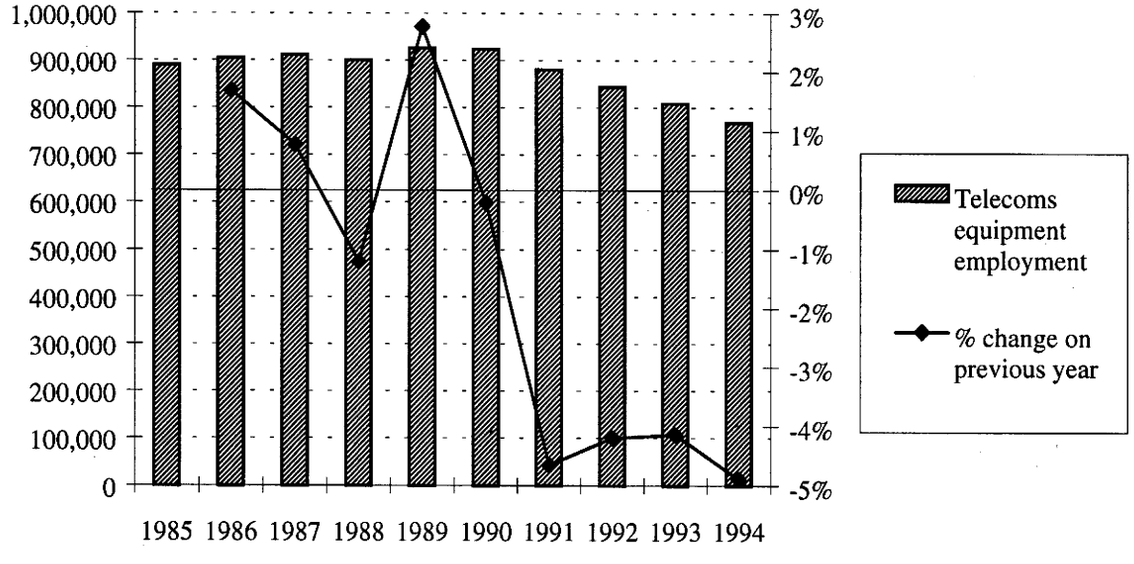
[38] See, for example, Siotis & Neven [1993] and Appendix A2 (the Diehl case study).

[39] Example firms include Madge Networks, Kalamazoo, ATML, and firms identified in Appendix A2.

(a) **The changing production mix in the sector** (see 4.2.3 and 4.2.5 above). The importance of labour in the mix of inputs is declining as the software and integrated circuits content of products increases. Labour inputs are becoming more concentrated at the front of the product development cycle, in research, development, software generation and other 'pre-production' activities. This is reflected in the declining 'blue collar' workforce, illustrated in Figure 4.27 below. The major product development cycles in EU switching peaked in the mid to late 1980s, and the lower levels of on-going activity are reflected in the falling employment statistics.

(b) **Demand-side factors**. Changes in the procurement behaviour and expectations of EU TOs have forced down EU equipment prices (see 4.2.6 above), applying increased pressure on manufacturers to optimize their cost bases. Employment costs are the largest variable cost faced by equipment manufacturers, and are the first target for savings. So far, savings have been effected within the existing multi-domestic corporate structures – no employment reductions have yet occurred as a result of a change to a 'transnational' structure (see Chapter 5).

Figure 4.26. Employment in the European telecoms equipment sector



Source: Panorama of EU Industry 95/6.

In many areas where European telecoms equipment revenues have grown, this has been 'jobless growth'. There are some specific exceptions, notably in wireless systems, but the overall employment picture in the sector is negative. The areas where European employment has declined in recent years (such as switching, transmission, satellites and CPE) correspond to those where single market measures have brought forward the restructuring of the industry and, through improvements in competitiveness, will reduce the medium to long-term impact on employment.

As a driver of change in the telecoms equipment sector, the single market programme has undoubtedly contributed to the decline in employment in the sector, and will continue to be a contributory factor in further falls (caused by major reorganization of the largest manufacturers). This negative impact was a predicted and inevitable consequence of the

reforms contained in the single market programme; the benefits of open markets, increased competitive intensity, lower prices and increased competitiveness could not be achieved without an adverse initial impact on employment.

ECTEL, in its response to the DRI survey of trade associations [DRI, 1995], noted that 'the increased competition within the EU brought about by single market measures has increased the global competitiveness of the EU industry. However it has also triggered a decrease in employment'. It also observes, however, that 'productivity growth is causing a steady decline in employment. Technological change is a more important factor in this development than the single market'.

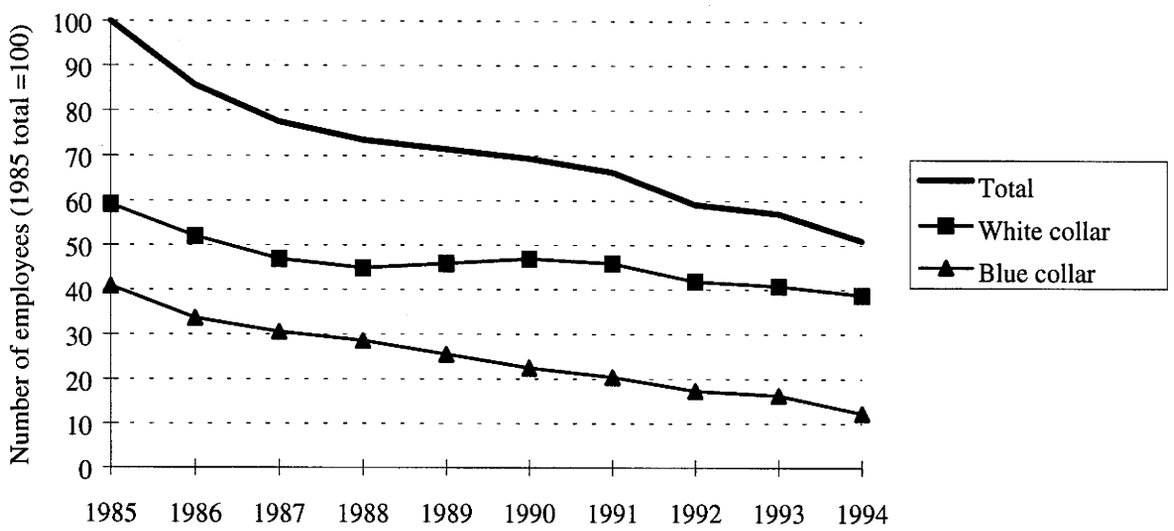
Continuing national regulatory reforms and strong growth in the telecoms services sector should be important stimuli of demand in the telecoms equipment sector (see Figure 4.12 above). At the same time, however, the growing competitive intensity of EU equipment markets will continue to expose inefficiencies and stimulate restructuring, and in many product categories the growth in demand will not have a significant impact on employment, due to the changes in production mix described above.

Employment effects are a consequence of changes in the competitiveness, productivity, structure and cost economics of the sector, as well as a function of demand for equipment. The impacts of the single market programme on these drivers of employment are addressed in Sections 4.2.2 (Competitiveness and productivity effects), 4.2.3 (Scale and scope effects), and 4.2.4 (Market access effects).

Developments in France can be used to illustrate the general trend, as France represents over 20% of EU telecoms equipment production. As shown in Figure 4.27, employment in the French sector fell steadily by around 5% per annum between 1985 and 1994, but the decline in employment for blue-collar workers (12% annually) has been much higher than for white-collar workers, indicating a shift in the production mix as the increasing technological content and complexity of telecoms equipment change the skills required in the industry.

The trend shown in Figure 4.27 can also be observed for individual manufacturers across Europe. Statements by the French industry organization, SIT, and in the annual reports of several companies suggest that the trend is expected to continue. For example, Siemens' 1992 annual report stated: 'The share derived from engineering and services, or software, is increasing steadily, while hardware, or actual production value-added continues to decline. Development, planning, sales and service now account for more than half our industry's activities. This shift is reflected in the structure and qualifications of our workforce.'

Figure 4.27. Employment trends in the manufacture of telecoms equipment in France



Source: SIT Annual Reports, 1990 to 1994.

The Antimonde for EU telecoms equipment employment

In the absence of the single market programme the rate of change in the sector would have been slower, and it is probable that the decline in employment in the sector would have been less significant. The actual reduction in employment between 1989 and 1994 of 150,000 jobs might have been only 100,000 under the Antimonde, although this figure is inevitably a subjective estimate. It is important to note that this positive variance would be due solely to delaying the trend as actually experienced. However, the postponement of change under the Antimonde would have increased the severity of the problems of competitiveness faced by EU manufacturers in the medium term, and so it is probable that the outlook for employment in the sector for 2000 and beyond would be considerably worse in the Antimonde. The long-term employment deficit in the Antimonde is likely to be much larger than the estimated Antimonde employment increment (50,000, as above).

4.2.11. Effects on consumers

Only about 20% of EU telecoms equipment sales are direct to end-users; the majority of these are to business users (fax machines, private switching and handsets). The remaining 80% of equipment sales are to telecoms operators, either for their own use (about 65%) or to sell on to end-users (about 15%). The benefits of the single market programme for telecoms equipment therefore feed through to consumers both directly, through better, cheaper equipment, and indirectly, through better, cheaper services.

The impacts of the single market programme on the telecoms equipment sector are benefiting consumers in three main areas:

(a) enabling consumers to have cheaper and better residential telecoms equipment,
(b) allowing cheaper telecoms services for consumers,
(c) contributing to cheaper and better mobile services for consumers.

(a) **Enabling cheaper and better residential telecoms equipment.** Reform of the terminals sector has brought greater competition in the markets for residential equipment (CPE) such as handsets, answerphones, home faxes and modems, and has contributed to the significant improvements in the range of products available and the range of retail outlets through which they can be purchased or leased.[40] The removal of many bureaucratic and frustrating restrictions on the installation of terminal equipment has been a major benefit for consumers in many EU markets.

Based on the analyses used to support Section 4.2.6 (above), residential CPE prices in the EU in 1985 averaged approximately 50% more than those in the USA (in raw terms[41]). This premium is estimated to have fallen to approximately 25% (in raw terms) by 1995. A significant portion of this reduction in premium can be attributed to the single market measures which underpinned the reform of these markets.

EU residential CPE prices also appear to have converged. It was estimated that the German CPE price premium (raw) was 80% in 1985,[42] the largest CPE premium in the EU. By 1995, the German CPE price premium (raw) is estimated to have fallen to between 30% and 40%, much closer to the EU median of 25%.

(b) **Allowing cheaper telecoms services for consumers.** There is no robust quantified relationship between telecoms equipment prices and telecoms service prices, even in competitive telecoms service environments. In monopoly and near-monopoly environments any linkage is weakened further, with little obligation on telecoms operators to pass on cost reductions through price cuts.

In overall terms, however, the falling unit prices of telecoms equipment provide a falling 'floor' for telecoms service prices, and the contribution of the single market programme to equipment price falls has assisted this trend in Europe. Figure 4.28 illustrates the decline in average residential telephone bills from 1983 to 1995 for eight EU operators. The average decline over the period 1985 to 1995 is approximately one third in real terms.

(c) **Contributing to cheaper and better mobile services.** Section 4.2.2 and Appendix A3 assert that the single market programme has made valuable specific contributions to the success of the GSM standard, which has benefited EU manufacturers, operators and users. The almost universal deployment of the GSM system in Europe has made high-functionality mobile services widely available to business users, and the success of the system in the business market is now leading to affordable services for consumers (through a combination of scale and competition effects). The growth of GSM usage has also contributed to the falling cost of analogue mobile telephony (through competition and substitution effects), which is now affordable for a large segment of the consumer market.

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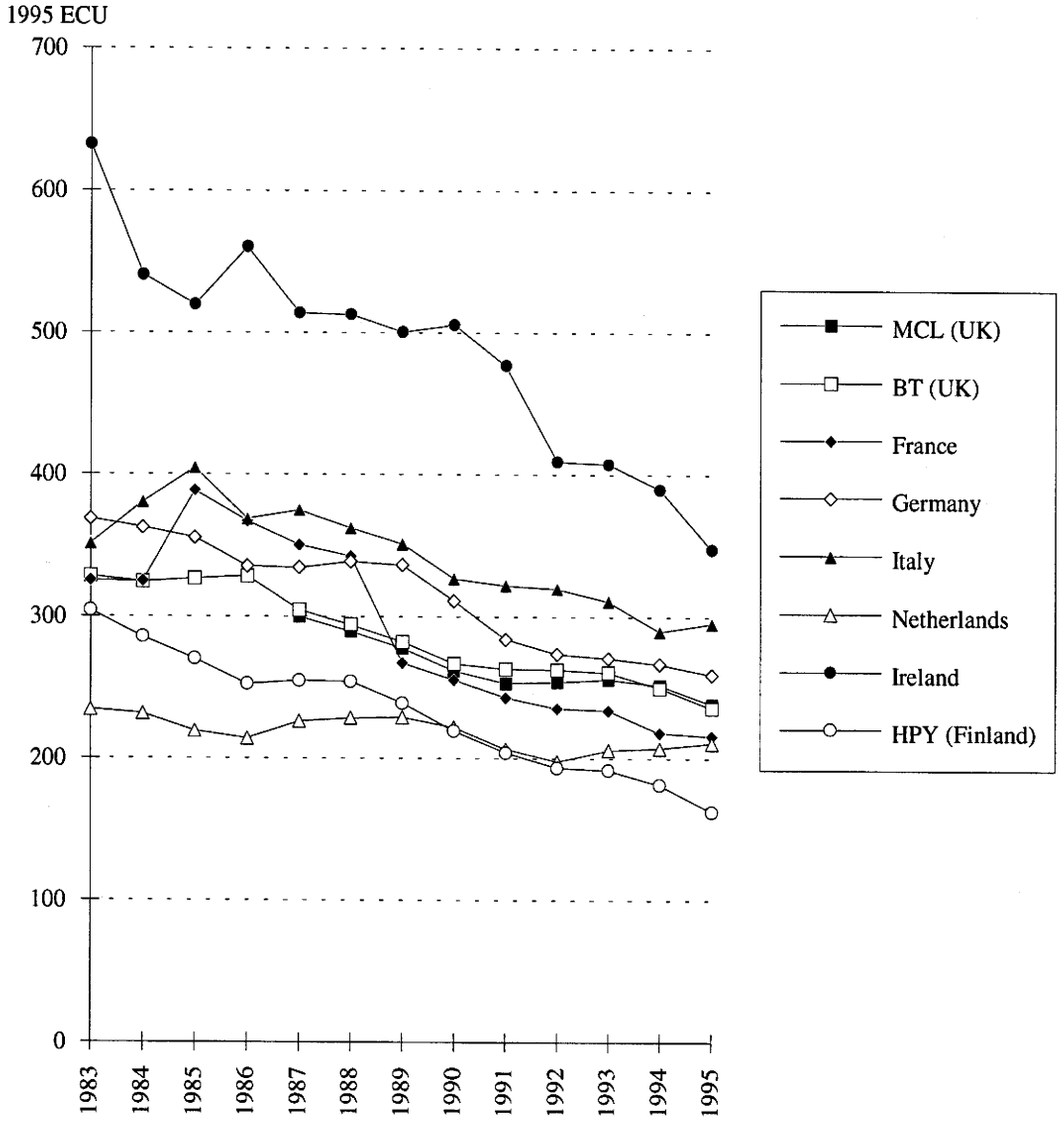
[40] See MZA [1995], volumes addressing CPE, for detailed analyses of country by country developments.

[41] See Appendix B1.2 for discussion of the issues of raw price differentials and corrected price differentials.

[42] Cecchini [1988].

Figure 4.28. Total cost of telephone service, average residential customer (average real cost per line) for eight EU TOs, based on published tariffs as at 31 January in each year



Source: Analysys [1995].

In summary, the impact of the single market programme on the telecoms equipment sector has led to significant benefits for EU consumers, through reduced prices and increased choice and flexibility.

5. The impact of single market measures on business strategies

5.1. Strategies in the telecoms equipment sector until the mid-1980s

This section examines the 'traditional' strategies which could be observed in the European telecoms equipment sector until the mid-1980s. A mid-1980s cut-off point is convenient because it pre-dates the most important single market measures, and also coincides with significant changes in telecoms equipment technologies.

Until the mid-1980s the European telecoms equipment sector could be characterized as a set of institutionalized national monopsonies (as described earlier in Chapter 4).[43] In each European country, the state public telecoms operator dominated the purchasing of telecoms equipment, including equipment for its own use and equipment for lease or sale to its subscribers. The procurement of telecoms equipment was closely integrated with national industrial policy, and a wide range of formal and informal measures served to protect domestic equipment manufacturing. The absence of accepted international standards in many key areas of telecoms equipment (for example, in trunk signalling and access unit signalling) also contributed to the division of Europe into distinct and self-contained national markets.

The cost structures for many important categories of telecoms equipment, such as switching systems and transmission equipment, contained a high proportion of fixed costs – research, development, overheads and capital equipment costs. The economies of scale resulting from these high fixed costs meant that each domestic equipment market could sustain only a small number of switching or transmission manufacturers. However, even for equipment categories with lower economies of scale, such as telephone handsets, there also tended to be only a small number of manufacturers in each market, in this case because there was little incentive for the monopsony PTO to maintain a larger number of suppliers.

The 'managed' approach to PTO procurement led directly to the strategies that were followed by equipment manufacturers in this period. In general, these strategies were composed from the following elements:

(a) **Integration across equipment types.** It was logical for the preferred national suppliers of different types of telecoms equipment to be integrated within the same corporate structure. The benefits of integration could be described loosely as economies of scope, although they derived primarily as an artefact of the managed sectoral environment rather than from the production characteristics of the equipment categories. In most European countries, integrated manufacturers produced switching equipment, transmission equipment and terminal equipment. As a result of this integration, each national equipment market tended to be dominated by a small number of relatively large, diversified manufacturers (e.g. GEC in the UK, Siemens in Germany, and Teli in Sweden).

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[43] See Foreman-Peck & Muller [1988] for a detailed analysis of national markets and Cecchini [1988] for an analysis of the consequences of this market structure.

(b) **Integration with the PTO.** In some countries the PTO was integrated with some of its most important suppliers through common state ownership structures (for example, Italtel in Italy, Teli in Sweden, and telephone handset manufacturing operations in many countries). In most countries there were very strong links between PTO research and development departments and equipment manufacturer product development departments, and it was common for manufacturers to produce equipment to match detailed proprietary specifications prepared by the PTO.

(c) **Integration with component suppliers.** Because of the protected nature of the equipment market it was common for manufacturers to be integrated far back into the value chain, and to produce a high proportion of their own components. In most cases, this did not result in an efficient value chain, although it would generally be a profit-maximizing strategy for the equipment manufacturer, and was also in line with national industrial policies. For many classes of electronic component, manufacturers justified their integrated operations on the grounds that the production of 'strategically important' components should be within their direct control.

(d) **Integration as part of a multinational parent group.** It was not incompatible with national industrial policy objectives or PTO procurement objectives for national equipment manufacturers to be owned by appropriate foreign parents, and indeed foreign ownership brought many benefits: product development costs could be shared with other countries, technology transfer could be achieved more easily, and the cost of investment capital could be reduced. For an ambitious international equipment manufacturer, the locally-approved creation or acquisition of national manufacturers was the only way to develop a multinational business. Although the costs and constraints of such a strategy were considerable, the benefits of operating in a protected market were attractive, and there was often no alternative entry route. Examples of operators which followed this strategy (although they implemented it in different ways) include Alcatel (following on from ITT), Ericsson, Siemens, AT&T and Philips. The resulting structures were best described as 'multi-domestic' corporations which lacked many of the horizontal linkages that characterize a true 'transnational' corporation.[44] To a great extent, these companies were constrained to match national manufacturing resources against national demand in each country of operation, and so could not access the efficiencies available from a rationalized European (or global) manufacturing strategy.

