LIBERALISATION OF THE TELECOMMUNICATIONS MARKET

by

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ABSTRACT

This study attempts to analyse the economic effects of liberalisation in the market for telecommunications customer premises equipment. Within the structure-conduct-performance framework an attempt is made to examine the effects of increased competition, to estimate the effect of imposed structural changes on the conduct of incumbent firms and to compare their behaviour with that of recent entrants into the liberalised market.

The methodology incorporated in this study involves the undertaking of an extensive interview programme. This covers both government bodies and the senior management of equipment manufacturers and suppliers, and is designed to complement the available published data. The originality claimed relates to the research programme itself and the subsequent use of the data collected to analyse the economic impact of liberalisation, both in the general equipment market and in sub-markets for large PABX, small business equipment and telephone handsets.

The results of this study suggest that competition is strongest in the market for small business equipment which is characterised by a higher total sales value than the handset and large PABX markets, and a higher sales volume than the latter. In each of the three sub-markets examined the incumbent firms have started with a competitive advantage over their rivals, but have not exploited this to the full. Foreign firms stand to gain relatively more than domestic firms from the unreciprocated opportunities presently available in the UK.

Competition has been successfully increased through government policy. The conduct of the market participants has altered significantly as a result, but it is doubtful whether the structural changes will help domestic firms to both establish and maintain a leading position in the world telecommunications market; indeed the reverse may be true.

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GLOSSARY

ANALOGUE TRANSMISSION	transmission of an electrical signal which has an amplitude or frequency which corresponds to a wave-form.
AT&T	American Telephone & Telegraph Company : the dominant long-distance network operator in the USA.
BABT	a non-profit making authority established to test subscriber apparatus and to report the results to the Secretary of State or Oftel, who grant product approval.
CELLULAR RADIO	mobile telecommunications services.
CONNEXION	a handset providing the first connection to the public network from any office or home; frequently termed the "primary instrument".
CPE	customer premises equipment ie subscriber apparatus which can be connected to the national telecommunications from the user's office or home.
CROSSBAR	an intermediate exchange technology between Strowger and electronic exchanges which makes connections through a matrix of moveable rods.
DIGITAL TRANSMISSION	transmission in which the analogue wave-form has been quantified and represented by a series of digital pulses.

EXTENSION	an additional telephone handset connected to the network through the same connexion as a suitably installed primary instrument.
FCC	Federal Communications Commission : the regulatory body in the US market.
KEY & LAMP UNIT	fore-runner to the key-telephone system.
KEY-TELEPHONE SYSTEM	subscriber apparatus which enables a number of telephone extensions to use the same exchange line, with each extension capable of answering and transferring an incoming call using the special handset provided.
MDT SCHEME	Manufacturers' Dedicated Test Laboratory Scheme : a scheme whereby manufacturers can test their own CPE products, but BABT must approve the results.
MICROWAVE TRANSMISSION	transmission through radio channels from one terminal station to another, possibly via several intermediate stations spaced approx. 40km apart.
OFTEL	Office of Telecommunications : designed on similar lines to the Office of Fair Trading to oversee and regulate the telecommunications industry.
PABX	private automatic branch exchange : an automatic exchange installed on user's premises which allows telephones to be connected internally, ie within the user's premises, or externally through the public telecommunications network.

PMBX	private manual branch exchange : as above but operated manually and consequently requiring the services of a telephone operator.
PUBLIC SWITCHING	process establishing a link between two subscribers through use of the public telecommunications network.
SPC	stored programme control : primarily employed in public or private exchange technology.
STATION	a telephone handset which represents a primary instrument, an independent extension or an extension attached to either a PABX or a key-telephone system.
STROWGER	electro-mechanical exchange technology employed to switch calls over the public network through the use of step by step selectors.
SYSTEM X	a fully electronic digital switching technology with the capability of transmitting both voice and data using micro-electronic technology and software.
TEMA	Telecommunication Engineering and Manufacturing Association.
TXE	electronic exchange technology which provides connections through matrices of gold plated reed relay switches in gas filled tubes.
VANS	value added network services ie network services which "add value" to the basic telephone network.