(e) **Integration with activities other than telecoms equipment manufacturing.** In an environment where telecoms equipment manufacturing has been managed as a 'strategic' activity within national industrial policy frameworks, it has been a natural development for equipment manufacturing to become integrated with other 'strategic' industries such as transportation, defence and power generation. All of the large European telecoms equipment manufacturers are integrated with other activities; indeed for many, telecoms equipment could not be described as the company's main activity.[45]

All these elements of strategy favoured the development of very large, diversified multi-domestic equipment manufacturers, and this can be seen in the market share statistics for the sector in Europe (see Section 4.2.7). Most product innovation in Europe occurred within the established structures (manufacturers, PTOs or state research facilities), but even where

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[44] Bartlett & Ghoshal [1989].

[45] Of the largest manufacturers, Ericsson is the most focused on telecoms; its only non-telecoms activity is a defence systems business.

innovation occurred outside the control of the existing players it was easily co-opted – small manufacturers required the patronage of the established players to prosper, and tended to be found as sub-contractors or component suppliers. Truly independent small manufacturers were a rarity.

5.2. Drivers of change for equipment manufacturers since the mid-1980s

This section describes five drivers of change which have undermined the earlier strategies of the telecoms equipment manufacturers, and shaped a significantly different set of strategies for the 1990s and beyond. The main drivers of change have been:

(a) an increased rate of technological change,
(b) changes in the purchasing behaviour of telecoms operators,
(c) erosion of national monopsonies,
(d) increased importance of global standards,
(e) rapid growth of non-OECD equipment markets.

5.2.1. An increased rate of technological change

Digital switching and optical transmission technologies reached commercial maturity in the 1980s, and marked a significant acceleration in the rate of technological change in the telecoms equipment sector. The impacts of this change have been profound:

(a) Product life cycles have shortened.
(b) Research and development costs have increased as a proportion of total product costs, and fixed production costs have increased for many categories of equipment (such as those with a high content of custom semiconductors, or a high software content).
(c) The requirement for continuous innovation has become increasingly important for sustained competitiveness.
(d) The overlap between computing technology and telecoms technology has increased, allowing competitive advantages in computing technologies (software, semiconductors, systems integration, etc.) to be transferred into the communications and telecoms sectors.
(e) The market for 'non-leading edge' products has diminished as the gap between the functionality of leading-edge products and products from the previous generation has widened (for example, in transmission systems, datacomms equipment and mobile communications).

The increased rate of technological change has, therefore, increased the potential competitive intensity of the telecoms equipment sector, and also increased the economies of scale which are available in many product categories, by increasing the importance of fixed costs. This means that the competitiveness of manufacturers (measured on a global scale, for specific equipment categories) has become more important, and the local competitiveness of manufacturers (measured in individual managed national marketplaces) has become less important. Greater economies of scale mean that the benefits of achieving competitive advantage are increased.

Equipment manufacturers have been aware of the magnitude and implications of these changes since the late 1970s/early 1980s, and recognized that their strategies had to change if they were to succeed in the new environment.

5.2.2. Changes in the purchasing behaviour of telecoms operators

Since the mid-1980s national telecoms operators have been preparing themselves for a competitive market for telecoms networks and services, and for their transition from public entities to commercial entities, often with the expectation of full privatization. The preparations for this transition are affecting all parts of the TOs business, not least their procurement strategies.

A TO which is preparing for a commercial, competitive future must procure the best equipment at the best price, and must measure price and functionality against global benchmarks, because its future competitors are likely to operate with leading-edge equipment, and its shareholders will expect a globally competitive rate of return. Given these priorities, the procurement strategies of TOs could not accommodate the continuing patronage of protected national equipment manufacturers.

At the same time, many national governments have recognized that it is not in the national interest for the competitiveness of the national TO to be sacrificed for the continuing protection of national equipment manufacturers. This recognition is particularly strong where there is an intention to privatize the TO, and a good privatization price depends on the perception that the TO's procurement strategy is reasonably free from industrial policy constraints. This does not mean that national industrial policies have abandoned telecoms equipment manufacturers, but many of the former protective instincts have substantially diminished.

To date, the changes in TO purchasing behaviour have not resulted in dramatic market share shifts (see Section 4.2.7), but they have had a significant impact on equipment manufacturer strategies:

(a) The rationale for the 'multi-domestic' strategies described in Section 5.1 is greatly undermined when TOs are freed from the inclination and obligation to purchase domestically. The inefficiencies and inflexibilities of the multi-domestic approach are quickly exposed when a TO begins to search globally for leading-edge products produced by manufacturers which have access to large economies of scale through more concentrated production.

(b) Many of the 'economies of scope' described in Section 5.1 disappear when the protection of national markets is removed. A wide portfolio of 'average' equipment is vulnerable to niche players with world-class equipment in a particular category. In the new environment it is increasingly difficult for any manufacturer to sustain the levels of innovation and investment that are necessary to have a full coverage of successful telecoms equipment products.

5.2.3. Erosion of national monopsonies

The gradual admission of competing operators and service providers into an increasing portion of the telecoms services market is beginning to undermine the historical monopsony

of the national TO. Although this process is still in its early stages, it has already made an impact on equipment manufacturer strategies:

(a) **Many manufacturers are targeting new network operators and service providers as important customers for telecoms equipment.** There are several categories of new network operator and service provider, each at different stages of development in Europe, and each with different equipment requirements and investment characteristics. The most mature group are the non-PTO mobile operators (e.g. Vodafone, Mannesmann Mobilfunk and SFR), followed by the non-facilities-based new entrants, including TOs entering foreign markets (e.g. SITA, Transpac and Concert). The least mature group are the facilities-based new entrants (e.g. Vebacom, Energis and Hermes), although operators in this group are likely to make the largest telecoms equipment investments in the coming period.

(b) **Manufacturers are taking advantage of new routes to market for terminal equipment and corporate networking equipment.** The removal of TO monopoly rights in the terminal equipment and corporate network equipment markets has given equipment manufacturers the opportunity to develop new distribution channels, either through direct sales or through distributors (see Appendix A1).

The transition from a managed monopsony to a more commercial environment for marketing and distributing equipment is challenging for the manufacturers who were used to operating with the former structures. The strategic and organizational implications of this transition are fundamental and wide-ranging.

5.2.4. Increased importance of global standards

Standards have always been important in the telecoms equipment sector, but it is only in the last decade that they have achieved a central role in the formulation of equipment manufacturer strategies. A mix of formal standards (e.g. in the fields of GSM, ISDN and SS7), quasi-formal standards (e.g. for ATM, TCP/IP and NMT) and proprietary standards in corporate networking (e.g. token ring, SNA and Netware protocols) have achieved positions of great importance in the sector.

The impact of these standards on equipment manufacturer strategies has been substantial:

(a) A standards-driven market has lower barriers to entry for small players with innovative products, and larger players are therefore forced to be pro-active with their product planning, rather than defensive. Although smaller manufacturers are particularly dependent on the existence of standards, the creation of accepted global standards is, in most cases, a significant benefit to all players in the sector, through the reduction of costs and risks.

(b) Where a manufacturer establishes a particularly strong capability or competitive advantage in a standardized product area, it can penetrate national equipment markets more rapidly and with lower costs and risks. For example, Ericsson and Nokia have been able to exploit and sustain their strong position in digital cellular systems because of the widespread acceptance of the GSM standards. Similarly, Cisco Systems has been able to capture a large share of national router markets because of the widespread acceptance of the TCP/IP standards. Competitive manufacturers can be more aggressive in their business planning where their products are supported by accepted standards.

5.2.5. Rapid growth of non-OECD equipment markets

Although the larger equipment manufacturers have always been interested in the non-OECD telecoms equipment markets, it is only in the last decade that the size and growth rates of these markets have reached a level where they have become a major focus of corporate strategy.

In order to succeed in these rapidly developing markets it is necessary to be truly competitive on price, functionality and quality. This increased pressure to achieve global competitiveness has accelerated the demise of the multi-domestic strategies of the large manufacturers (described in Section 5.1 above). For world-class competitiveness it is necessary to have a high degree of focus on each targeted product category, which requires a clear concentration of responsibility within the organization. The multi-domestic model does not deliver this degree of focus.

5.3. The role of single market measures in changing manufacturers' strategies

This section examines the role of single market measures in each of the drivers of corporate strategy described in Section 5.2 above.

Table 5.1. Single market measures and drivers of manufacturer strategies

	Drivers of change in strategy (see Section 5.2 above)	Relevant areas of the single market programme	Assessment of the importance of the single market programme for manufacturers' strategies
1	An increased rate of technological change	R&D measures	Low
2	Changes to the purchasing behaviour of telecoms operators	Telecoms services measures Public procurement measures	High
3	Erosion of national monopsonies	Telecoms services measures Approvals measures Competition measures	High
4	Increased importance of global standards	Standards measures R&D measures	Moderate
5	Rapid growth of non-OECD equipment markets	Not applicable	Nil

Single market measures have had a particularly important impact on the development of equipment manufacturer strategies, by changing the purchasing behaviour of the major customers of telecoms equipment, the TOs, and by dismantling the national monopsonies that have traditionally existed for telecoms equipment. Looking at each of these areas of impact in turn:

(a) The single market programme has had relatively little impact on the technological changes that have been a key driver of equipment manufacturer strategies. The speed

and direction of technology change have been set in a global context rather than a regional or national context.

(b) The single market programme has been a crucial factor acting to change the purchasing behaviour of TOs. In the absence of key single market measures these changes would have been slower, uncoordinated between EU markets, and less radical.

(c) The single market programme has been a key driver of the move away from national monopsonies (and near-monopsonies) for telecoms equipment.

(d) The single market programme has had a valuable but secondary role in the development of global standards. There are examples of specific contributions on matters such as GSM (see Appendix A3), but other bodies, such as the ITU, CEPT, ETNO, the ATM Forum, the Internet Engineering Task Force etc. have been the main drivers of the formation of key global standards with major impacts on manufacturer strategies.

In summary, the single market programme has had several important and specific impacts on the issues that are driving European equipment manufacturer strategies.

5.4. Strategies in the telecoms equipment sector in the 1990s

5.4.1. Large manufacturers

The largest manufacturers are primarily focused on achieving and maintaining competitiveness in the global marketplace. It is no longer possible to succeed through focusing only on the management of a collection of local markets. A more integrated approach to product development strategy has become essential, and the required economies of scale can only be accessed through a 'transnational' approach to the marketplace.[46]

The transition from a multi-domestic approach to a transnational approach is illustrated in Figure 5.1. The inversion of the product/country matrix for a large organization such as Alcatel or Siemens is a major challenge, requiring enormous changes in corporate culture and systems. The transformation must be managed so that there is no damage to traditional customer relationships, customer support, product support or company control mechanisms. The morale of managers and workers must be maintained through a period of uncertainty and upheaval, and the continuity of product development and production operations must be protected.

The complexity and risk of restructuring mean that the transition will take several years to complete. Alcatel, Ericsson and Philips are currently conducting high profile transformation programmes along the lines shown in Figure 5.1, but similar processes are underway at Siemens, Nortel and elsewhere.

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[46] See Bartlett & Ghoshal [1988].

Figure 5.1. Transition of large equipment manufacturers from 'multi-domestic' forms to 'transnational' forms

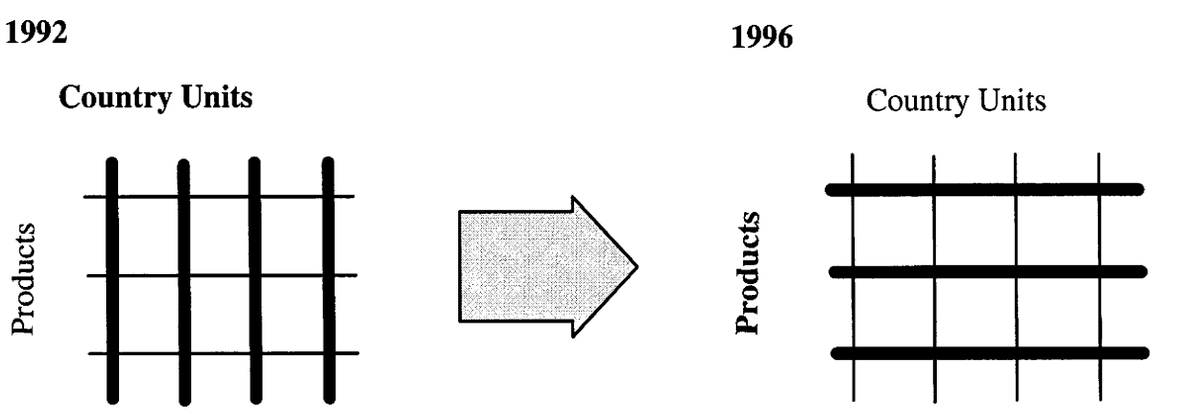


Table 5.2 summarizes the main areas of strategic focus for Europe's 10 largest telecoms manufacturers in 1995. As well as the transition to transnational operations, the following key strategic areas are identified:

(a) Development of non-EU markets. Non-EU markets are particularly important for manufacturers of public switching and transmission systems (notably Asian markets), and mobile systems and terminals (North America and Asia). Central and East European markets also need to be addressed by manufacturers of these products who want to achieve a level of global market share that delivers the necessary economies of scale. Addressing these markets means operating on a truly global basis, which presents manufacturers with significant strategic and organizational challenges.

Table 5.2. Areas of strategic focus for Europe's ten largest telecoms equipment manufacturers, 1995

	Transition from multi-national to transnational	Develop non-EU markets	Rationalize operations to reduce costs	Focus on specific areas of the product range	Develop alliances with other manufacturers
Alcatel	✓	✓	✓		
Siemens	✓	✓	✓		
Ericsson	✓	✓	✓	✓	
Nokia		✓	✓	✓	
Bosch			✓		✓
GEC			✓		✓
Ascom			✓	✓	
Matra			✓		✓
Philips	✓	✓	✓		
Nortel	✓	✓	✓		

(b) All the large manufacturers are faced with the requirement to adjust their operations to reflect the changing nature of telecoms equipment development and production. Plant closures, partial closures, sales of 'non-core' businesses, and voluntary and compulsory redundancies are all observable consequences of the requirement to control costs and match capacity against demand.

(c) As competitive intensity increases, there is a greater incentive to specialize in areas of competitive strength. The clearest examples of specialization strategies are Ericsson and Nokia, who are increasing the focus of management, capital investment and technical resources on their mobile systems and terminals businesses. Most other large manufacturers are recognizing that they cannot expect to compete successfully in all areas of the telecoms equipment market, and they are identifying weak areas in their range for disposal or withdrawal.

(d) Alliances have been a key feature of the development of the sector since the 1970s, and remain an important focus for manufacturers' strategies. For those players that are concerned about the relatively small scale of their operations or their limited 'market reach' in the global marketplace, alliances are particularly important. Whereas in the 1980s alliances were pursued to gain access to specific national markets, in the 1990s alliances are attractive to players looking to escape from limited national or regional markets.

It is notable that the large EU equipment manufacturers have, in general, not chosen to focus primarily on defensive or obstructionist strategies designed to delay the increase of competitive intensity in their traditional markets. This has almost certainly been a rational choice: it is unlikely that a defensive strategy could have succeeded in the EU political and industrial climate of the 1990s, and given the speed with which a truly global equipment market has developed.

The single market programme has had a significant impact on the current strategies of the large EU equipment manufacturers.

5.4.2. Medium-sized manufacturers

Excluding medium-sized operations which are subsidiaries of the larger players, medium-sized companies account for only 10% to 15% of EU telecoms equipment sales.[47] Medium-sized players can be divided into those firms for which the new environment is an opportunity (such as many of the ISDN equipment suppliers, telecoms software houses, test equipment makers and datacomms equipment manufacturers) and those firms which are threatened, as their traditional dependence on a single local PTO customer is challenged.

(a) Firms in the first category have a relatively clear strategic focus. They tend to have an over-riding product or service specialization which drives strategy formation for the business. Alliances and distribution agreements tend to be important elements of strategy for product-based firms, being necessary to achieve the required 'market reach'. Firms which are offering telecoms equipment 'services' (such as systems integration) tend to share the strategic concerns of the business services sector – personnel resource constraints are the main determinant of growth and profitability, and tend to be the main

[47] It should be noted that some of the output of firms in the fields of software development or systems integration is not captured under the telecoms equipment categorization codes.

focus of strategy. There are relatively few firms in this category in the EU (compared with the US environment). In the US there are a large number of firms with turnovers between ECU 50 million and ECU 500 million producing corporate networking products, telecoms software products, satellite-related products and terminals-related products (software and hardware). All of these are areas where EU competitiveness is weak. The single market programme has created a much more favourable environment for the development of such firms in Europe, but it will be several years before the effects of this improvement are visible. Those few firms that already exist are more likely to thrive in the current EU environment than would have been the case before the single market programme.

(b) Medium-sized firms which are threatened by the increase in competitive intensity have very few strategic options. Compared to the larger manufacturers they are much less able to absorb continuing price falls, and they are unlikely to be able to invest in major product development programmes to maintain their product ranges. The opportunity of being acquired by a larger group (at an attractive price) is much reduced, now that a local manufacturing presence is not an essential pre-requisite for entering a national market. Many of these manufacturers are either state-owned or part of a diversified industrial group. The most likely strategies for these manufacturers entail a gradual winding-down of capacity, with minimal capital investments and the disposal of those parts of the business that continue to be viable.

5.4.3. Small manufacturers

There has been a significant growth in the number and importance of small firms in the telecoms equipment market in recent years, even though they still only account for a few percent of turnover in the sector. Single market measures have been an important enabler for the growth of small firms, combined with the increasing number of technology-driven market opportunities for small entrants in areas such as datacomms, voice processing, and subcontract development work for larger players.

It will be several years before the creation of an environment that is more conducive to the creation and growth of small telecoms equipment players results in a significant increase in the share of equipment production arising from small players. However, the benefits of such a transition (in terms of EU competitiveness, innovation levels and employment in the sector) will be considerable, and the single market programme represents major progress towards this goal.

APPENDIX A

Case studies

A1. Alcatel Business Systems Group

A1.1. Preliminary remarks

The figures used to support this case study are those of the Business Systems Group (BSG) for the period 1987 to 1994. The BSG product portfolio is wider than just PBX systems. Although BSG's products have changed over the period, it is the closest approximation to Alcatel figures within the private switching business.

Since the end of 1995, Alcatel has been reorganized and PBX are now part of the newly-created 'Business Systems Division', which also includes Terminals and Datacomms.

A1.2. History of Alcatel's private switching business

1986

Acquisition by CGE (Compagnie Générale d'Electricité) of 56% of ITT's worldwide telecoms operations, and the creation of Alcatel NV joint venture (37% owned by ITT, 56.3% owned by CGE) to handle all cable and telecoms businesses.

1987

The decision to privatize CGE was made in January: privatization was completed in May.

The jump of BSG's turnover from FF 7.5 billion to FF 17.5 billion (23% of Alcatel NV's turnover) was mainly due to the integration of former ITT subsidiaries within the newly-formed Alcatel NV.

The first restructuring exercise for Alcatel NV was as follows:

(a) Alcatel Business Systems Inc. to regroup all BSG activities in the USA except for Friden Alcatel (mailroom systems);
(b) a merger to take place between Telic Alcatel and Alcatel Electronique in France;
(c) the disposal of Sesa (France), GSI (France) and the 'consumer goods' part of SEL (Germany) to be carried out;
(d) the Dial acquisition, giving Alcatel 15% of the corporate Italian market, to be completed.

At this time, Alcatel's production was in the region of 2 million PBX lines across the whole PBX range. It was Europe's leading manufacturer, and the second largest worldwide (with a 20% market share).

Figure A.1.1. Turnover analysis

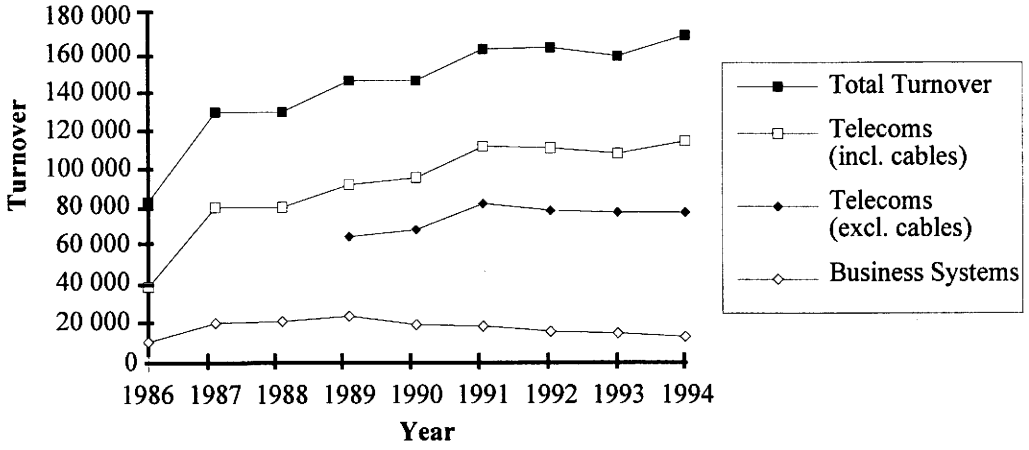
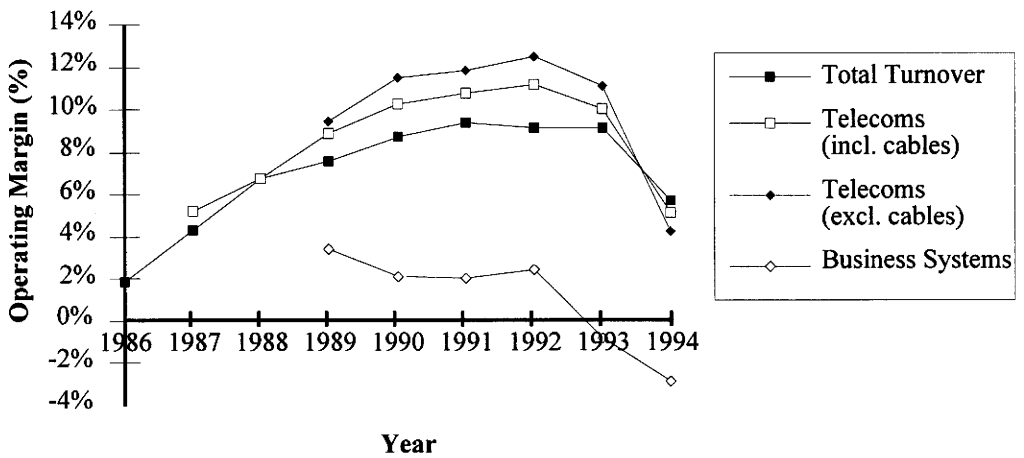


Figure A.1.2. Operating margin analysis



1988

There was a 4% increase in BSG turnover to FF 18.2 billion (23% of Alcatel NV's turnover).

Alcatel's share in the French PBX market share rose to more than 50%.

The new Telic 2600 Delta (ISDN-compatible, integrating voice and data communications) was launched. Alcatel made the following statements in its annual report:

'In order to take advantage of the deregulation process in Europe [...], Alcatel has reinforced its position as European leader by using the industrial and technological strength of its Telic Alcatel subsidiary and its subsidiaries in all European countries.'

'The aim of Alcatel is to propose in every country in which it is represented, [PBX] ranges using a unified technology through progressive rationalization of products within the different subsidiaries, and to create a distribution organization adapted to each country.'

Restructuring of the distribution networks in Belgium, Spain, Italy, Norway and Portugal took place.

BSG refocused its core business through the disposal of its computer manufacturing activities (Qume and Alcatel Information Systems in the USA).

1989

In Belgium, the Netherlands and Italy the set-up of distribution structures was finalized, having been adapted to fit in with the deregulation of private switching activities across Europe.

Alcatel reinforced its position with the following activities:

(a) acquisition of two PBX distributors and maintainers in France (Sofintel and l'Abonnement Téléphonique);
(b) acquisition of the private switching activities of Scanvest Ring in Norway;
(c) acquisition of a shareholding in two distributors and maintainers in the UK;
(d) public offer for the PBX manufacturer National Telecommunications (finalized in 1990) in the UK.

Restructuring of the private switching sector in France concluded in 1990 with the following structure:

(a) one manufacturer: Alcatel Business Systems;
(b) five distributors: Opus Alcatel, Telic Alcatel, Alcatel Data Systems France, Satas, Intervox.

At this time, Alcatel's production was in the region of 2.7 million PBX lines across the whole PBX range. It was Europe's leading manufacturer and the second largest worldwide.

The general evolution of Alcatel PBX range involved the following events:

(a) approval in Germany of a new digital PBX (less than 100 extensions) derived from the T1600, and developed first for the French market;
(b) the launch of the Opus 40/80;
(c) approval of the 2600 Delta (200 to 300 extensions) in Germany.

An agreement was made with Siemens to propose a common protocol for heterogeneous private networks ('IPNS Forum').

An agreement was made in Egypt to manufacture Alcatel PBXs locally (30,000 lines p.a.).

BSG finalized the disposal of its computer manufacturing activities (sale of CTM, a subsidiary of Alcatel SEL).

1990

1990 saw the market slowing down, as it became more sensitive to short-term economic life cycles than public switching, and BSG's turnover fell from FF 20.6 billion to FF 16.1 million.

Alcatel estimated that three factors allowed the company to fare better than its competitors: its ongoing restructuring efforts, the density of its distribution network, and its leadership of the market in Europe.

In order to access new markets, Alcatel acquired local companies or created joint ventures with local partners as follows:

(a) the acquisition of National Telecom (manufacturer of small PBXs) in the UK;
(b) a joint venture with a Yugoslavian company (serving almost half its home market) for the manufacture of PBXs;
(c) an agreement in Hungary with a manufacturer and a subsidiary of the national telephone company;
(d) the opening of subsidiaries in Czechoslovakia and Tunisia.

Alcatel announced that it had developed a protocol with Siemens for heterogeneous PBX networks and that the protocol had been adopted by other manufacturers.

1991

Difficult market conditions at this time were due to two main factors:

(a) the slow-down of capital spending by clients (caused by the slow-down of the world economy);
(b) strong pressure on prices caused by competitors from South-East Asia entering the terminals market (not the PBX market).

BSG continued to refocus its core business, through the disposal of the mailroom systems activity, while Alcatel continued to adapt its production capacity to match market evolution.

BSG's turnover fell again, from FF 16.1 billion to FF 15.3 billion. However, its market share in Germany, Italy and Belgium increased and it maintained its leading position in France and Portugal.

There was a general evolution of Alcatel's PBX range. Identical, or at least compatible, systems were available in most countries following rationalization and harmonization of the PBX range which had started a couple of years before.

1992

BSG's turnover fell from FF 15.3 billion to FF 12.4 billion, mainly because of the disposal of its mailroom systems business and the continuing pressure on its clients' capital spending budgets. Fax R&D and manufacturing was also disposed of in early 1992.

The rationalization of production capacities in Europe continued through this period.

Harmonization and simplification of the PBX range also continued through this period, as part of the process of convergence with ATM.

Alcatel Business Systems opened subsidiaries in Bulgaria, Hungary, Kazakhstan, Poland, Russia, Slovakia and Tchequia. It also won important contracts in Chile, China, Malaysia and Thailand.

1993

Although not published, BSG's turnover was estimated[48] at this time to have decreased from FF 12.4 billion to FF 11.5 billion.

On 1 January 1993, Alcatel merged its two previously separated distribution networks in France (Opus and Telic) to form ARE (Alcatel Réseaux d'Entreprise).

Alcatel announced the Alcatel 4000 series, which would allow for the evolution to ATM from all existing Alcatel equipment.

Alcatel announced a specially designed Alcatel 4300 series for rural areas. Contracts for the series were won in Latin America and China. Alcatel also announced customers in Costa Rica, Slovakia, Turkey and Venezuela for the large capacity version of the 4300.

1994

The Alcatel PBX offering was completely reorganized around the 4000 series as follows:

(a) the Alcatel 4210/4220 PBX was rebadged and sold within 13 European countries, and was also distributed by operators in France and the UK;
(b) the Alcatel 4400 (between 150 and 800 extensions) was approved and distributed in France, Germany, Austria, Belgium, the UK and Portugal. Its introduction into many other European countries was planned for mid-1995.

Alcatel established a joint venture to manufacture, distribute, install and maintain PBXs in China (Shanghaï Bell), where the potential market is estimated at 4 million lines per annum.

A1.3. Single market impacts on Alcatel's PBX business

A1.3.1. Sourcing patterns and upstream/downstream linkages

Downstream impacts

The single market programme has raised the expectations of clients in terms of PBX interfaces, respect of conformity with standards, etc. Multinationals are now looking for European products and have quickly learned to play suppliers against each other.

With the creation of the single market, clients have increased expectations that PBXs should be transparent for more than just basic voice telephony. In this context, measures such as the Mutual Recognition of Conformity have been welcomed by large users and by manufacturers such as Alcatel. However, there is a danger that if PBX standardization focuses too much on the specification of low-cost equipment, the resulting PBXs will only be able to perform a minimum set of functions. There is also some concern that, without proper specification and customer information, SMEs without testing facilities will be at a disadvantage to their larger counterparts. If no 'voluntary label policy' is promoted, SMEs could suffer, as they will not have the means to test the PBX they intend to buy, and 'plug and play' PBXs are still not available.

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[48] Source: Chevreux de Virieu.

Upstream impacts

In chip design and manufacture, European efforts such as ISDN have enabled the European industry to become more competitive. For example, AMD (the US chip manufacturer) found it difficult to follow the evolution of the ISDN standard closely, and this left the market open for the success of Siemens' ISDN chips. Siemens was keen to make a major investment in this area, based on its assessment of the opportunity to sell its chips on a European scale.

In PBX, and as far as Alcatel is concerned, there are no upstream impacts for European manufacturers. Indeed, Alcatel CPUs are sourced from Intel or Motorola, and transmission chips are ASICs from Alcatel.

A1.3.2. Productivity and competitiveness

Productivity

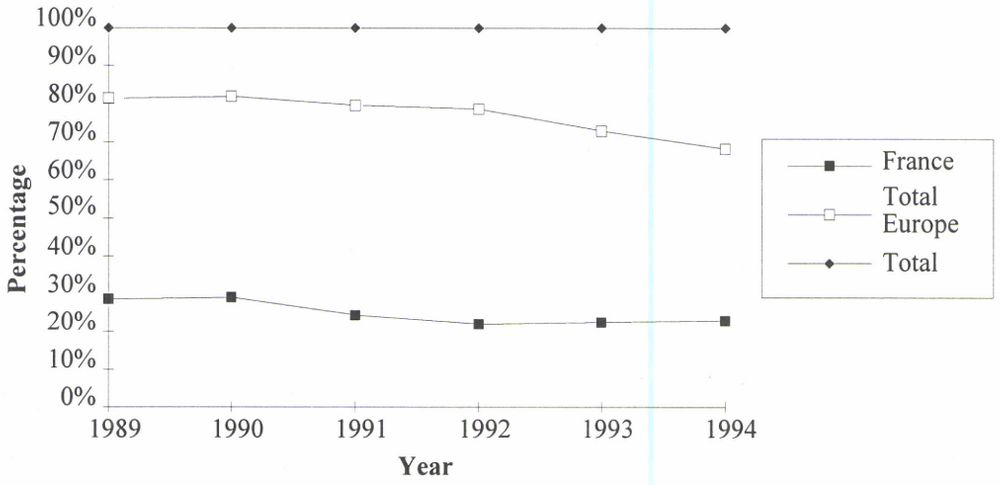
Software development costs are becoming more and more important for PBX manufacturers. In this respect, Alcatel made labour productivity gains by choosing the CHORUS operating system for its new 4210/4220 and 4400 series. The choice of CHORUS and the resulting productivity gains were linked to the evolution of the UNIX world and the convergence between telecoms and computing rather than the single market programme. However, there is still the question of the relationship between the success of CHORUS itself in Europe and the USA and the single market programme.

Competitiveness

Alcatel was competitive enough to have a truly European customer base as early as 1986, through its acquisition of 56% of ITT's worldwide activities.

As shown in Figure A.1.3, Alcatel's overall telecoms sales (not just PBXs) in France fell in percentage terms over the period 1989 to 1994, and have now more or less stabilized at around 23%. A similar pattern has been seen in Alcatel's European sales (which are now below 70% of its total sales), while the rest of the world accounted for more than 30% of its sales in 1994, of which almost 14% were in Asia and less than 6% in North America.

Figure A.1.3. Geographical breakdown of Alcatel's telecoms sales



A1.3.3. Scale and scope effects

Economies of scale

As mentioned briefly above, Alcatel is now in a position to make the most of scale economies, having almost completed the rationalization of its PBX range. Although this rationalization was necessary, the single market programme enabled Alcatel to go much further in the homogenization of its PBX range than would have been possible in an environment where it would have had to sell PBX in 15 different markets, each with its own set of standards and approval procedures. For this reason, the Terminal Equipment and Mutual Recognition of Type Approval Directives were at least a catalyst for Alcatel's rationalization efforts.

Terminals such as handsets for connection to Alcatel PBXs are now part of the same family as the 4210/4220 and 4400 range ('reflex' handset) – an improvement on the days when each Alcatel range of PBXs had its own range of terminals. However, the re-badged 4300 and 4600 are still sold with the old terminals of the Opus and Telic ranges.

ETSI has so far failed to persuade manufacturers to produce and market the 'universal terminal' which could be connected to any brand of PBX. Every manufacturer, including Alcatel, has its proprietary protocols which prevent other terminals being connected to its PBX. This 'competitive bias' now extends to the lifetime of a PBX, which used to be 15 years but is now down to just seven or eight years. This means that terminals can be transferred to the next PBX, giving an obvious price advantage to the existing PBX supplier when tendering for a PBX renewal.

A universal ISDN terminal has been very slow to emerge, but the blame for this delay does not lie with the manufacturers. PBX manufacturers have had to concentrate on developing ISDN terminals according to ETSI's specifications, and ETSI working groups have produced standards for terminals which are high in functionality but correspondingly expensive. The standards were oriented towards equipment for residential customers using basic-rate ISDN, in the belief that this group would lead the development of ISDN. Since the terminal was conceived as being standalone, the PBX intelligence has not been re-used in the standard,

which explains the high cost of a conformant ISDN functional PBX terminal. With current market conditions and pressure on price, Alcatel and other manufacturers have no choice but to market cheaper 'stimuli' terminals behind their PBX.

All of the above might change with the ADSI (Analog Display Services Interface), developed by Bellcore and made available as an open non-proprietary protocol for implementation in 1993. Indeed, ADSI might sound the knell of proprietary terminals, because it enables 'enhanced services' to be provided over the PSTN to standard (screen based) stimuli phonesets. However, there is no implementation of ADSI over a PBX yet, and it remains to be seen whether manufacturers will do it or not.

Economies of scope

Realization of potential economies of scope is an area of weakness for Alcatel (as for many other large manufacturers), but these difficulties cannot be solved by the single market programme. For example, although ISDN and GSM protocols are similar in concept to the work of ETSI, GSM development teams have tended to start from scratch instead of building on the competence of ISDN development teams. This illustrates the potential organizational problems for large companies such as Alcatel.

The grounds on which to build economies of scope were certainly there, but manufacturers in general, and Alcatel in particular, have been slow to exploit them. Things are starting to change within the company, however, and the use of DECT with a 4200 or 4400 PBX seems to be a technical success, showing the trend of increasing economies of scope and better co-operation among development teams.

A1.3.4. Changes in market access resulting from the single market programme

Prior to 1988, the PBX market in Europe was similar to the public switching market in that it was difficult to get approvals in foreign markets, and so to sell PBX in Europe. Moreover, each PSTN had its own protocols and technical interfaces, which made it impossible to sell the same product in different European countries.

CGE partly avoided the 'approval hurdle' by forming a joint venture in 1986 – Alcatel NV, in which it bought 56% of ITT's worldwide telecoms operations, thereby gaining access to many new European markets.

Directive 91/263/EEC (Mutual Recognition of Conformity) simplified the approval process across Europe, with technical specifications being based on European rather than national guidelines, but its positive effects are only now being felt by Alcatel. Even within a single country such as France, achieving a nationwide conformant system can be a long process. France Telecom implemented six different versions of ISDN before finally converging with Euro-ISDN. One problem is that separate national versions of ISDN can act not only as a barrier to entry for foreign players, but also as a 'self-imposed' barrier to entry for players outside their home market. Development money could be put to better use if Alcatel – and others – could avoid so many versions for the French market only.

During the period under review, Alcatel had different families of PBX in various countries. The group even had two different families in France, due to the acquisition of Thomson Télécommunications in 1983, which brought the OPUS range of PBX.[49]

In 1995, Alcatel claimed to have completed its rationalization programme and proposed a unique range of PBXs across Europe, the Alcatel 4000 series, which is fine-tuned for each geographical market. However, the reality is more complex since the Alcatel 4000 series encompasses both new products and old products which have been re-badged.

Table A.1.1 shows the evolution of Alcatel PBX range in a number of countries.

Table A.1.1. Evolution of Alcatel's PBX range

Country	1985 to 1992	From 1993 onwards
France	Telic 1600 and 2600 Opus 300 & 4000 ISN 40	*Re-badged* Alcatel 4100 Alcatel 4600 M/L (previously Telic 2600) Alcatel 4300 VS/S/M/L/VL (previously Opus 300 & 4000)
UK, Sweden	Opus 300 & 4000	*New Products* Alcatel 4210/4220 & 4400
Germany	SEL 5605, 5610, 5625, 5630 SL	
Belgium	5400 BCN (ITT origin)	
Spain	Alcatel 12 & 100 Opus 300 & 4000	
Italy	Opus 300 & 4000 Telic 2600	

There are a number of reasons for this rationalization programme:

(a) the prospect of being able to sell the same core PBX in each European country;
(b) increasing R&D costs – having one core PBX for the whole of Europe allows Alcatel to concentrate R&D within one central lab, rather than the four or five which were previously used. The three main labs are now Colombes (for the 4400), Strasbourg (for the 4400 and 4210/4220) and Stuttgart (for the 4210/4220). The same goes for the reflex dedicated terminals);
(c) the push of multinational corporations to use the same base product in every country – this trend favoured North American players whose products were more modular than Alcatel's;
(d) liberalization of distribution channels. In many countries distribution was entirely controlled by the PTO. For example, Spain and Germany were not viable markets

[49] The actual merger was completed in 1985/86.

because Deutsche Telekom and Telefónica respectively had a monopoly on PBX sales and distribution.

The 1988 Terminal Equipment Directive had a strong impact on market access in countries such as Spain and Germany. However, even without this directive, Alcatel had avoided the problem by acquiring (in 1985) an ailing local PBX manufacturer in Spain (Standard Electrica) and signing a framework distribution agreement with Telefónica against a promise to keep Standard Electrica staff.

After a period of acquisitions, Alcatel's positioning in various European countries in 1994 was as shown in Table A.1.2.

Table A.1.2. Alcatel market position in Europe, 1994

Country	Alcatel rank (market share)	Manufacturers acquired
France	1 (45%)	Thomson CSF Téléphone (1985/86)
UK	10 (3%)	National Telecom (1990)
Sweden	3 (15%)	
Germany	2 (14%)	SEL (ITT - 1986)
Spain	1 (30%)	Standard Electrica (1985)
Italy	1 (17%)	Dial (1987)

Source: Arcome, 1994.

Even though the monopoly on PBX sales and distribution has disappeared throughout Europe, the problem of distribution circuits still exists, because PBX installation and maintenance is largely a locally-based business in which it is difficult to have a European approach (except for large corporate accounts). However, this is not a single market problem: it is not an aim of the single market programme to give an advantage to multinationals such as Alcatel to work locally to the detriment of local maintainers.

In summary, with regard to market access, the single market programme was a secondary factor in explaining Alcatel's acquisitions and subsequent rationalization programmes. However, we would argue that Alcatel's developments in Europe would have been slower without the harmonization of a commercial environment, and without the removal of barriers to trade brought about by the single market. Alcatel itself recognized at an early stage that the single market was a catalyst to expand into Europe:

'In order to take advantage of the deregulation process in Europe [...], Alcatel has reinforced its position as European leader by using the industrial and technological strength of its Telic Alcatel subsidiary and its subsidiaries in all European countries.'