CHAPTER ONE : INTRODUCTION

On 21st July 1980 Sir Keith Joseph, the Secretary of State for Industry, announced to the House of Commons that a Bill would be introduced to facilitate the liberalisation of the UK telecommunications market. Liberalisation policy was to be introduced both in response to the many calls which had been made for the introduction of competition into particular sectors of this market, and as an important step in establishing the conditions considered necessary before British Telecom (BT), a state monopoly, could be sold to the private sector. To avoid the transformation of a publicly owned monopoly into a privately owned one, which would entail some considerable and detrimental welfare consequences, significant measures of competition had to be introduced into BT's market.

The liberalisation measures introduced by the government, outlined in Chapter 3 below, included the introduction of at least some degree of competition in the market for telecommunications transmission, free competition in the supply of value added services over BT's network, and competition in the supply of attachments for connection to BT's network. These measures were introduced through the 1981 and 1984 Telecommunications Acts.

Through the creation of a competitive environment in the telecommunications market the government stated its objectives[1] as :

a) successfully promoting the interests of consumers, purchasers and other users of telecommunications services and products, by increasing both efficiency within firms and the variety of products within markets;
b) the promotion of competition;
c) the promotion of efficiency and economy;
d) the promotion of research;
e) the establishment and maintainance of a leading position in the world's telecommunications markets and
f) the attraction of multinationals to the UK.

Although it is frequently introduced as a necessary measure prior

to the complete or partial privatisation of some publicly owned company, liberalisation also represents an important policy in its own right, and has many supporters who staunchly disagree with the concept of privatisation [2]. Given the separability of the two policies of liberalisation and privatisation, a suitable case can be made for analysing the liberalisation of the telecommunications market, in terms of its apparent effectiveness, as a policy which is independent and distinct from the subsequent privatisation of BT. This argument is especially strong in the particular case of the market for customer premises equipment [3] where BT's own involvement has been traditionally restricted to that of a distributor, even though it has clearly dominated the market from that position [4].

The aim of this thesis is to analyse the economic impact of liberalisation policy in the customer premises equipment (CPE) sector of the telecommunications market. This particular sector has generally been viewed as the one in which liberalisation will have most effect. Not only does this sector offer considerable potential for both technological progress and increased consumer freedom, but it has also been a prime candidate for this type of policy for many years. Some of the reasons for the growing discontentment with the prevailing uncompetitive market structure are discussed in Chapter 2 below.

This thesis is primarily concerned with the apparent impact of liberalisation policy on the manufacturers of telecommunications equipment, and consequently claims originality, not on the basis of a significant contribution to economic theory, but as a result of undertaking an original research programme. The quantitative and qualitative information included in this thesis was collected both from published sources and from a series of interviews held with the senior management of the majority of firms participating in the CPE market in 1984/5. This information is employed in an effort to a) test the accuracy of expectations based on established theory pertaining to this subject and b) reach some conclusions regarding the apparent effectiveness of liberalisation policy, at least with regard to this particular sector of the telecommunications market.

A search of recent literature confirms that no other study of this dimension has been carried out in this particular market, although

both Foreman-Peck & Manning (1986) and Gist & Meadowcroft (1986) have published some work on the topic of liberalisation in the CPE market. The former authors report the results of a recent study into the impact of liberalisation in the UK, undertaken for the Anglo-German Foundation and the EEC FAST programme. This study found that although liberalisation gives rise to the possibility of domestic manufacture of telecommunications products being replaced by foreign production, this has not in fact occurred - domestic output has actually increased in real terms. From the consumers' point of view this study established that it is only obvious that business users have benefitted from the policy. The net benefits of liberalisation for residential consumers are more difficult to ascertain and Foreman-Peck & Manning conclude that BT is likely to retain its monopoly in that particular sector of the market for some time.

Gist & Meadowcroft focused on one particular sector of the CPE market ie the market for PABX products [5] and have little doubt that consumers have benefitted from both price reductions and a wider choice of product subsequent to liberalisation. Gist & Meadowcroft concede that at least some of the benefits now available to consumers must be attributable to liberalisation, but are particularly sceptical about the strength, and hence effectiveness, of the regulatory regime created in the liberalised market.