'The aim of Alcatel is to propose in every country in which it is represented, [PBX] ranges using a unified technology through progressive rationalization of products within the different

subsidiaries, and to create a distribution organization adapted to each country.'[50]

A1.3.5. Direct short-term impact on production costs

As explained in Section 4.2 of the main report, single market measures are not, by and large, the main driver of falling production costs for equipment.

Rationalization of Alcatel's various families of PBX has certainly allowed production costs to decrease (scale effects). If the data were available, it would be interesting to distinguish between small/very small PBXs and large/very large PBXs, as these are likely to have different production economies.

Following its rationalization programme, Alcatel production is now organized as follows (Table A.1.3):

Table A.1.3. Alcatel manufacturing countries, 1996

PBX range	Country of manufacturing	Main markets served
Alcatel 4600 M/L	France (Brest)	Europe
Alcatel 4300 VS/SM/L/VL	France (Brest), China (Shanghaï)	Europe + China
Alcatel 4210/4220	France (Brest)	Europe
Alcatel 4400	France (Brest)	Europe

It is also possible to argue that the prospects of the single market provoked the entry of many competitors from North America and Asia (terminals), which in turn provided a major incentive for European players such as Alcatel to lower their production costs. This is a similar situation to the price cap imposed on telecoms tariffs in the UK, to encourage greater efficiency in BT; the difference is that the price cap on equipment manufacture is being self-imposed by new entrants to the European market.

However, these changes are at best indirect consequences of the single market programme. At worst, it is possible that Alcatel's rationalization would have been necessary, and that North American and Asian players would have entered Europe even without the single market.

A1.3.6. Evolution of final prices

It is clear that the 1988 Terminal Equipment Directive has significantly increased competitive intensity in EU PBX markets, and that final prices have fallen substantially in real terms in the years following the enactment of the directive in each national market.

The price history of three different PBX ranges in France and Germany has been analysed.[51] The analysis was carried out for the overall market, not just Alcatel, but the approximation

[50] Annual Report 1988.
[51] Source: MZA report, *The European Telecommunications Market* – prices per extension, excluding terminals.

should be acceptable, as Alcatel is the leading player in France and the second most important in Germany.

As shown in Figure A.1.4, prices in Germany were much higher than those in France in 1990, due to Deutsche Telekom's monopoly on PBX distribution. Since then, however, prices have fallen quite drastically in Germany. The greatest reduction in prices was for PBXs with between two and ten extensions, which occurred as a result of the arrival of Asian competitors in the German market.

Figure A.1.4. Historical price trends for PBXs in France and Germany (nominal ECU per extension)

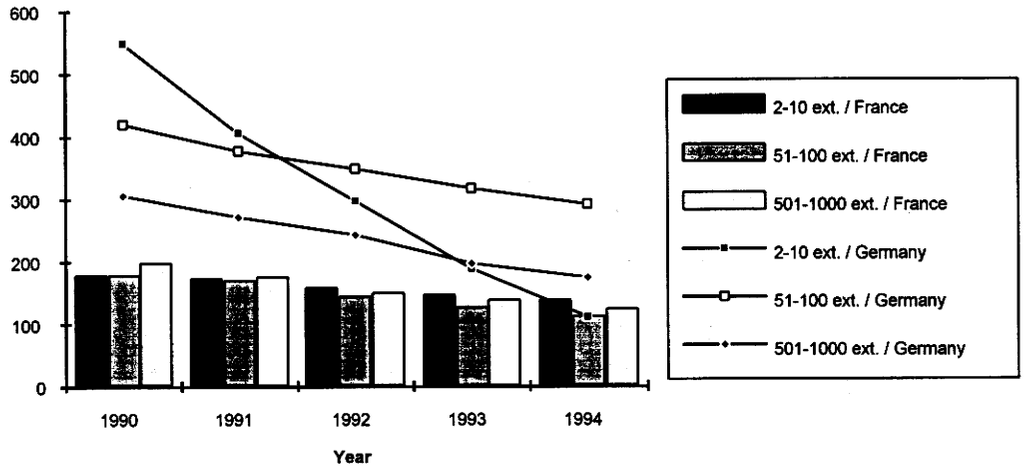


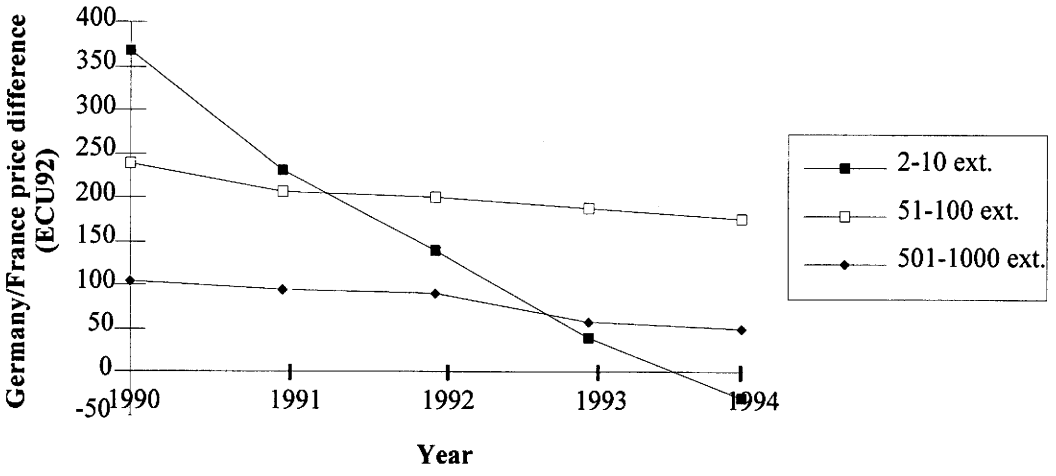
Figure A.1.5 shows that there has been some price convergence in all categories between German and French prices, but that there is still a relatively high price difference in absolute terms between the German and the French market in all size categories except for the 2-10 extensions range.

Final prices have fallen dramatically, but it must be borne in mind that the average life of a PBX has been halved from 15 years to just 7 or 8 years. Until the mid-1980s there were no published catalogue prices. PBXs do now have published catalogue prices, which are falling over time. However, it should be noted that although Alcatel (and others) have been pressurized to reduce their PBX published prices, they have tended to increase the price of additional (optional) PBX features and services, and it is difficult to capture this effect in an analysis of price trends.

A1.3.7. Concentration and competition effects

See Section A1.3.4 above.

Figure A.1.5. Price differentials between German and French PBX markets, ECU per extension, 1990 to 1994



A1.3.8. Development of cross-border sales and marketing

In addition to the ordinary commercial concerns of profitability and efficiency, Alcatel and Thomson also oriented their strategy towards maintaining a high level of employment in supplying products for the DGT. The DGT, however, wanted to maintain two separate companies in order to avoid being dependent on one supplier. Cross-border sales were not a key issue at that time, although Alcatel's management did not share the government's view that it was just 'one of the two national champions'. However, cross-border sales and marketing have been driven by broader strategic issues for Alcatel, spotted as early as 1983 by Georges Pébereau, then responsible for Alcatel:

'[He] was convinced that the market for public switching equipment, the core of the telecommunications industry, would become increasingly concentrated, with perhaps only three major suppliers left worldwide by the year 2000 [...]. Pébereau concluded that Alcatel could survive in its core markets only as an international player with world scale. Being too small at that time, it could gain sufficient critical mass only through acquisitions, both at home and abroad – they represented the sole means of prising open protected national markets.'[52]

This country-by-country approach, although not the best economically, was justified by the 'nationalistic' market structure of public switching across Europe, and was not an obstacle for Alcatel since it boasted healthy operating margins in public switching over that period (12.2% in 1989 and 17.1% in 1990 for the Public Network Systems division). Alcatel's international development was driven by public switching rather than PBXs, and it did not rely on cross-border sales and marketing of PBX products.

Single market measures subsequently removed some of the barriers to trade, but by that time Alcatel was already present in most European countries, and so it focused efforts to rationalize the range of products it manufactured rather than its sales and marketing operations.

[52] *Source*: INSEAD [1993].

Moreover, PBX sales and distribution require proximity to the target market, which makes it difficult to employ cross-border marketing techniques. Despite Alcatel's efforts to rationalize its product range, much customization still occurs according to the preferences of the national market; examples of these special features are the message centre function (compulsory in Scandinavia) and special switchboards for the blind (compulsory in France).

A1.3.9. Foreign direct investment and location effects

External foreign direct investment (FDI) from North American companies has grown significantly in anticipation of the single market. These entrants clearly felt that there was a need for local operations that went beyond marketing and distribution functions, and focused particularly on R&D in Europe. For example, IBM (La Gaude), Digital (Annecy) and Nortel (Marne-la-Vallée) all considered that research labs working with European standards such as ISDN (and later GSM) must be based in Europe. In Marne-la-Vallée, for example, Nortel Eurolab carries out the adaptation (software development and testing) of its PBX range for the different European national markets.

With regard to Alcatel, in the early 1980s FDI was primarily driven by foreign market entry strategy in the public switching business, and took the shape of acquisitions. Table A.1.4 shows the FDI track record of Alcatel in deals at least partially related to PBX.

Table A.1.4. Alcatel's foreign direct investment, 1986 to 1994

Year	FDI	Main driver	Country
1986	Acquisition of 56% of ITT telecoms operations	Foreign market entry in public switching	Worldwide Germany for PBXs
1987	Completion of the Dial acquisition	Taking over its Italian PBX distribution channel	Italy
1989	Acquisition of Scanvest Ring (PBX part only)	Foreign market entry in PBX	Norway
	Shareholding in two distributors & maintainers	Foreign market entry in PBX through a distribution channel	UK
	Agreement to manufacture PBXs locally	Foreign market entry in PBXs	Egypt
1990	Acquisition of National Telecommunications	Foreign market entry in small PBXs	UK
	Agreement with a local manufacturer and a subsidiary of the PTO	Foreign market entry in PBX	Hungary
	JV with a local manufacturer	Foreign market entry in PBXs	Yugoslavia
1994	JV to manufacture, distribute install and maintain PBXs	Foreign market entry in PBXs	China

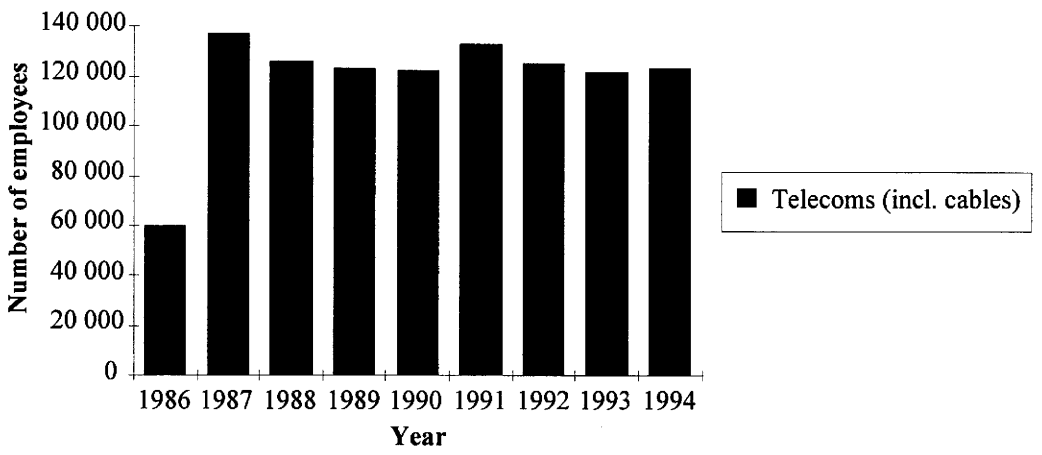
As the table shows, Alcatel gradually moved its FDI from acquisitions to joint ventures and simultaneously from Western Europe to Eastern Europe and Asia. The same geographical move applies to the opening of subsidiaries (not counted here as FDI); for example, in 1992 Alcatel opened subsidiaries in Bulgaria, Kazakhstan, Poland, Russia, Slovakia and the Czech Republic.

As we already saw, Alcatel concentrated its core PBX R&D in France and Germany ; apart from these main labs, labs in other countries each have a specialization: Network Management for Norway, PBX Applications for Austria, Terminals for France, Cordless Terminals for Spain.[53] On the top of that, very small teams are in place in almost every country for customization of products.

A1.3.10. Effects on employment

Specific data on Alcatel's private switching activity proved difficult to obtain. Some data are available on Alcatel employees in the telecoms sector (including cables), but this is rather inconclusive. In any case, the number of Alcatel acquisitions makes it difficult to assess the net impact on employment, even at the level of the firm. It is therefore extremely difficult to evaluate changes in employment, and not feasible to link the observable changes to single market measures.

Figure A.1.6. Alcatel employees in the telecoms sector, 1986 to 1994



At a sectoral level, it can be argued that the European efforts in the area of standardization have prevented Asian or American standards from becoming dominant in Europe, in contrast to what happened with *de facto* standards in the computing industry (e.g. IBM SNA). This standardization effort (focused on the activities of ETSI) has allowed European players to be more competitive (in Europe and in other regions) in relation to Asian and American players.

[53] This information is valid as of end 1995 but is likely to change rapidly due to Alcatel current reorganization.

A2. Diehl

A2.1. Background

Diehl company is a German ISDN card supplier. It was chosen as a case study example in order to illustrate the birth and the success of a small company in developing and expanding its cross-border sales in the EU. Moreover, ISDN is a key network technology in meeting the telecoms needs of SMEs and is also a good example of European co-operation benefits.

A2.2. History of Diehl's business

The new ISDN environment has been an opportunity for the development of small and medium-sized firms: Diehl is a typical illustration.

Diehl began in the earliest stages of ISDN when its founder, Guntram Diehl, developed one of the first ISDN PC cards in his garage. Mr Diehl was a student in electrical engineering, and when ISDN appeared, he saw the opportunity to develop a PC card. At that time, IBM wanted to show an ISDN IBM product at Telecom '87, and got in touch with Mr Diehl. He developed a 3270 emulation into a host through ISDN. Co-operation was also pursued for subsequent shows in Japan and elsewhere. However, there was no market since there was no ISDN availability.

In 1987, a field ISDN trial was launched by Deutsche Telekom in the Stuttgart area. IBM had some customers in this area, and some Diehl ISDN cards were sold. ISDN then began to be launched in other areas in Germany. In 1989, Diehl began to co-operate with a small engineering company SOTEC (10 employees) to create an administrative and commercial basis. SOTEC merely acted as a convenient vehicle for Diehl early in its existence. At the first official ISDN show in Wiesbaden, in 1989, Diehl was represented under SOTEC name and saw its ISDN competitors. This show marked the commercial start of Diehl: sales activity were included in 1990 under the Diehl company name.

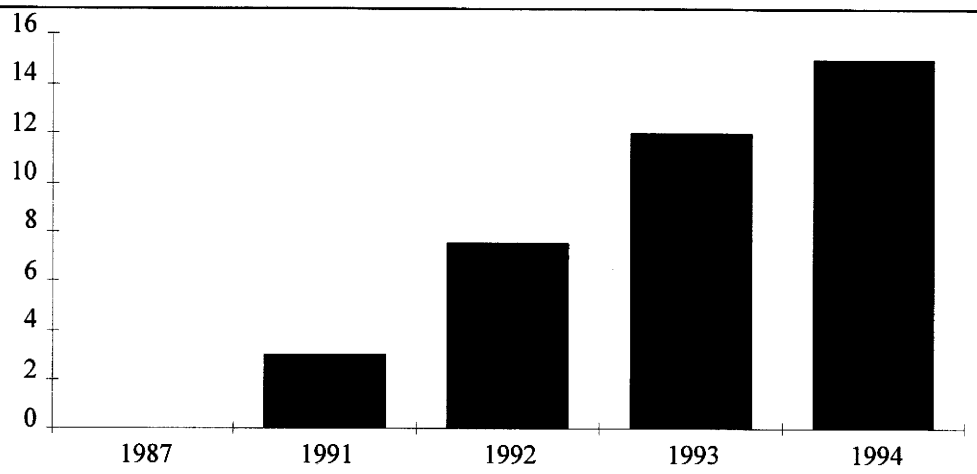
In 1991, Diehl began to develop its activities from being a hardware producer to being a provider of networking solutions. Growth accelerated in 1992 when Deutsche Telekom began an intensive ISDN campaign based on attractive tariffs, promotion and co-operation with ISDN products distributors. Diehl has always focused on growth and is now well placed in the ISDN market. Figure A.2.1 illustrates its growth in turnover.

At the end of 1994, Diehl was acquired by Eicon, a Canadian company. Eicon is Canada's third largest software company. It is well-known as an X.25 and Frame Relay specialist, and produces a wide range of network products for both LANs and WANs. This acquisition allows Diehl to target a wider marketplace and Eicon to cover the ISDN range.

Today, Diehl has nearly 60 employees and four offices in Germany :

(a) a sales office in Dietzenbach, near Frankfurt;
(b) production in Schönaich, near Stuttgart;
(c) headquarters in Leonberg, near Stuttgart;
(d) a development office in Berlin.

Figure A.2.1. Turnover (million DM)



Diehl used to sell most of its equipment through indirect distribution channels, especially in foreign countries via agreements with companies such as Compulink, Racal Datacom, Integro, etc. Now, Diehl will use direct distribution through Eicon channels.

A2.3. ISDN context

ISDN has been recognized as a key part of the telecommunications policy, which aims to create an advanced telecommunications infrastructure. ISDN is the trans-European network (TEN-ISDN) supported by the European Commission. ISDN can meet the communication requirements of SMEs which, unlike large enterprises, cannot afford private options such as leased lines or virtual private networks (VPN). Since 1984, the EU has pursued a policy of supporting ISDN, including harmonized implementation of ISDN (Euro-ISDN) based on European standards defined by ETSI.

Diehl's growth has reflected ISDN roll-out in Germany and in Europe. The ISDN terminal equipment market is dominated by PC cards and terminal adaptors production, which form the basis of a wide range of applications.

In general, EU countries have moved slowly towards launching ISDN and implementing standardized ISDN (Euro-ISDN) due to technical difficulties. Lack of progress in standardization, low digitalization of public networks and ISDN complexity have been limiting factors. Historically, France and Germany have dominated the European ISDN market, and still represent more than 70% of the European market. Recently, the UK market has displayed a steadily increasing pace of development.

As the experience of Germany and France shows, operators have been prime movers in creating the ISDN market. The main factors behind the success of ISDN in Germany and Diehl's growth result from the initiatives undertaken in this area by Deutsche Telekom:

(a) In 1990, Deutsche Telekom sponsored large projects with corporate customers to develop new experiments and applications based on ISDN. Diehl sold 600 ISDN cards in two pilot projects.

(b) Availability of ISDN. Initially Deutsche Telekom did not make ISDN available everywhere in Germany, and this contributed to the slow take-off of ISDN. Subsequently, Deutsche Telekom changed its policy and began to deploy ISDN very aggressively across the country and reinforced its ISDN marketing by subsidizing basic rate access. This led to a surge in ISDN connections and a corresponding surge in Diehl's sales.

The single market programme has also been very important for the development of Diehl. The gradual harmonization of technical standards between EU national markets, and the removal of barriers to obtaining equipment approvals have enabled small, start-up producers such as Diehl to establish themselves in the EU ISDN market.

A2.4. Single market impacts on Diehl

A2.4.1. Sourcing patterns and upstream/downstream linkages

Downstream linkages

European end-users of telecoms services and equipment have only begun to benefit fully from ISDN since Euro-ISDN became available. Until this point they had to face:

(a) the lack of interoperability of ISDN services and equipment, due to the variety of national ISDN standards and the absence of common API;
(b) the complexity of ISDN: the technical basis is now fully specified by ETSI but ISDN is such a rich and complex protocol that lack of a common interpretation hinders application development;
(c) the lack of transparent operation with other equipment, such as PBX, routers and LAN equipment.

With Euro-ISDN, products can work on different ISDN networks (with slight exceptions for France and Germany).

The purchasing behaviour of many incumbent TOs has changed completely in recent years. Most TOs now wish to foster ISDN roll-out and encourage ISDN product distribution, and do not hesitate to take out contracts with non-national companies. For example, Diehl has access to contracts awarded by PTOs in other EU countries and has distribution agreements with a number of different operators.

Consumer behaviour in the ISDN field is quite similar Europe-wide, and large accounts and SMEs assess how well a product will meet their needs before they consider the origin of the product. Customers in each national market now have access to a wide range of ISDN products from a range of manufacturers.

Upstream linkages

Single market measures have not significantly affected the upstream linkages in the ISDN PC card market. Diehl develops software for its products with highly qualified staff. Diehl manufactures ISDN equipment in its Schönaich factory with components provided by

Siemens, IBM and other US and Asian providers. Diehl has not experienced any significant problems with component supply or price volatility.

A2.4.2. Productivity and competitiveness

The European ISDN industry is highly competitive, and its players have forged a technological lead over their American and Japanese counterparts. In 1994 and 1995 there has been a wave of take-overs of European ISDN manufacturers by North American companies which needed to buy European developed skills and technology to meet the rapidly growing demand for ISDN products and applications in their own countries.

The table below shows the leading ISDN equipment suppliers in Europe (Dataquest, 1994). Of these larger manufacturers, all except Diehl remain European owned. Most acquisitions have involved the smaller companies in the market.

Table A.2.1. Main players in European ISDN adaptor and PC card markets, 1994

Europe	Largest Supplier	2nd Supplier	3rd Supplier
ISDN adaptors	PHILIPS/TRT (Netherlands/France)	CONTROLWARE (Germany)	MATRA and SAT (France)
ISDN PC cards	AVM (Germany)	ITK (Germany)	Diehl/Eicon (Germany/Canada)

Source: Dataquest.

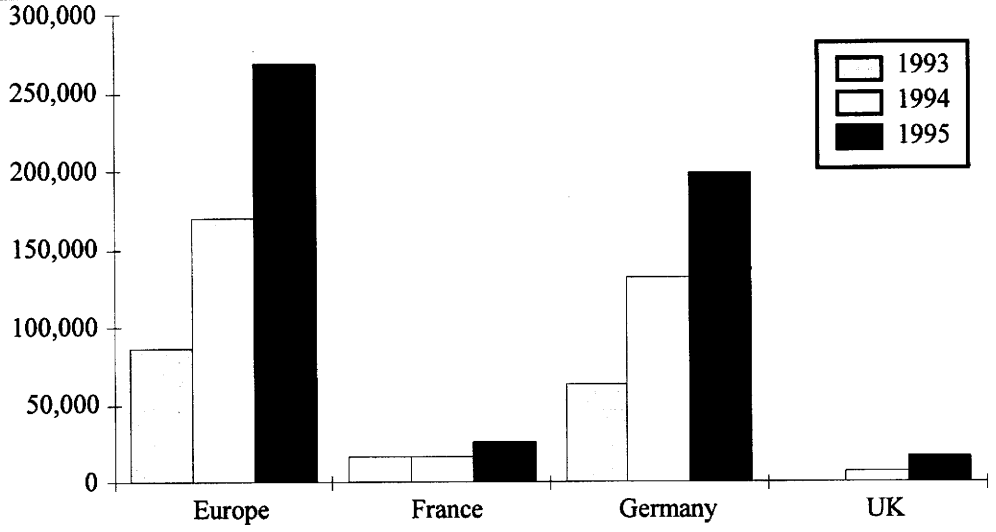
A2.4.3. Scale and scope effects

Scale effects as a result of single market measures were very limited until 1993. ISDN take-off was slower than expected until 1992, thus the market did not achieve critical mass. By 1993, however, the situation had changed. Diehl is currently the third largest ISDN PC card manufacturer in Germany, producing more than 3,000 PC cards a month.

Adaptation of product range has developed Diehl's original PC card into a more diversified product line that includes a complete range of ISDN PC cards and adaptors. This process was performed to meet users' requirements in Germany as in Europe, but was only viable because of the opportunity to address several national markets with almost identical products.

Figure A.2.2 below indicates the number of ISDN PC cards sold in Europe in the years 1993 to 1995.

Figure A.2.2. ISDN PC cards sold in Europe, 1993 to 1995



Source: Diehl.

A2.4.4. Changes in market access resulting from the single market programme

An important administrative change is that goods now cross borders without undergoing checks. The removal of border controls also means that VAT is no longer paid to customs at the time of importation. Intra-Community VAT is now declared and paid to the tax authorities in the same way as internal VAT. This change had a clear impact on Diehl since export activity really began in 1992 in a favourable environment and did not encounter any special difficulty due to administrative barriers.

Approval issue

At the early stages of ISDN (approximately 1988-93), national ISDN protocols existed, and there were particularly wide variations in the protocols for France and Germany, the two largest ISDN markets. The costly adaptations which were required disadvantaged small manufacturers which could not afford to make such investments on a low volume of sales.

Gaining approvals was a major obstacle to entering foreign markets. National approvals were very specific and stringent:

(a) tests specifications were based on national ISDN specifications;
(b) national administrative procedures were very complex and performed by technical or administrative staff without any involvement or assistance from the manufacturer;
(c) the time taken to complete type approval from start to finish was very long (often several months);
(d) in some countries, local representation was mandatory.

Two factors have improved this situation:

(a) Directive 91/263/EEC (Mutual Recognition of Conformity) simplified the approval process across Europe. Technical specifications are now Europe-wide rather than nationally based. However, pan-European approval requires Common Technical Rules (CTRs) to be published, and this has been delayed for ISDN.

(b) The Memorandum of Understanding signed by most European PTOs to introduce core Euro-ISDN by 1993 committed them to deploying a common version of ISDN that would be interoperable across the European Union. Euro-ISDN is based on ETSI specifications and was accepted by operators as a common basis even before the relevant CTRs were developed.

Positive effects have already been felt by Diehl, as approval procedures have been softened in France and Germany. The greatest benefits were expected to be gained from the introduction of CTRs 3 and 4, thus enabling Europe-wide approvals for ISDN terminals. Ahead of CTR availability, interim pan-European approval arrangements are promoted by the Commission, and numerous European countries accept mutual approval recognition, even though the final CTRs are not yet published. Only in France and Germany is equipment which conforms to Euro-ISDN standards still required to be submitted to further testing procedures.

Diehl's experience

Diehl's experience allows this evolution to be examined in terms of regulatory issues and with regard to the general conditions of market access. The changes to approvals procedures have produced benefits in terms of administrative and technical issues.

(a) **Administrative issues.** Regulatory bodies are far more co-operative and are moving towards a more commercial attitude, due to competition with other national bodies within the Mutual Recognition Process. Administrative procedures are easier and are more clearly described to the manufacturers. Time-scales have been drastically reduced, sometimes from six months to one month. The nature of these changes is illustrated by occasions where national regulators have contacted Diehl, asking Diehl to consider submitting its equipment for approval in their countries.

(b) **Technical issues.** The adoption of the NET3 Directive standardized the technical basis for ISDN equipment, but national approval was still necessary. Subsequently, an interim CTR (iCTR) was published and approval on the basis of this iCTR is now recognized in all EU countries except Germany and France. These two countries have implemented a version of Euro-ISDN with their own national variations, and require additional tests to obtain approval (the German and French markets represent more than 70% of the European market). The main problem for Diehl was that all approvals gained on the NET3 basis had to be re-obtained on an iCTR basis.

In addition, more laboratories are now able to perform testing upon ISDN products (both Euro-ISDN and the French and German variations). Diehl can arrange to test most products in Germany before formally applying for approval. Most European countries no longer require local representation. Diehl can therefore gain approval with a limited amount of effort and resources, compared to the situation five years ago, and no longer needs to devote internal resources to keeping up to date with the evolution of national protocols.

Diehl states that it had developed special skills in obtaining approvals in the traditional regime, and rarely failed to gain the approvals that it required. However, each approval was time-consuming and costly. It can no longer use its skills in obtaining approvals as a competitive asset, but the process is now much less onerous and costly. Test costs are as follows for a PC card:

(a)	ISDN level 1, 2, 3 tests:	DM 3,000;
(b)	EMC tests:	DM 1,000;
(c)	electrical safety tests:	DM 1,000.

Approvals costs are now approximately DM 400.

Diehl would benefit from a faster adoption of the final regulatory and technical framework because the uncertainty that exists during the period before adoption has a negative effect on business. When users hear about pending changes, they tend to wait for adoption to be completed and postpone any purchasing decision until this has occurred.

Application Programme Interface

Another potential obstacle to ISDN development concerns the development of APIs (Application Programme Interfaces). The customers' requirement for end-to-end interoperability applies to ISDN applications and products. The standardization of API ensures application portability regardless of the PC card. In the early stages of ISDN, no standard ISDN API was defined in France, and the CAPI standard was promoted in Germany and the 'German ISDN island' (Germany, Switzerland, Belgium, Scandinavia), based on 1TR6. In 1995 CAPI was the most common API in Europe. Europe-wide API standardization is a necessity, with a choice between evolution of CAPI and a European specified API (PCI) pushed by French suppliers. The result is that both have been incorporated into the European standard (ETS 300 325).

Conclusions

ISDN was initially developed on a national basis. National differences remain an important factor but the situation is steadily becoming more harmonized. According to a TEN-ISDN study, in 1993, German ISDN terminals suppliers accounted for 98% of sales within the German market, and French suppliers for 93% of sales in the French market. However, Diehl now makes more than 30% of its sales abroad and expects this to increase in future, in part because of its acquisition by Eicon.

A2.4.5. Direct short-term impact on production costs

Single market measures have not directly affected ISDN telecoms equipment production costs. The single market is allowing greater access to potential scale economies, but these are not considered in this section.

Production costs can be split into software costs and hardware costs. On the hardware side, production of ISDN terminals is based on use of ISDN chips, memory, and bus components. Major telecoms semiconductor companies are active in this market segment, including European manufacturers such as Siemens and SGS-Thomson. ISDN hardware components

prices have already dropped steadily under the pressure of international competition and will continue to fall.

On the software side, the key factor affecting production costs is the degree of complexity:

(a) PC cards with a high degree of complexity require considerable software development, and result in a high cost which can deter users. This kind of 'sophisticated' PC card dominates in France.
(b) PC cards with a low degree of complexity are far cheaper to develop, but require more development on the application side. This kind of 'basic' PC card dominates in Germany.

Approval costs have been drastically reduced since European approval based on NET3 and iCTR. According to a study carried out in 1993, major manufacturers estimated that traditional national type approval added 20% to ISDN card prices.

A2.4.6. Evolution of final prices

In many cases, national ISDN enabled manufacturers to maintain high prices for long periods, because of lack of competition. In consequence, prices have not related to the marginal costs of production and market prices still vary widely among European countries.

The price of ISDN PC cards decreased slowly for the first five years of ISDN, before the rate of price reduction accelerated in 1993 because of increasing competition.

Due to greater scale effects and fiercer competition, prices in Germany are currently lower than in France, and they began to fall earlier. Prices started falling in France only when Diehl, TELES and other German suppliers introduced greater competition into the French market, initially selling equipment at up to 50% less than the prevailing prices.

Diehl offers a wide range of ISDN cards (DIVA card up to 2Mbit/s card). The price evolution of Diehl's basic ISDN card is summarized in Table A2.2.

Table A.2.2. Prices for Diehl basic ISDN cards, 1988 to 1995

Period	Price (ECU)	Price (DM)
1988-91	1,350-1,710	2,600-3,300
1991-92	1,245-1,450	2,400-2,800
1992-93	985-1,140	1900-2,200
mid-1995	725-1,040	1,400-2,000

1993: 1 DM = 0.519 ECU.

Prices can be lower with volume discounts of up to 30% available. A Diehl PC card can be sold today in Germany for less than DM 1,000 (equivalent to ECU 500). Some competitors in Germany now offer low-end cards extremely cheaply, around DM 400, and promotional prices as low as DM 200 have been offered.

A2.4.7. Changes in competition and market concentration

The ISDN market is a typical example of a new activity market with low barriers of entry for SMEs. Single market measures have been very important in the establishment of an environment where small manufacturers can survive and grow.

The evolution of the ISDN market has been as follows:

(a) the initial step is characterized by the creation of small innovative start-up companies;
(b) the market matures, grows large and the start-up companies grow correspondingly larger. Manufacturers from other parts of the telecoms sector are attracted into the market now that it has become more established;
(c) there is then a period of concentration in the industry, with acquisitions of small companies by bigger companies.

In 1995, a large number of manufacturers were present in the ISDN market. A wide range of ISDN products had been developed, but mainstream distribution and marketing channels were not well established. Smaller companies did not have sufficient experience of marketing and distribution outlets in new markets, so they needed the support of bigger companies. The single market was still seen as an opportunity by non-European players such as US or Japanese ISDN companies which were much larger than European ISDN SMEs.

Table A.2.3 opposite shows recent activity in the EU ISDN cards sector.

A2.4.8. Development of cross-border sales and marketing

The main constraint on cross-border sales and marketing have been the issues of technical harmonization referred to earlier, and the resource constraints of small start-up companies. Table A2.3 illustrates the range of cross-border distribution agreements that are in place in the ISDN card sector, and the number of arrangements is increasing steadily as technical constraints diminish and the card manufacturers grow and mature.

A2.4.9. Foreign direct investment and location effects

Diehl is one of a number of small European ISDN producers recently acquired by North American players.

Before the acquisition, Diehl was looking for a partner to develop world-wide activity. The objective was to gain market reach, access more distributors and sell through a wider range of channels.

Eicon produces a wide range of network products for both LANs and WANs, and needed to be well prepared for the anticipated growth of the ISDN market. Eicon bought Diehl for DM40 million. Both companies operate under their own names, and Diehl's former owners continue to act as managing directors. Diehl's name is well known by users in Europe, and will be incorporated in Eicon's product range for overseas operation. Eicon products (soon Diehl products) are distributed world-wide in more than 70 countries. Diehl agreed to the acquisition on the basis of a continuation of existing operations, with the benefits of increased market reach. Improved access to capital was a relatively minor consideration.

Table A.2.3. Acquisitions and distribution agreements in the EU ISDN sector, 1994 to 1995

Company	Acquisitions and agreements for distribution
Eicon (Canada)	Acquisition of Diehl (Germany)
CISCO (USA)	Agreements with ITK (Germany), SYNAPTEL (France), acquisition of COMBINET (USA)
SHIVA (USA)	Acquisition of Spider Systems (UK)
SAT (France)	Acquisition of EURONIS, Access Privilege, Atlantis (France), Dr Neubaus (Germany)
US Robotics (USA)	Acquisition of ISDN Systems Corp.
BAY Networks (USA)	Acquisition of XYLOGICS (USA) who had just acquired Scorpion Logic (UK)
3COM (USA)	Acquisition of SONIX (UK), agreement with AVM
MICROCOM (USA)	Acquisition of MBP Software (Germany)
TELES (Germany)	ARIA-XCOM (France)
SCII (France)	Ericsson (Sweden)
ACC-Newbridge (USA)	LCE (France)
AVM (Germany)	More than 25 countries
Newbridge (Canada)	OST (France)

Source: Arcome.

The effects of the single market programme clearly acted to increase Diehl's attractiveness to Eicon, which was no doubt reflected in the acquisition price.

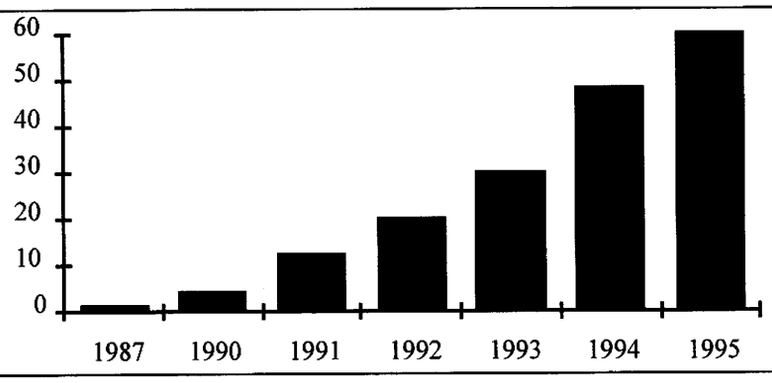
A2.4.10. Effects on employment

In Germany and France, many small and medium-sized companies have been set up on the basis of the ISDN opportunity to develop new services. Most German ISDN suppliers are small companies, as exemplified by Diehl and its main competitors in the PC card market (such as AVM and ITK). The first French company to develop an ISDN PC card was SCII, a small company which is now exporting to European countries (Belgium, Germany, UK, etc.) and the rest of the world (Japan, USA, South Africa, Australia, etc.).

These new jobs are of high quality, requiring a skilled and trained workforce. The value added per employee is high (turnover is ECU 150,000 per employee at Diehl)

Diehl is a representative example of ISDN start-up companies. Since its creation in 1987, Diehl has grown to nearly 60 employees (see Figure A.2.3).

Figure A.2.3. Number of Diehl employees, 1987 to 1995



A3. The development of GSM and the single market

The European digital mobile telephony standard GSM ('Global System for Mobile Communications', formerly 'Groupe Spécial Mobile') is arguably the most advanced commercial mobile telecoms technology standard in the world, and is second only to the American analogue mobile telephony standard, AMPS, as the most widely used.

The success of the GSM standard has had a substantial positive impact on the European telecoms equipment sector, both directly, through the revenues, profits, employment and market shares that have been achieved, and indirectly, through the increased self-confidence of the industry and the increased global reputation of European equipment manufacturing.

This Appendix seeks to demonstrate that the success of the GSM standard owes much to the beneficial impacts of the EU single market programme, as well as reflecting well on the vision and co-operative spirit of the operators and manufacturers who brought the GSM standard into being. The case study has been included to support the assertions made in the main report (for example, Sections 4.1.2 and 4.2.5) concerning the impacts of specific single market measures on the European equipment sector.

A3.1. GSM – a global standard and a European success story

Conceived initially as a European standard, outside of North America and Japan, GSM is fast becoming the global *de facto* standard for digital mobile telephony. The selection of GSM by mobile communications operators around the world, in competition with other digital standards – most notably the North American digital mobile telephony standard, D-AMPS, and the Japanese PDC – can be attributed to five key features of GSM:

(a) technical advantages, such as the broad and growing range of advanced features;
(b) high system capacity;
(c) high voice quality;
(d) capability for future integration with fixed networks;
(e) early identification of the services which will be progressively implemented.

However, perhaps the most significant factor favouring GSM has been the breadth of adoption, and the subsequent impact on production volumes of equipment (leading to rapid reductions in prices as manufacturers benefit from economies of scale) and roaming capabilities. This reinforcement of benefits has created a virtuous circle, such that the adoption of GSM has increased rapidly from its initial European focus. The success can be expressed in several ways, for example:

(a) To date, the GSM standard has been adopted by 138 operators in 77 countries, 75% of which are outside Western Europe.
(b) Just three years after the launch of the first commercial GSM service, over 8 million customers now use GSM world-wide, and subscriptions are forecast to reach 50 million by the year 2000.
(c) World-wide, by the end of September 1995, 100 GSM networks were operational and a further 24 were planned for launch within the following 2 years.

(d) In western Europe, there are now a total of 35 operational GSM networks with over 7 million subscribers across the continent, a figure which has grown by 139% over the last 12 months.

The growth of GSM has brought substantial benefits to many European telecoms equipment manufacturers. Manufacturers of handsets, base stations, switching, network management systems and billing systems have experienced profitable growth through the exploitation of the GSM opportunity. These encompass large manufacturers such as Ericsson, Nokia, Siemens and Bosch, and smaller players such as Kingston-SCL (billing systems), Gemplus (SIM cards), Benefon (handsets), Rohde & Schwarz (test equipment) and many others.

A3.2. The development of the GSM standard and the role of the single market programme

Many players have contributed to the success of GSM. The main contribution of the single market programme was to provide an environment where it was possible for the European Commission to reserve a suitable band of frequencies throughout the EU, and then defend these reserved frequencies against other claims, over a prolonged period. Without this vital pan-European action, it is unlikely that the GSM standard would have developed in the way it has.

GSM was conceived in Vienna in June 1982 when the CEPT (Conférence Européenne des Postes et Télécommunications) Telecommunications Commission set up a group to develop specifications for a pan-European cellular communications system for the 900MHz band. The formation of the Groupe Spécial Mobile, whose first meeting was held in December 1982 in Stockholm, chaired by NMT champion Thomas Haug of the Swedish Telecommunications Administration, heralded an as yet unknown commitment to co-operation between operators and telecoms administrations, and later equipment manufacturers, in the development of a commercial telecoms standard.