These two studies have concentrated on the market sector for PABX and have selected to treat this as one market, whereas a strict division arguably exists between products incorporating more than 120 lines, and those which offer less. This distinction has been made in the following analysis of the CPE market where the relatively smaller PABX products, together with key-telephone systems [6], are classified as "small business systems", and discussed in Chapter 6 below. The impact of liberalisation in the large PABX market, ie that in which products with more than 120 lines are supplied, is discussed in Chapter 5. The results of the case studies presented in these chapters confirm that not only are these distinct markets attractive to different categories of manufacturers but that, partly as a consequence, the conduct of firms within the two sectors differs quite markedly. In the larger sized product market BT is a new entrant firm

attempting to win market share from the traditional manufacturers, but in the small business system market, where it traditionally monopolised product provision, the roles have been reversed and it is BT who is under threat from both domestic and foreign entrants.

Neither of the two studies discussed above gave much consideration to the market for telephone handsets. In Chapter 7, however, this market will be confirmed as relatively important because of the high volume of product being traded, even though the unit value of product is relatively low. The handset market also appears to be the only sector of the CPE market in which new domestic entrants are presented with attractive opportunities and a reasonable chance of success and long term survival.

This thesis attempts to go further than either of the two studies discussed above by investigating the economic impact of liberalisation in three individual sectors of the CPE market, ie those dealing with large PABX, small business systems and handsets, prior to drawing conclusions regarding the success or failure of policy in the CPE market as a whole. This approach provides a greater appreciation of the characteristics of each particular sector. It highlights the extent to which participating consumers and manufacturers differ between markets, the apparent consequences of the different market structures on the conduct of firms, and the subsequent effectiveness of liberalisation policy within specific sectors of the market as a whole.

To further clarify the nature of competition within the individual sectors, each firm interviewed in this study will be categorised according to its ownership and commercial background as :

a) large incumbent firms;
b) exclusive suppliers to BT;
c) agent firms;
d) joint ventures;
e) multinationals and
f) small domestic firms.

This categorisation is justified in Chapter 5 where the consistency with which members of each of the above groups of firms have decided to participate in each product market is found to be clearly

significant. However, it is not only with regard to market location that firms from each category act in a similar manner; this effect is continued through to the choice of appropriate market conduct, ie not only have the members of each category of firm generally decided to enter the same sectors of the market, but they have also adopted quite similar market strategies within these sectors.

This study employs a structure-conduct-performance framework as a means of analysing the effects of liberalisation. This can be justified as one of the most suitable frameworks within which any problem relating to industrial economics can be investigated. This framework has the particular advantage of facilitating a dynamic approach to analysis, and this is clearly critical for the study of the effectiveness of policy in any market.

The economic, political and technological history of the CPE market, and the domestic telecommunications market as a whole, is discussed in Chapter 2 which attempts to highlight the specific features which made this particular market such a prime candidate for liberalisation policy. Chapter 3 subsequently discusses the introduction of competition into the US market and outlines the liberalisation policy measures introduced into the UK market through the Telecommunications Acts of 1981 and 1984. The consequences of the introduction of competition through the methods selected in the US market may have influenced the formation of suitable policy in the UK, and by outlining both sets of measures it is hoped that the two approaches can be suitably compared and contrasted.

Chapter 4 discusses economic theory which is relevant to the attempt by any government to introduce some element of competition into a previously monopolised or highly concentrated market. By aiming for a significant increase in the level of competition in the CPE market, the government has effectively placed on one side the ever-present problem of the second best. But the government may also have failed to give sufficient consideration to some market characteristics which can severely limit the achievement of a competitive solution. These characteristics, and their potential effects, are discussed in Chapter 4, both in general terms and with regard to the CPE market in particular.