It was clear to CEPT that unless the opportunity was taken there and then the 900MHz band would rapidly be allocated for different and incompatible systems in different countries, (although, already in 1978, it had been decided in principle, to reserve two blocks of 25MHz in the 900MHz band for mobile communications in Europe) and that in view of the difficulty of finding another commonly available band the opportunity would be gone for decades to create a system with pan-European roaming and open interfaces. Considering that little more than a handful of cellular radio networks existed at that time, and the popularity of mobile telecoms services largely unrealized, this was a far-sighted step.

However, despite the enthusiasm and commitment of a small body of engineers and administrators, the scale of the task of co-ordination and in particular the necessity to enforce the release and/or reservation of spectrum in each European country began to hinder progress. As a result, the European Commission first became involved in GSM in 1987, focusing its attention on co-ordination of commercial and radio issues rather than technical specification details. In the following year the responsibility for GSM was moved from CEPT to the TC/SMG of ETSI (the European Telecommunications Standards Institute), integrating the GSM process into the Commission's activities and reflecting a shift from policy-making to concrete standardization work.

'The impact of the Commission's mandate behind the activities of ETSI was particularly important for the development of the GSM standard. It first of all gave authority to a normally much slower decision process based on negotiation. Second, it added technical expertise by opening the standard-setting process to non-PTT members such as manufacturers and others ...' [Müller & Toker, 1994].

EC involvement at this stage resulted in three documents which had an important impact on the scope and speed of GSM development between 1987 and 1990:

(a) Council Recommendation 87/371/EEC. This document established the principles for a Memorandum of Understanding (MoU) which ensured co-ordinated implementation of the system across Europe and widened the scope of original agreements drawn up within CEPT to include the whole of the European Community.

(b) Council Directive 87/372/EEC. This directive established a similar co-ordinated approach to the release of spectrum in the 900MHz range (which had already been reserved for land mobile use). The directive required radio spectrum regulators to make available an initial allocation of 2x9MHz of radio spectrum (905-914MHz and 950-959MHz) in time for a mid-1991 launch of service and to plan for the release of 2x25MHz as soon as possible thereafter (890-915MHz and 935-960MHz).

(c) The GSM MoU. This document established a formal mechanism for the implementation of GSM by operators in individual countries. This required the co-operation of all parts of the European telecoms sector and played a fundamental role in encouraging all parts of the industry to develop the system and service specifications. This MoU was originally signed by 13 European countries.

At the end of the 1980s, some analogue networks were approaching capacity and national governments were under intense pressure from national operators to allocate frequency space earmarked for GSM to the analogue operators. However, the Commission intervened and in 1991 issued a directive absolutely reserving the two blocks of frequency in the 900MHz band.

The so-called 'phase 1' of the GSM standards was frozen in 1990, allowing the manufacturers to develop equipment on detailed and stable specifications. Already in 1991/92 the first operational GSM networks opened in Europe. The importance of the role of the EC in ensuring that GSM development progressed against these ambitious time-scales, and in imposing procurement policies to encourage a strong and competitive European manufacturing base for GSM equipment (within the constraints of GATT) can be seen from the following benefits derived from the existence of the GSM standard.

In 1989/90 the UK Government, driven by an urge to increase competition, particularly for local access, requested that the GSM standard should incorporate a path to a digital mobile telephony standard based on frequencies in the 1800 band (DCS1800). The work of adapting the GSM standard to incorporate these requirements began in 1990.

Criticism

Early on, criticism was raised about the delay in the implementation of GSM, due to the instability of GSM specifications. The 1 July 1991 deadline for commercial GSM networks was not met, mainly because of delays in developing and agreeing type approval tests.

Handset development also proved more complex than first thought (these two problems contributed to the fact that handsets did not actually appear until June 1992).

To help rectify this situation, the Commission, in 1991, issued a stage 2 of the Terminal Equipment Directive of 1988, calling for mutual recognition of terminal approval across the single market. An agreement was reached in May 1992 within the MoU on the reduced set of 11.10 tests, as a basis for an Interim Type Approval (ITA), which enabled accredited test laboratories in Denmark, France, Germany and the UK to begin mobile station technical type approval.

A3.3. The effects of other single market measures on GSM

Apart from its direct involvement in the GSM process, some of the Commission's other work may have had even greater, albeit indirect, effects on the success of GSM. It can be argued that without the 1987 Green Paper on the development of a common market for telecommunications services and equipment, the 1988 Terminal Equipment Directive and the 1990 Procurement Directive, it would have mattered little what specific measures had been taken to manage the GSM process.

Economies of scale

By liberalizing the telecommunications market and introducing competition, the single market programme set the basis for low-cost mobile services. Consumers as well as operators are benefiting from rapid reductions in prices as, for example, the unsubsidized retail price of handsets has fallen from approximately ECU 2,000-2,400 (allowing for development overheads distribution and profits) to ECU 400 [Analysys, 1994].[54] The airtime rates have also fallen dramatically, due to competition of often two GSM operators per jurisdiction.

Common standards and open interfaces

The issue of telecommunications liberalization is reflected in some specific characteristics of the GSM specifications, notably in the fact that the GSM system would be built up around open interfaces. Despite this and the Procurement Directive, there are indications that some preference for local suppliers still exists, but the specification of open (non-proprietary) interfaces[55] and the mutual licensing of Intellectual Property Rights (IPRs) associated with common standards for GSM have encouraged further competition in equipment supply (especially within the European sector[56]) helping to encourage innovation and responsiveness from manufacturers, as well as the more obvious impact on prices of handsets and infrastructure equipment.

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[54] Analogue handset prices fell by about 20% in 1994 as a result of huge growth in volumes. Price cutting is not expected to be as severe for GSM as for analogue: it is more difficult to copy software, and as it is an evolving standard new entrants will find it hard to cope with constant changes to a complex product. The GSM handset market is dominated by three companies (Motorola, Ericsson and Nokia), each with approximately 25% of the market.

[55] Open interfaces are specified between: terminal and base station (the air interface); base station and switching centre; and switching centre and location registers.

[56] The notable absence of non-European manufacturers (with the exception of Motorola and Nortel) and in particular Japanese manufacturers from the GSM market is likely to be as a result of being unable to reach agreements with the holders of IPRs for GSM. For example, Motorola and Philips own the rights to GSM speech coding, Motorola and Interdigital control the TDMA spectrum elements, and Bull owns the rights to the GSM SIM card.

Approval and mutual recognition

One of the major benefits of GSM is the ability to use the same handset throughout Europe and beyond, enabling users to roam between countries and be contactable on the same number and have all their calls billed to the same account. However, this inevitably introduces problems of handset testing and approval procedures. Through the action of the European Commission, and specifically as a result of Directive 91/263/EEC issued in April 1991 a process of mutual recognition of the validity of tests in other European countries was established. Manufacturers no longer have to submit new terminal designs for repeated testing in all other European/MoU countries.

There has been no precedent for this type of approach to mutual recognition, and it seems very unlikely that such an approach would have been possible without the intervention of the EC, and enforcement of this directive. Furthermore, this approach made it possible to appoint a single supplier of the highly sophisticated, automated system simulator needed for performing type approval tests.[57]

Other EC initiatives such as the RACE programme have also contributed to GSM's development. Funding and co-ordination of development outside of the strict confines of the GSM standard have promoted further collaboration between industry and academia in and across Europe, and more specifically between manufacturers.

A3.4. A new era of co-operation in Europe

In parallel with the drafting of technical specifications within the GSM Committee, operators realized the importance of commercial and operational co-operation. This was put on paper by the signing, by 13 EC and EFTA operators, of the Memorandum of Understanding (generally referred to as the GSM MoU) in Copenhagen in September 1987. The GSM MoU covers areas such as time-scales for procurement and deployment of systems, compatibility of numbering and routing plans, concerted service introduction, etc. The co-operation between mobile operators, as reflected in the number of signatories to the MoU (see Figure A.3.1), has risen sharply since then.

During the CEPT years (1982-87) equipment manufacturers were not invited to take part in the discussions around the development of GSM. However, many equipment manufacturers were being supplied information by 'friendly' operators. Only in 1988 were the manufacturers invited to contribute directly to the process.

The 121 GSM recommendations regarding infrastructure and handset design were frozen in February 1990 after eight years of development, allowing equipment manufacturers to focus on finalizing the developments of systems and handsets.

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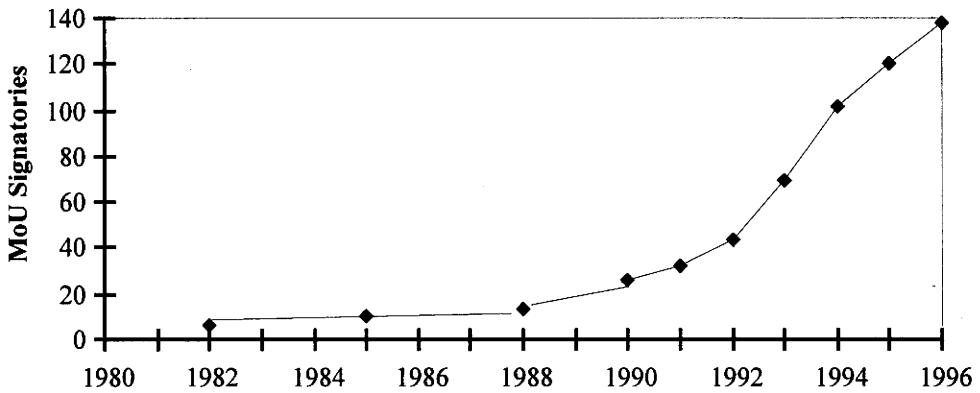
[57] The only accredited equipment for type approval tests was developed by Rhode & Schwarz. Other manufacturers have developed test equipment, but in all cases these are aimed at pre-approval testing and are not accredited for type approval.

Figure A.3.1. Growth in the number of signatories to the GSM Memorandum of Understanding (MoU)



According to Meurling and Jeans [1994], one driving force, and an important factor to explain why the European equipment industry was enthusiastic about GSM (even though an international standard would inevitably stimulate more competition) were the German and French industries seeing GSM as a possibility of breaking Ericsson's dominant position in analogue mobile telephony. However, after testing eight experimental TDMA (Time Division Multiple Access), four broadband from a French-German consortium, and four narrowband from Finland, Norway and Sweden, all Member States (except Germany and France) voted to adopt Scandinavian technology.

Co-operation and the issue of Intellectual Property Rights (IPRs)

The GSM system has been criticized for being too complex and over-designed; it could also be argued that GSM has not fully delivered its promises from a technical perspective. Nevertheless, the operators, regulators and manufacturers have worked together in a spirit of unprecedented co-operation to produce real products, with broad appeal and utility, at no greater cost than existing systems against a very ambitious time-scale.

However, the co-operative climate was fraught with problems regarding the protection of IPR. For example, Motorola was pursuing patents on the European telecommunications scene more aggressively that its European competitors, who at that time had developed a kind of club mentality with a gentleman's agreement to be generous to each other when it came to patents [Granstrand, 1993]. Some manufacturers felt that their ideas, put forward for mutual benefit, were being exploited by outsiders. Motorola claims that the GSM group considered IPR matters and discovered its patents too late [Granstrand, 1993]. According to Ericsson, this was a particularly difficult problem during the CEPT years (1982-87).

Many compromises were made, and short cuts were taken, resulting in a number of disputes over IPR issues. Agreements have been reached between European manufacturers to allow mutual licensing of IPRs. However, the notable absence of non-European manufacturers (with the exception of Motorola and Nortel) and in particular Japanese manufacturers is likely to be due to their inability to reach agreements with the holders of IPRs for GSM.

A3.5. GSM's contribution to the improving fortunes of two European telecoms equipment manufacturers

Two of the three largest manufacturers of mobile telecoms equipment in the world are European. Nokia and Ericsson are the second and third largest manufacturers of mobile phones (after Motorola) respectively and are the two largest producers of GSM network systems.[58]

In 1994, Nokia Mobile Phones' net sales increased by 70% to ECU 1.730 million (FIM 10,702 million), selling twice as many phones in 1994 as in 1993. In the same year, Ericsson's Business Area Radio sales grew by 55% to ECU 4.640 million (SEK 42,506 million), an estimated 75% of which was attributable to cellular telephony (systems and handset) sales. Both companies are now experiencing higher growth in markets outside Europe. In 1993, 43% of Ericsson's sales were in Europe; in 1994 this fell to 36%. In comparison, 65% of Nokia's 1994 sales were in Europe.

The dramatic growth in turnover (a four or five fold increase in the last five years) for both Ericsson's and Nokia's mobile communications divisions cannot be attributed solely to GSM, but to the general explosive development of the market for cellular-based telecoms services. Indeed, of the total installed base (number of subscribers in service) in July 1995 for Ericsson, there were 22.7 million subscribers connected to Ericsson's analogue system and 5.1 million to its digital system respectively, making the digital base about 22% of the total (please note that the number of subscribers only is a proxy for the value of equipment sold). The manufacturers do not publish figures that allow the analysis of the split in sales and profit between analogue and digital systems, but it is estimated that GSM accounts for over 50% of new orders for these vendors.

To date, over ECU 20 billion has been invested in Europe alone in GSM, of which over 75% going to the five major European manufacturers. In the absence of a pan-European standard, investment levels of this scale may have been possible, but fragmented standards and preference for local suppliers would have almost certainly led to a weakening of some key equipment manufacturers and may have resulted in keener competition from suppliers from Asia-Pacific and North America. Large players such as Ericsson, Nokia and Siemens may not have grown strong enough nor gained the experience to compete on a global scale.

A3.6. Some outsiders' views on the GSM process

In its technical magazine 'Tele', No. 3, 1993, Swedish telecoms operator Telia accredits the success of GSM to 'the vision of the Commission'. In the magazine Telia also says: 'The work with GSM in Europe took its inspiration from the Nordic success with the automatic, analogue mobile telephone systems. It must also be viewed against the back-drop of the goal-focused and energetic work of the European Commission during the 1980s.'

A representative for Ericsson who has been involved with the development of GSM from the start is B. Wanblad. His view is that the introduction of GSM was primarily market driven. The single most important initiative from the Commission to make GSM successful were the

[58] This is difficult to confirm from publicly available data sources, but can be verified by an analysis of known contracts and estimates of the likely values of these contracts.

measures to liberalize service markets, claims Mr Wanblad. The second most important action the Commission took was successfully to manage the process of spectrum allocation in the member countries. Thirdly, the move to very rapidly ensuring the compliance of spectrum allocation by directive was to the credit of the Commission. 'GSM would have happened even without the Commission, but not so quickly', says Mr Wanblad.

Another Ericsson representative, Mr G. Sandegren, remembers the very strong and firm signals from the Commission on how important it was for the GSM process to succeed. The issuing of firm deadlines made the participants work harder and closer together, and the spirit of co-operation was very good, says Mr Sandegren. The Terminal Equipment Directive [stage 2] was an important measure, but something similar would probably have happened even without the Commission at some stage. The Commission was not clear about which organization would be responsible for what under this directive though, claims Mr Sandegren.

The MoU Group

The MoU Group provides the commercial equivalent of the GSM Technical Co-ordination function within ETSI. It contains several working groups with development of operational and service functions as tasks. The Chairman of the MoU Group is designated by operators. The Chairmanship is held in rotation for six months.

A3.7. Summary

The successful development of the GSM system was made possible by a united effort by PTTs, research institutes and manufacturers (who participated from 1987 onwards). But this kind of common effort towards a unified system would have foundered without intervention from the EC, driven by the objectives of the single market programme, especially in securing the legal basis for setting aside the necessary frequencies in its Member States. It is clear that the issue of standardizing a pan-European mobile telecommunications service has been a major priority for the Commission, and that its actions were perceived as timely and decisive.

Even though the GSM project encountered some inevitable difficulties, it can be heralded as a European success story:

(a) GSM is a harmonized, complete and future proof standard, based on an open network architecture, allowing competitive supply for equipment and services on a world-wide basis.
(b) GSM implementation has been more or less on target despite tough time-scales.
(c) Many are committed.
(d) GSM is the first real example of European reciprocal type approval.

The historical development of GSM is summarized in Table A.3.1.

Table A.3.1. Significant milestones in the development of GSM

Date	Achievement
1982	Groupe Spécial Mobile is created in CEPT
1984	Three working parties created: WP1 for definition of services, WP2 for specification of radio transmission and WP3 for all other issues
1986	A Permanent Nucleus is set up - a full time team responsible for co-ordination of all GSM working parties
1987	Main radio transmission techniques are chosen, based on prototype evaluation (1986)
1988	ETSI is created and CEPT technical standardization activities, including GSM, are transferred to ETSI. CEPT was restricted to Administrations only. ETSI is open to industry and user groups, although GSM allowed industry reps to participate from early on
1990	The Phase 1 GSM900 specifications (drafted 1987-90) are frozen (after an 18 month delay)
1990	DCS1800 adaptation starts
1991	First systems are operational
1991	Activities concerning the post-GSM generation of mobile communications were added to the scope of the GSM Technical Committee which was renamed SMG (Special Mobile Group). DCS1800 specifications are frozen
1992	All major European GSM900 operators begin commercial operations

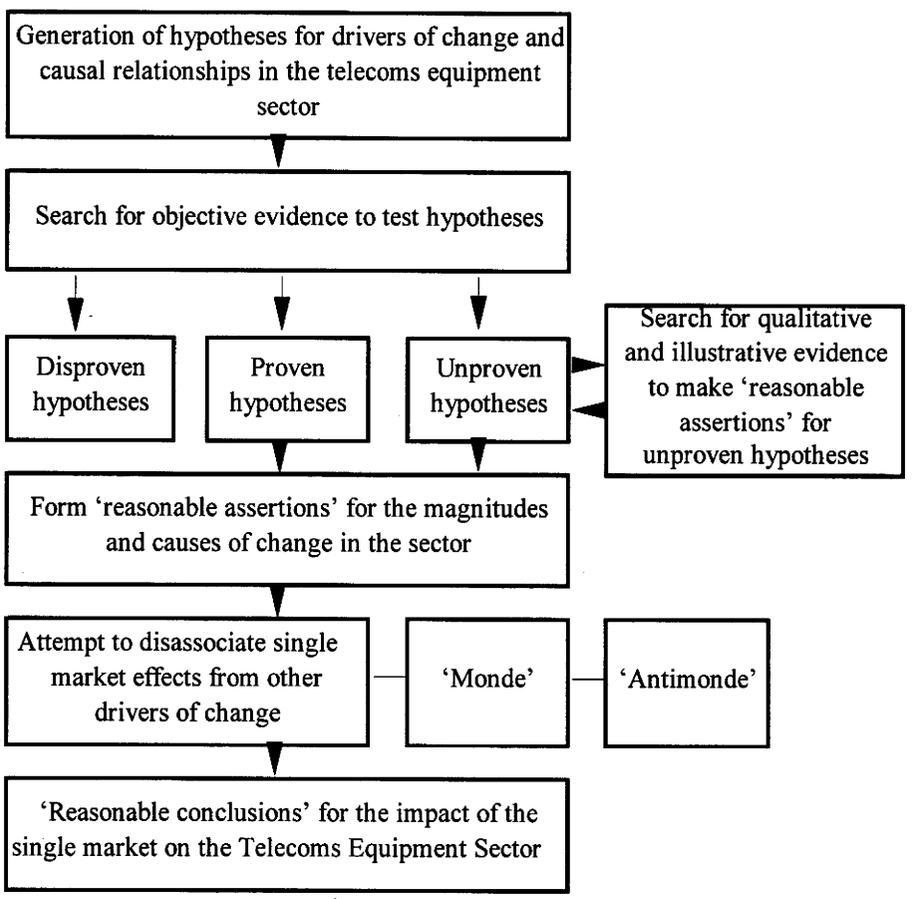
APPENDIX B

Methodology notes and discussion of constraints

B1. Notes on study methodology

This section describes the methodologies used in this study. The following graph illustrates the overall approach to the work:

Figure B.1.1. Summary of study methodology



Section B.1.1 discusses the generation of hypotheses and postulated causal relationships. Sections B.1.2, B.1.3 and B.1.4 describe the specific approaches used to test individual hypotheses in the areas of price convergence, competitiveness and productivity impacts.

B1.1. Assessment of causalities

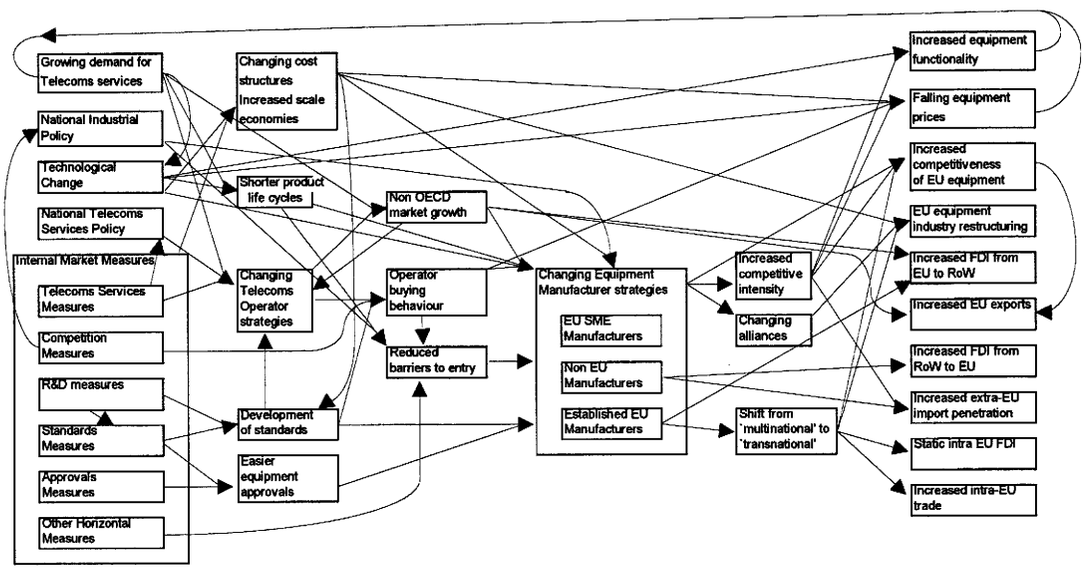
An assessment of causal relationships affecting the telecoms equipment sector must encompass the following areas:

(a) demand for telecoms services and products;

(b) technological developments (including developments in neighbouring sectors);
(c) development of standards (formal, proprietary, ad-hoc, etc.);
(d) regulation of the telecoms services and equipment sectors;
(e) industrial policy and trade policy at national and supranational levels;
(f) telecoms operator strategies;
(g) macro-economic developments at national, regional and global levels;
(h) the EU single market programme.

Figure B.1.2 illustrates the main drivers of change in the European telecoms equipment sector, taking into account each of the areas mentioned above.

Figure B.1.2. Detailed causality diagram for drivers of change in the European telecoms equipment sector



It is clear that even this level of detail, which is considerably simplified from the full set of causal relationships, is too complex to be analysed in full. It was therefore necessary to focus on a simpler set of the main causalities, ignoring those which are assessed as second-order effects. Figure B.1.3 shows the simplified set of causal relationships that was used in the study.

It was possible to derive a manageable number of hypotheses from this simplified set of postulated causal relationships, and the study was thus able to proceed to the testing of hypotheses (as shown in Figure B.1.1 earlier). After several iterations, the main hypotheses which emerged from this work were:

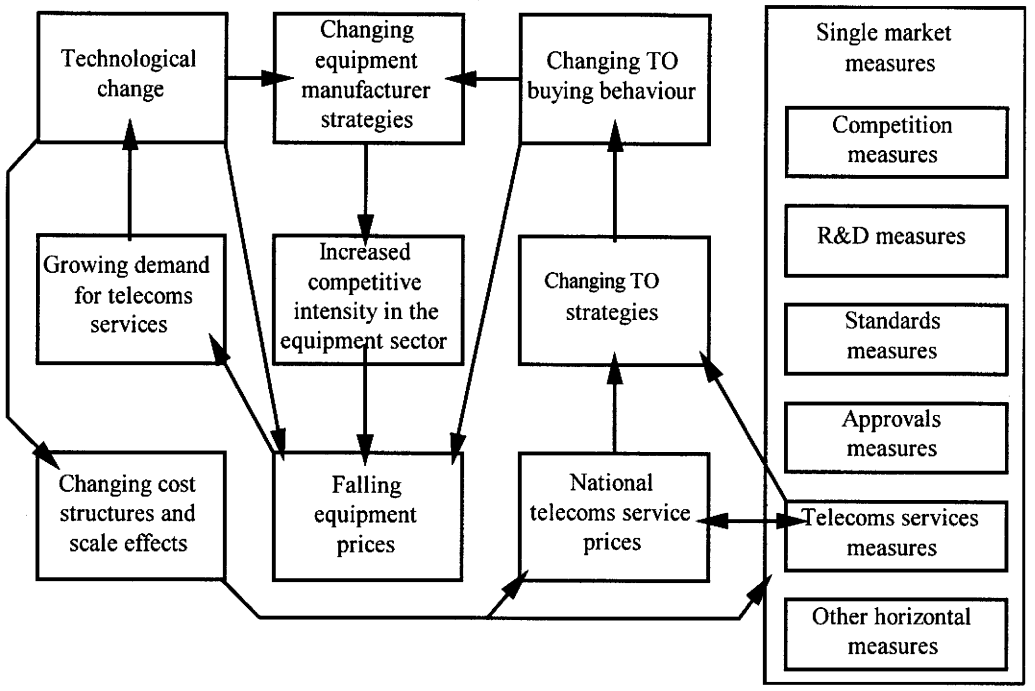
Hypothesis 1 The differential between EU telecoms equipment prices and 'competitive world market prices' (taken as being equivalent to US domestic prices) reduced in the period in question (1985 to 1995).

Hypothesis 2 European telecoms equipment manufacturers have become more competitive (in global terms) because of their reaction to changing market conditions in the European and global marketplaces.

Hypothesis 3 The EU single market programme has been a significant driver of the changes postulated in hypotheses 1 and 2.

Attempts to test these three main hypotheses (and their subsidiary hypotheses) formed the main activity of the study. None of these hypotheses emerged as proven conclusions, but each resulted in 'reasonable assertions', presented with a range of quantitative and qualitative supporting material.

Figure B.1.3. Causality diagram for major drivers of change in the European telecoms equipment sector



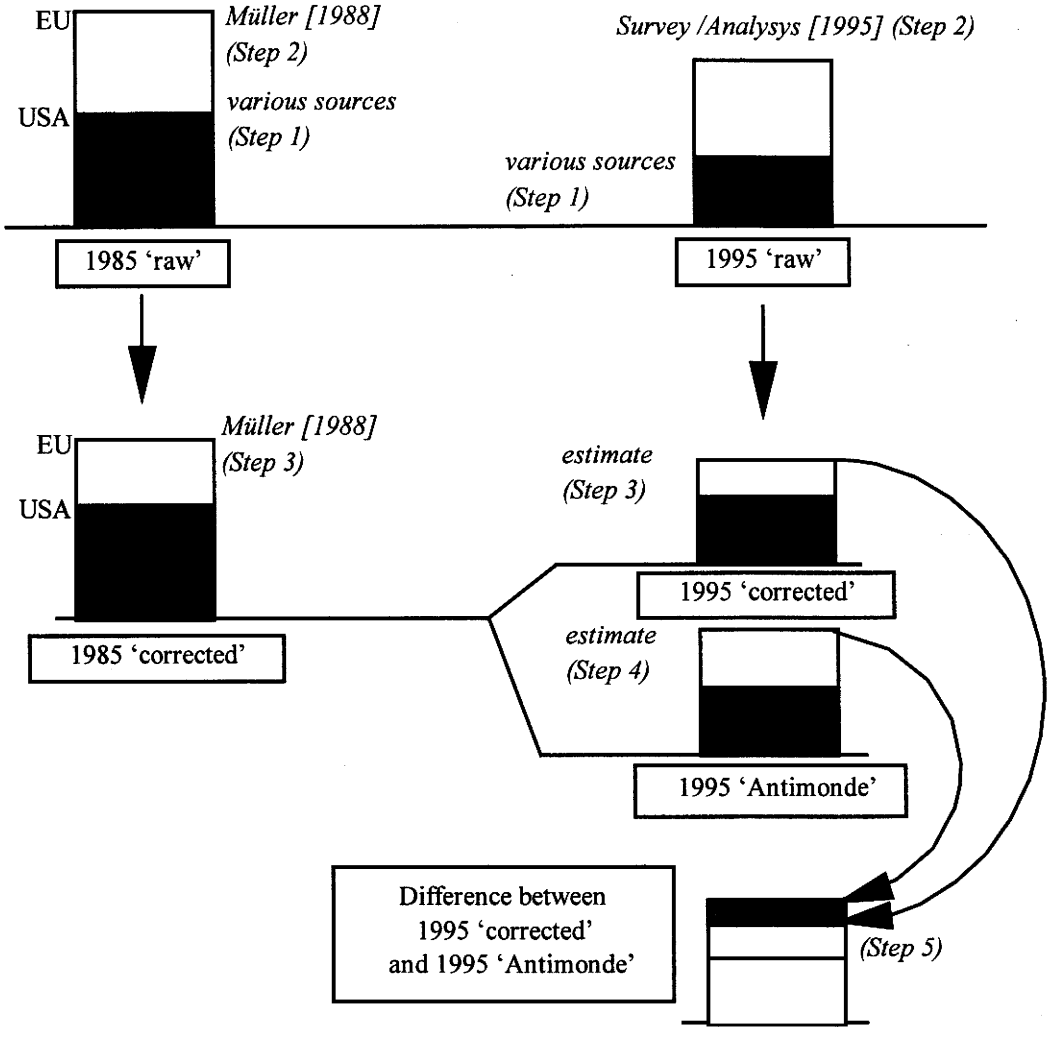
B1.2. Assessment of price convergence

Work carried out as part of the Cecchini study programme [INSEAD, 1988] established that, on average, EU telecoms equipment prices were 20% higher than those in US domestic markets in 1985. Cecchini refers to 'competitive world market prices', but in all cases these were US domestic market prices.

A key hypothesis to be tested in our study is that the EU 'price premium' reduced in the period 1985 to 1995. This section describes the various approaches taken to testing this hypothesis. Section B.2.1 (below) focuses on the particular constraints that make this hypothesis difficult to test in a rigorous manner.

Figure B.1.4 overleaf illustrates the various stages undertaken in comparing prices, both in the 1988 INSEAD work and in this study:

Figure B.1.4. Assessment of EU-US equipment price differentials, 1985 to 1995



Three sub-categories of telecoms equipment were analysed in this study – public switching equipment, transmission equipment and customer premises equipment (CPE). The overall trend for all telecoms equipment was calculated as a weighted average of the three categories.

Step 1: Establishing US prices for 1995 and 1985

US prices for 1995 for public switching (US$ per switched circuit) and transmission equipment (US$ per voice channel equivalent) were estimated from a variety of sources (Dataquest, trade press, brokers' reports, Analysys proprietary information and Analysys interviews with US industry contacts). Estimates of 1985 US prices for public switching and transmission equipment were based on similar sources, including also Yankee Group (1987), ADL [1983] and INSEAD [1986]. 1985 nominal prices were converted into 1995 US$ and then to 1995 ECU. The range of prices and the median prices were assessed for 1985 and 1995 in Section 4.2.6 of the main report.

The complexity of the CPE product category means it is necessary to use a price index rather than assess the 'price per unit'. Attempts to define items of 'reference equipment' proved unsuccessful due to the range of product types and the significant changes in product

functionality that have occurred over the period in question, although Table 4.13 in the main report illustrates price trends for two types of CPE (voice feature terminals and analogue mobile terminals). The change in the index of US CPE prices between 1985 and 1995 was estimated from a variety of sources (MZA, ADL, US Department of Commerce, expert interviews and Analysys proprietary materials).

The degree of estimation involved in using these various sources to establish US price trends between 1985 and 1995 made it difficult to maintain theoretical rigour, so the resultant trends were tested with Analysys and Arcome consultants and with independent parties to ensure that they are plausible.

Step 2: Estimating 'raw' price differences between EU and US prices

1985 price differentials were taken from the work of Professor Müller [INSEAD, 1988], whose methodology is summarized in Cecchini [1988] and described in more detail in the INSEAD report.

The assessment of 1995 price differentials is based on three approaches:

(a) **Knowledge of specific equipment contracts**. Analysys Ltd has been closely involved with both sides of the telecoms equipment procurement process in over a hundred projects with EU operators and manufacturers between 1985 and 1995, and so has a considerable volume of data concerning the prices paid for public switching and transmission equipment. However, Analysys' information covers only a small percentage of the relevant equipment contracts, and our experience also indicates that prices vary widely between contracts (for a variety of commercial and technical reasons). Our first-hand information is also rather sparse in key sub-sectors of the CPE market.

(b) **Third-party materials**. Information from MZA Ltd (an EU telecoms equipment market research specialist) was used to augment our first-hand information on CPE prices. Materials from Dataquest, Elsevier, Yankee Group, NBI and the telecoms trade press were used to supplement our first-hand materials on EU public switching and transmission prices, although it should be noted that there is no consensus among these sources about the precise levels of equipment prices in the mid-1990s in EU markets.

(c) **Expert survey**. A survey of 130 senior figures in the sector (managers in equipment manufacturing and telecoms operators, senior journalists, consultants and academics) yielded over 50 usable responses. The survey asked for an assessment of price premiums in a number of EU national markets or in the EU overall, for public switching, transmission equipment and CPE. Few of the respondents were able to provide estimates for all national markets or for all three equipment categories, but the survey responses matched Analysys' first-hand assessments very closely and were in line with the mid range observed in the third-party information.

These three approaches all indicated clearly that the EU-US 'raw' price differential for telecoms equipment has declined considerably from the 50% premium found by Müller for 1985. We conclude from these three approaches that the raw premium in 1995 was 20%, although any figure between 10% and 30% could be supported by different approaches to the synthesis of the data.

(a) The overall 1995 premium from a review of Analysys' in-house experience was 20%, with lower and upper confidence limits of 15% and 25%.

(b) The average overall 1995 premium from a synthesis of third-party materials was 23%, with lower and upper confidence limits of 15% and 30%.
(c) The average overall 1995 premium from the expert survey was 18%, with lower and upper confidence limits of 10% and 30%.

The analysis focuses on maximizing the quality of the EU total aggregate differential, rather than country-by-country differentials or differentials for specific equipment types. This is because the reliability of estimates for sub-categories is probably too low to justify analysis at these levels of detail.

Step 3: 'Correcting' price differentials for functional and accounting differences between EU equipment and US equipment

Müller reduced the raw premium identified for 1985 prices, firstly to take account of differences in functionality between typical US equipment and European equipment, and secondly to take account of the different apportionment of R&D expenses in the US and Europe, which affects contract prices. This correction reduced the 'raw' premium for 1985 from 50% to 20%. In order to maintain comparability between the 1985 analysis and the 1995 analysis, we have applied the same correction factor to the 1995 raw premium. On this basis, the corrected premium for 1995 is 8%. Application of the same correction factor appears to us to be prudent, even though the apportionment of some US R&D costs has changed over the period. Professor Müller's work describes the 1985 correction as a shift to a 'more likely' real premium, and is an informed estimate rather than a calculated figure.

It should be noted that in undertaking this study in 1995, we had no feasible alternative to the re-use of the 1985 correction factor if comparability was to be maintained. Researching current price and functionality differentials has been a very challenging but feasible task. However, attempting to re-investigate price and functionality differentials of ten years ago would not have been feasible. We have no evidence to suggest that the 1985 estimate should or could have been modified, and we are confident that the re-use of this estimate for 1995 data is at least prudent.

Step 4: Estimating the Antimonde price differential

In the absence of the single market programme, the price differential seen in 1985 would not necessarily have remained unchanged until 1995. The differential could have increased (given the rapid declines in US prices) or reduced. There is no rigorous approach which can be used to establish a 1995 'Antimonde' price differential – there is no equivalent 'parallel market' that can be assessed, and examination of the different liberalization histories of individual EU (or non-EU) national markets is unproductive for such a specific indicator as equipment price differentials – examples can be found where price differentials with the USA have increased or decreased, and specific national effects are clearly the dominant determinant of price trends (examples considered include Greece, Switzerland, Norway, Mexico, Australia and New Zealand). It was assumed, on an arbitrary basis therefore, that the 1995 Antimonde premium is 15%, compared with 8% in the real market. This has been discussed with a wide range of well-informed individuals, and appears to be a plausible 'mid-range' Antimonde assumption. It should be noted, however, that some of our industry contacts suggested that the price differential in the Antimonde would have increased above the 1985 figure of 20%, as Europe failed to match rates of price reduction in the USA.

Step 5: Comparing actual differential and Antimonde differential

This indicates that the actual corrected 1995 price differential is 7% less than the figure which might reasonably be postulated for the 1995 Antimonde. In other words, it is estimated that, on average, EU telecoms equipment purchasers are paying 7% less than they would in a world where the EU single market programme had not occurred.

Steps 3 and 4 involve very approximate assumptions that cannot be tested with any rigour, but which have a direct impact on the final result. The limitations of these steps in the analysis mean it is inappropriate to be overly concerned with the precise percentage differential derived from Step 2. Rather, the key output from Step 2 is the strong hypothesis that US-EU price differentials narrowed markedly between 1985 and 1995.

B1.3. Assessment of competitiveness impacts

This section supplements Section 4.2.2 of the main report, 'Competitiveness and productivity effects'.

Assessment of the competitiveness of a firm, a regional group of firms or an entire economy is notoriously problematic. There is no consensus among academics or consultants concerning even the basic principles or the measurements of competitiveness. Popular works in the field such as Porter [1985 and 1990] and the annual IMD surveys are frequently criticized for weaknesses of theory or implementation, whereas less ambitious academic papers tend to arrive at an impasse of untestably complex causal possibilities. These problems with competitiveness analysis are compounded by the speed of change in the sectors which are of greatest industrial importance (such as software, computing and electronics), where relevant historical data are very sparse. However, in spite of these concerns, it was extremely important for this study to understand trends in the competitiveness of EU telecoms equipment manufacturing.

In this context we adopted a synthetic approach. All of the measures of competitiveness are flawed, but by looking at them all together it is possible to examine various positive and negative hypotheses concerning the competitiveness of EU equipment manufacturing. Seven indicators were used in this study:

(a) EU share of world production,
(b) non-EU import penetration of the EU market,
(c) EU export penetration of the non-EU market,
(d) profitability of EU producers,
(e) comparison of products,
(f) subjective assessment of firms' performance,
(g) comparison of telecoms equipment with neighbouring sectors.

(a) EU share of world production rose strongly between 1985 and 1995, but this is largely due to the appreciation of the ECU against the dollar.[59] The world market for telecoms equipment is primarily dollar-denominated, as are many other industrial markets such as aerospace, shipping and capital goods. Individual EU markets are denominated in national

[59] 1 ECU = US$ 0.76 in 1985, and 1 ECU = US$ 1.31 in 1995, an ECU appreciation of 72% over ten years.

currencies, so the overall EU market can be characterized as ECU-denominated. Measured in dollars, the size of the EU market has grown dramatically in real terms, but this trend does not match the actual development of the market in terms of volume or local currency.

Dollar/ECU fluctuations of the magnitude seen in the previous decade obscure any messages concerning EU competitiveness which might otherwise be provided by this indicator. It is, of course, possible to construct qualitative arguments in this area – for example, the assertion that EU production shares have at least held steady, despite a period of dollar devaluation (which could have led to loss of share, if EU competitiveness had been weak). However, such arguments cannot lead to any strong hypotheses concerning EU manufacturer competitiveness.

(b) Penetration of non-EU imports in the EU market is estimated to have increased from about 3% in 1985 to over 10% in 1995 (see Sections B2.1 and B2.6 below for notes on the data problems in this area). This increase in import penetration cannot be taken as an indication of a decline in EU competitiveness, because of the many impediments to imports that existed in 1985. As these formal and informal impediments have been removed, external imports have risen towards their 'natural' level. Extra-EU imports have grown more rapidly than intra-EU equipment trade because non-EU manufacturers appear to be more competitive in the manufacture of terminal equipment (such as fax machines and handsets), which represents over 75% of extra-EU equipment imports.[60] This faster rate of growth of imports does not necessarily demonstrate a decline in EU competitiveness – EU terminal manufacturers did not appear to have a particularly competitive position in the mid-1980s, but this was concealed by obstacles to market access.