Chapters 5-7 present case study material relating to the markets for large PABX products, small business systems and telephone handsets respectively. In each case the characteristics of the particular market sector are discussed, as are the views of participating firms, classified as above, regarding the opportunities made available by liberalisation policy. Various market strategies, selected by each category of firm, are considered under the headings of a) conditions of production, investment and R&D etc, b) product approval and testing and c) retail distribution, price and non-price competition. This is followed by a statistical analysis of the structure of each sector, the conduct of market participants and the performance of competitors. This information, and the more subjective analysis presented in the case study reports, is employed to test three major hypotheses constructed on the basis of the relevant economic theory discussed in Chapter 4 ie :

Hypothesis 1 : the government has successfully introduced, through the particular measures it has adopted for this purpose, a socially efficient level of competition;

Hypothesis 2 : the interacting strategies of the competing groups will lead to a prevalence of non-price, as opposed to price, competition;

Hypothesis 3 : liberalisation in their domestic market is not expected to increase the international competitiveness of the incumbent firms.

The final chapter in this thesis draws upon the material presented in each of the preceding chapters and examines the expected and actual consequences of liberalisation policy in the CPE market as a whole. The conclusions previously drawn for each product market, and the relative importance of each of these markets within the CPE market as a whole, lead to a more general conclusion that liberalisation policy has successfully introduced some degree of competition into the market, but has not been as effective as was initially expected. This result, however, cannot be attributed solely to liberalisation policy being inadequate in either design or implementation. The CPE market's failure to attain the expected levels of competition must be judged to be at least partially a consequence of its particular structure, both before and after liberalisation. The market is characterised by considerable economies of scale and a significant level of buyer

power, exercised by BT, and high levels of concentration may, therefore, be efficient. Partly for this reason, the initial expectations of liberalisation were arguably too ambitious ever to be attainable in this particular market.

NOTES

1. These objectives are outlined in more detail in Wheatley (1983).

2. A good example of this attitude is provided by Tony Benn who supported liberalisation when he was Postmaster General during the 1960s, but who publicly objected to the recent privatisation of British Telecom.

3. Customer premises equipment includes any item of equipment which can be connected to the national telecommunications network from the consumer's home or office.

4. BT has recently become indirectly involved in the manufacture of CPE products after its takeover of Mitel Telecommunications. This takeover occurred after the fieldwork for this study had been completed, and Mitel consequently appears in the sample of firms, presented in Chapter 5, as a foreign multinational. However this classification of Mitel remains arguably valid given that the Monopolies and Mergers Commission ruled against BT supplying Mitel products at least until 1990, and possibly thereafter, as part of the conditions necessary before the merger was allowed to proceed.

5. A PABX is an automatic telephone exchange which is installed on the customer's premises and enables users to make both internal calls, to other telephones on the same premises, or external calls through the public network.

6. A key-telephone system enables a number of handsets to be connected to one exchange line - any extension can answer incoming calls and transfer these as necessary. This product provides an alternative to PABX products for small business users.

CHAPTER TWO : DEVELOPMENT OF THE INDUSTRY

(I) PREFACE

This study of the CPE market was undertaken in 1984/5 at which time British Telecom (BT), in the process of being privatised, remained the dominant network operator. The development of the Post Office network, and the transformation of Post Office Telecommunications into British Telecom plc, are consequently of considerable relevance to the liberalised market for telecommunications equipment.

This chapter traces the economic, political and technological history of the UK telecommunications industry, from its inception in 1875 until the government's liberalisation policy was announced in 1980. The discussion focuses primarily on the CPE market but, for this to be achieved, an adequate understanding of the development of the national telecommunications network is also required. The technology incorporated within the national network is of crucial importance to the CPE market, in so far as it determines the technological characteristics and standards required by any products designed to be connected to the network. The ownership of the national telecommunications network/s is also of significant importance and may restrict the channels through which CPE products reach the end-consumer, consequently exerting a considerable influence on the structure of the CPE market.

(II) INITIAL DEVELOPMENTS

Alexander Graham Bell constructed the first experimental telephone in Boston (USA) in 1875, as an indirect consequence of his research into the use of accoustics in the teaching of speech to the deaf. Being immediately aware of the potential importance of this development, Bell secured patent protection both in the United States and abroad. His initial invention of the telephone was then followed rapidly by several technological innovations, which led both to the sophistication of the product itself, and to an increasing demand for its use. Bell subsequently established a company to promote and market the telephone, but only after his offer to sell the relevant patent to Western Union, the giant telegraph company, for $100,000, was rejected in what is now viewed as one of the greatest commercial errors ever made.