(c) EU export penetration of the non-EU market is estimated to have more than doubled between 1985 and 1995, from around 3.5% to approximately 7.5%. This would appear to indicate an increase in EU manufacturer competitiveness, although to some extent the caveat in (b) above also applies here – world markets have become more accessible for exporters over the period. At the very least, this indicator appears to show that EU competitiveness has not declined since 1985.

(d) Profitability of EU producers has declined (and in some cases disappeared) since 1989 (see Section 4.2.7 of the main report) after having generally risen during the 1980s. This does not necessarily indicate a decline in their competitiveness over the period – many of the world's leading manufacturers have exhibited poor profitability in recent years (e.g. NEC, Northern Telecom and IBM), although the costly multi-domestic production systems of the main EU manufacturers have proved difficult to rationalize as equipment prices have fallen and margins reduced.

Another hypothesis is that the competitive intensity of the industry as a whole has increased in the last decade, and that all players in the traditional telecoms equipment industry have faced price pressures and reduced margins, including in their competitive activities. In this case, only activities experiencing significant volume growth, such as mobile equipment, would show improving profits, and traditional switching, transmission and terminal manufacture would show a decline in profitability. This is well supported by circumstantial evidence, such as the relative levels of profitability of Ericsson's switching and radio systems activities.

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[60] Eurostat [1995].

However, such observations are not rigorous, and profitability analysis cannot sustain a strong hypothesis for the evolution of competitiveness of the EU sector. (See also B.2.1 below.)

(e) Comparison of products. It is possible to assess the competitive position of EU manufacturers in specific product areas in subjective (but informed) terms. In the course of this study, the weaknesses of other approaches led us to concentrate on this indicator, although on its own it clearly does not represent a credible basis on which to draw firm conclusions about EU manufacturer competitiveness. Our assessments are based on (i) Analysys's in-house experience from vendor selection projects, support of equipment proposals and operators' in-service experience of different equipment solutions, (ii) interviews with industry experts carried out informally in the course of the study, and (iii) trade press assessments.[61] The assessments (summarized in Table B.1.1 below) do not address cost-competitiveness in the wider sense, although the inability to bid lower than competitors on specific contracts does count against a manufacturer.

Taking into account the relative sizes of these categories (and ignoring IT equipment), the overall picture is that EU manufacturers have generally improved their competitiveness over the period 1985 to 1995.

(f) Subjective assessment of firms' performance. Even more subjective than an assessment of individual products, an assessment of the overall culture and performance of an equipment manufacturer cannot be used as primary evidence of any change in competitiveness. However, the opinions of industry experts often provide a useful insight, even if they are non-rigorous and based on anecdote.

Europe's largest equipment manufacturers in the mid-1980s received considerable criticism for their perceived inflexibility, lack of innovation and bureaucratic cultures. Whether or not this level of criticism was justified, it has certainly diminished over the period. Indeed, there is considerable and growing qualitative evidence that re-structuring and re-engineering is creating more entrepreneurial and effective business units in many parts of these large organizations, but there are many areas where substantial progress is still required.

Whether these improvements are translating into improved competitiveness in the marketplace is not yet apparent, but these trends certainly support the hypotheses in (d) and (e) above.

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[61] See, for example, *Communications International* annual vendor surveys, and *Data Communications International* annual 'Hot Products' awards and regular *Communications Week International* surveys. The telecoms trade press is sophisticated and well informed (in comparison to that of many other manufacturing sectors).

Table B.1.1. Assessment of EU equipment competitiveness

Equipment category		Subjective assessment of EU manufacturers' competitiveness	
		1985	1995
Switching	Traditional	Moderate	Slightly stronger
	Broadband	-	Weak/patchy
Transmission systems	Copper	Moderate	Moderate
	Fibre	Moderate	Stronger
	Wireless	Weak	Much stronger
	Satellite	Weak	Weaker
Business CPE	PBX	Moderate	Moderate
	Fax	Weak	Weak
	Modem	Weak	Weak
	ISDN equipment	-	Strong
Residential CPE	Fixed handsets	Weak	Weak
	Mobile handsets	Weak	Very strong
Software systems	Network management	-	Weak/patchy
	Subscriber management	-	Weak/patchy
IT equipment (not part of the traditional scope of the telecoms equipment sector; see B.2.1 below)	Routers	-	Very weak
	Hubs	-	Very weak
	Servers	Weak	Weaker
	LAN systems	Weak	Weaker
	Network management systems	Weak	Weaker

(g) Comparison of telecoms equipment with neighbouring sectors. Zysman and Borrus [1994] noted that telecoms equipment was an island of success for EU firms, surrounded by a sea of weaknesses – semiconductors, computers, software and consumer electronics – and commented that EU telecoms manufacturers seemed set to maintain their market shares and overall competitiveness. The contrast between the performance of the EU telecoms equipment sector and its neighbouring electronics sectors is striking, and is only partially explained by the greater protection which was afforded to telecoms equipment manufacturing in national markets during the 1980s. Although it adds little to the competitiveness analysis, a comparison with these neighbouring sectors does highlight the EU equipment manufacturing record in a number of areas, such as:

(a) avoiding product obsolescence through effective R&D and production investments,
(b) maintaining close relationships with customers,
(c) exporting into developed and under-developed markets,
(d) managing international operations,
(e) managing the risks and opportunities presented by industry standards, and

(f) exploiting innovations.

Undoubtedly more could have been achieved, and competitiveness could be stronger, but such a comparison does not undermine the hypothesis that EU manufacturer competitiveness has improved since the mid-1980s.

The following table summarizes these seven perspectives on EU competitiveness.

Table B.1.2. Summary of EU telecoms equipment manufacturer competitiveness indicators and hypotheses

Indicator	Initial competitiveness hypothesis	Robustness of hypothesis
(a) World market share of EU production	Strong improvement	Poor
(b) Non-EU import penetration of the EU market	Decline	Poor
(c) EU export penetration of the non-EU market	Improvement	OK
(d) Profitability of EU producers	Decline	Poor
(e) Comparison of products	Improvement	OK
(f) Subjective assessment of firm performance	Improvement	Poor
(g) Comparison of telecoms equipment with neighbouring sectors	Sustained	Poor
Overall assessment	'Improvement' hypothesis	Poor
	'Sustained' hypothesis	OK

None of the indicators is able to support a robust hypothesis, but the collective indication is that the competitiveness of EU telecoms has at least been sustained over the last decade, and may have improved.

The competitiveness of EU manufacturers is likely to be weaker in the Antimonde than in the actual environment. This is due to the absence of a variety of direct and indirect factors resulting from the single market programme, which are likely to have improved EU competitiveness (see Section 4.2.2). However, quantification of the effects of this shortfall in competitiveness is necessarily subjective and so the quantified conclusions can only be indicative. In such an environment the simplest indicators are the most appropriate: in Section 4.2.7 we illustrate the difference between actual competitiveness and Antimonde competitiveness using the share of the world market taken by EU manufacturers. No attempt has been made to decompose this figure (for example, into EU and non-EU shares), as further complexity would give a false impression of the level of rigour behind the definition of the Antimonde for EU manufacturer competitiveness.

B1.4. Assessment of productivity impacts

Section 4.2.2, 'Competitiveness and productivity effects', states that there are no strong, testable hypotheses linking the single market programme to changes in the productivity of EU equipment manufacturers.

The usefulness of qualitative productivity analysis in the telecoms equipment sector is highly doubtful, and the trends in the sector towards shorter product lives, greater product innovation and higher fixed costs (notably in software development and research and development) are further undermining the measurement and interpretation of productivity. Of course, the importance of productivity remains high, but the inability to make valid measurements reduces the analysis of productivity to the same level as the analysis of competitiveness (as discussed in the previous section).

By way of example, it is worthwhile examining the specific problems associated with measuring productivity in high-technology sectors such as telecoms equipment, software and computing:

(a) **Measurement of units of output.** For productivity measures to be comparable between firms or between periods there must be some homogeneity between the units of output. However, this homogeneity has broken down in most of the telecoms equipment sector. Use of 'number of lines' as the measure of output for public switching is no longer appropriate, as switch functionality has increased and diversified. In transmission equipment the unit of output is now an aggregated 'transmission system', which is poorly characterized by the traditionally meaningful measures of capacity and length. In terminal equipment the diversity of products and the shorter product life cycles undermine the search for a stable unit of output – even within categories. For example, comparison of a 1995 Ericsson GSM handset with a 1995 Motorola GSM handset or a 1996 Ericsson GSM handset shows that it would be quite inappropriate to use 'GSM handsets' as the unit of output for an analysis of GSM handset productivity. Such an analysis would be severely distorted by the differences in product specification, and the necessary corrections could only be highly subjective.

(b) **Measurement of output by value.** In an environment where prices are falling rapidly, it is inappropriate to measure output in terms of unit value or total value, and it also reveals little about the underlying productivity of the firm.

(c) **Measurement of inputs.** In a sector with high product development costs (and significant scale effects) it is very difficult to disaggregate the inputs to the production process to a level at which it is possible to conduct a valid productivity analysis. This problem is compounded by the size and complexity of telecoms equipment manufacturers, with many shared costs and shared components (shared by different products, and in the case of integrated circuits, shared by different manufacturers). Analysis of inputs at the level of the firm is certainly more straightforward, but much less useful (as it tends to degenerate into an analysis of profitability).

These problems are largely insoluble, and in the absence of any strong hypotheses linking the single market programme to underlying productivity, it was decided that this study would not invest time in attempting to relate measures of productivity to underlying productivity in the sector.

B2. Discussion of constraints

The telecoms equipment sector is, in general, well represented and characterized by data available from a variety of credible sources. Inevitably, however, there are constraints on the use of the available data to support or disprove specific hypotheses. This section attempts to document and explain the most important limitations, and describe the more or less satisfactory 'fixes' used when these constraints were encountered in the course of the study.

B2.1. Sector definition

For historical reasons the definition of the telecoms equipment sector excludes the fastest-growing areas of the networking equipment market, such as routers, hubs, servers, network operating systems, and network applications software. These equipment categories have evolved in the IT market, being originally developed as local area networking systems used on single sites. The firms which are strongest in these sectors come from IT backgrounds, and tend to be US-based (e.g. Cisco, 3Com, Bay Networks, Madge, Novell, Fore, Stratacom, Microsoft, IBM). These firms are characterized as computer businesses (SIC 357, NACE 33) or software businesses (SIC 737, NACE 839.2) rather than telecoms equipment businesses (SIC 366, NACE 344). As might be expected given the close technical and commercial interaction of these activities, they are not well disaggregated from the rest of the IT industry.

The inclusion of non-traditional equipment categories within the definition of the telecoms equipment sector is one factor behind some of the discrepancies in market data that exist between the various primary data sources for the sector, but several other factors also contribute to this long-standing problem (notably the treatment of exchange rates, disaggregation of company data and other methodological differences). A comparison of sectoral data from all the reputable public sources (notably Eurostat, EITO, OECD, and DoC) and reputable proprietary sources (Dataquest, NBI, Yankee Group, CIT, Elsevier, Electronics Magazine Survey, MZA, etc.) reveals significant discrepancies, with several showing significant year-on-year discrepancies due to changes in definitions and methodologies (notably Eurostat and EITO).

None of the data sources provides full coverage of the key data required for this study, so it was necessary to reconcile and synthesize data from the various sources. In some cases we chose to use an individual source, due to the level of corroboration or insight into the methodology used (for example, we tended to use OECD trade data, due to their consistency, stability and fit with other data sources). However, in general we had to estimate data which 'correct' or 'average' between sources and can be reconciled with other estimates made during the study. This means that the underlying quantitative picture of the sector is internally consistent but does not match precisely with any of the public or proprietary primary sources.

One particular area of difficulty concerns the analysis of foreign direct investment (FDI). Most FDI data addresses the macro-level flows of investment between countries (such as UNCTAD and OECD data). Information on sectoral FDI flows is much more restricted. However, even the limited data that is available at a sectoral level is not usable for an analysis of trends in telecoms equipment FDI, because of the mixing of telecoms equipment manufacturing with other activities. This mixing arises from the highly diversified nature of the main players in the telecoms equipment industry. FDI data may be estimated for corporations such as Siemens, Alcatel, Philips, Motorola, NEC or IBM, but the disaggregation

of these estimates to the level of activity types is not straightforward. In addition, several areas of activity such as electronics component manufacturing are associated with large FDI flows. These large flows make dissaggregation even more difficult. We are not aware of any existing comprehensive quantified analyses of FDI flows in the global or EU telecoms equipment sectors. (See also WS Atkins [1996].)

B2.2. Equipment price data constraints

Equipment price trends are particularly important for this study (see B1.2 above and Section 4.2.6 in the main report) but are particularly problematic. 'Real' telecoms equipment prices are generally confidential and, even when available, difficult to interpret.

For those few categories of equipment where published price lists are available, most sales tend to be at prices that do not correspond to the published price lists, due to volume discounts and bundling.

Prices for the majority of equipment, particularly switching and transmission equipment, are negotiated on a contract-by-contract basis, and are only loosely disaggregated between the component elements. Contracts are awarded on the basis of sealed bids or negotiations, and in either case the final price, terms and full specification of the purchased equipment tends to be confidential. Manufacturers devote considerable effort to tracking prices in their different markets, and such intelligence is regarded as highly valuable and sensitive within the industry. Organizations such as Dataquest and NBI sell information relating to price trends which is synthesized from information from their industry contacts and in-house experts, but there are discrepancies between these proprietary sources.

Our solution to the problems of tracking price trends was described in B1.2 (above).

B2.3. Constraints on the analysis of large organizations

The telecoms equipment sector is dominated by very large organizations, many of which are active in a number of other industrial sectors. Although this industry structure makes sectoral analysis much more straightforward in many respects, the size and complexity of such organizations does cause some important analytical difficulties:

(a) **Flows of investment are not easily visible.** The country-by-country telecoms equipment-related investments made by large multinational firms are not transparent, and it is difficult to dissociate them from flows related to other sectors.

(b) **Transfer prices are not visible.** The transfer prices for the movement of components or finished products between business units are not transparent. In some cases, such as the extension of intellectual property rights from one business unit to another, or the 'internal licensing' of a technology or brand, there is no internal accounting, even though these represent transfers of real value within the organization, and in a more fragmented industry structure these would be matched by monetary transfers.

(c) **Business life cycles and performance are obscured.** The processes of innovation, business creation and business decline are concealed within the internal operations of large companies, whereas in a more fragmented industry structure these processes would be visible through the creation, growth and decline of firms.

(d) **Market forces are 'damped'.** Large organizations are able to sustain unprofitable operations for longer periods than would be possible for smaller, more focused groups.

This provides large organizations with the opportunity to re-engineer the operations, shift resources away to other activities or merely ensure the survival of the unit until market conditions improve. Of course, there is always the danger that this 'damping' effect will allow unprofitable activities to continue with no effective remedial actions. The consequence of this effect for sectoral analysis is that the impact of changes in the marketplace are retarded, and therefore the effect on sectoral indicators is delayed and made more complex (see B2.4 below).

B2.4. Constraints for causality analyses

In addition to the complexity of the causal relationships in the telecoms sector (illustrated in B1.1 above), the combination of anticipation effects and lagging effects makes it particularly difficult to identify the underlying interaction of factors both in the sector and in the Antimonde for the sector.

We expect strong anticipation effects to drive large equipment manufacturers to prepare for changes in their relationships with the telecoms operators. Anticipation is plausible, because the directions of change and the basic timetable of change have been well defined for several years in advance throughout the duration of the single market programme, and because of their size and strength, equipment manufacturers have had the resources to act in preparation for change.

We also expect to see strong lag effects influencing the rate of change of market structures, market shares and patterns of production. These lag effects are caused by the close relationships which inevitably exist between equipment manufacturers and telecoms operators, the sunk costs of the large multi-domestic equipment manufacturers, and the organizational inertia of large corporations, irrespective of the pressures for change exerted by senior management.

The dynamics of a such a lead-lag system are difficult to identify or predict. The speed of change is very sensitive to small misreadings of either the leading or lagging factors. The interpretation of 'mid-range' rates of change (such as those observed for most indicators in the telecoms equipment sector over recent years) can be a misleading guide to the underlying unobservable rates of change, and a misleading guide to short-run future developments. These effects reduce the confidence which can be placed in any conclusions regarding the impact of a particular factor, and increase the importance of simple indicative conclusions rather than complex and apparently analytically rigorous conclusions.

In some circumstances it is possible to indicate causality by comparing developments in countries subject to perturbation (in this case, EU countries subject to the single market programme) with countries that have not been subject to perturbation (for example, other OECD states such as Australia, Canada, Japan, Norway or the USA). However, such comparisons cannot yield any valid insights in this case, for the following reasons:

(a) The starting conditions (in the mid-1980s) for the EU states and non-EU states are generally quite different. For example, the USA already had a homogeneous competitive market for telecoms equipment by this date. Similarly, the conditions of the Japanese or Canadian markets cannot be matched with the EU markets in the mid-1980s.

(b) The telecoms sectors of all OECD countries have undergone significant reforms in the period 1985 to 1995. A comparison with EU developments might yield some insights

into the relative effectiveness of each reform programme, but this would not address the question of the absolute impact of the single market programme.

(c) European OECD countries that are not part of the EU (Norway and Switzerland) have been both directly and indirectly affected by the single market programme, and thus cannot form a reliable control for causality analysis.

B2.5. Constraints for the analysis of economies of scale

In Section 4.2.3 we asserted that there are strong scale effects and learning curve effects inherent in the production of many categories of telecoms equipment, and provided qualitative and illustrative arguments to support this assertion.

We have not undertaken a more sophisticated quantitative and representative analysis of scale effects or learning curve effects in the sector, for the following reasons:

(a) The existence of strong scale effects in the telecoms equipment and related industries is well known and well documented.[62]

(b) The quantification of scale effects in telecoms equipment is a major exercise, which is complicated by the high level of shared costs in large organizations, the opaque nature of costs within large organizations (particularly for the historical analysis of trends in economies of scale), and the complexity of product and component life cycles within the sector (where strong and often independent scale effects are expected in components and in products).

(c) No strong hypotheses existed which linked the single market programme directly with the mechanisms which determine scale effects. Clearly, there are single market measures which increase a manufacturer's opportunities to access economies of scale (see Section 4.2.3), but this is a second order effect, and could only be quantified in a subjective and illustrative analysis.

B2.6. Constraints arising from exchange rate effects

The 72% appreciation of the ECU against the US dollar over the decade 1985 to 1995 leads to major problems of consistency and interpretation for telecoms equipment market statistics. It is inappropriate to work entirely in US dollars or entirely in ECU, but the use of both currencies can easily lead to confusion and apparent inconsistency. In general we have worked in 1995 ECU in this study, but the international telecoms equipment market is largely 'dollar denominated', and so it has been necessary to use 1995 US dollars in several areas where ECU-denominated figures would provide a misleading picture of trends (notably the trade figures in Section 4.2.8).

The appreciation of the ECU makes it very difficult to interpret trade and market share developments over the period. For example, the growth of external EU equipment exports (rapid in terms of US dollars, slower in ECU terms) could be interpreted as indicating that EU manufacturers have the market power to maintain their ECU prices through inflation of their US dollar prices, although this does not match with the observed characteristics of the export marketplaces, where EU manufacturers generally face strong US and Japanese competitors.

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[62] For example, Bain [1956a and 1956b] for economies of scale, Arrow [1962] for learning curve effects. See also Gruber [1994], Mansfield [1988], MERIT (various) and BRIE (various) for more recent and specific treatments.

(It is not possible to calibrate against export volumes with any accuracy, although volume growth has outstripped the value growth, as prices have fallen.) Trade flows do not correlate well enough with exchange rate movements to allow for any simple correction algorithm, so the analysis of trends is quickly reduced to an unsatisfactory subjective level.

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