Bell introduced the telephone into Britain in August 1876 and again made a specific approach to the relevant telegraph monopoly. He offered to supply the British Post Office with telephones at rates which would be 40% below those payable by the public. Bell's offer was not accepted for 2 years, but competition was eventually established between the telegraph and telephone, and competition between specialised telephone companies soon followed. The "Telephone Company" was floated in June 1878 with an initial capital investment of $100,000, and the ability to work the Bell patent, while the "Edison Telephone Company of London Ltd." was formed, only thirteen months later, to exploit a similar patent which had been filed, in July 1876, by Thomas Alva Edison.

Competition in the UK market was soon so fierce that the two major private competitors judged the effects to be harmful enough to warrant amalgamation, and subsequently achieved this on 13th May 1880. This move resulted in the formation of the "United Telephone Company" (UTC), with a capital of £500,000 and the ability to work both the Bell and Edison patents. Some £200,000 in shares was allocated to the Bell Company and £115,000 to the Edison Company in what was simply the first of many amalgamations which would occur within the industry.[1] The UTC decided to reserve the development of telecommunications

services in London for its own exploitation, but licenced subsidiaries to provide services throughout the rest of the country.

By the end of the 1870's the Post Office had concluded that the telephone system in the UK represented a natural monopoly, in so far as "competition" appeared to be inefficient. The Post Office also viewed the telephone as a direct threat to its own telegraph revenues and subsequently declared, in 1879, that telephone companies were infringing the monopoly conferred upon it in the 1869 Telegraph Act. The Post Office sought a court injunction to restrain the telephone companies, and to prevent them from becoming significantly involved in the wholesale side of the business. A court hearing in November 1880 gave judgement in favour of the Post Office by effectively ruling that a telephone was really a telegraph, a telephone conversation was really a telegram, and that telephone companies and their subscribers were consequently infringing the Post Office's statutory monopoly over the provision of telegraph services.

As a consequence of this effective extension of monopoly, telephone development in Britain was placed firmly in the hands of the Post Office. This, however, in turn raised the critical question of whether the Post Office should actively develop the telephone itself, eradicate the device altogether in an effort to defend its already established telegraph monopoly, or facilitate a relatively unrestricted amount of enterprise through the issue of licences on quite a liberal basis. The latter option was chosen because the Treasury would not agree to finance the Post Office to the extent necessary for it to establish its own network of exchanges, although it granted permission for the Post Office to establish a limited number of strategic exchanges which would prove useful in its subsequent licence negotiations.

The licences issued by the Post Office permitted private companies to operate telecommunications networks for up to 31 years, but were clearly restrictive in so far as they did not grant companies the wayleave rights necessary to erect telegraph poles or to lay wires as and where required. Licenced companies were also obliged to pay 10% of their gross income, as a royalty, to the Post Office, and could only operate in areas of a 2 mile radius in London and a 5 mile radius

elsewhere. The provision of trunk lines and call offices by licenced companies was initially forbidden, but the subsequent paralysis of the industry, and extensive public indignation at this situation, later pressurised the Post Office into reversing this decision. The Post Office retained the power to purchase the entire UK telecommunications system at the end of 1890, 1897, 1904 or 1911.

The decision to issue licences increased the forces of competition to such an extent that companies again sought amalgamation. A major move in this direction was provided by the proposal to amalgamate the UTC, the Lancashire & Cheshire Telephone Company and the National Telephone Company. This latter company had been established in 1881 to serve Scotland, the Midlands and Ireland, and had subsequently taken over many of its smaller competitors. However, the government forbade the proposed amalgamation, calling it "departmental and disingenuous". The three companies remained determined to achieve their goal and subsequently decided that the National Telephone Company, as the largest with 10,813 exchange lines, would simply "absorb" the other two companies. The new amalgamated company eventually opened with 23,583 exchange lines, of which 6793 had been transferred from the United Telephone Company and 5979 from the Lancashire & Cheshire Telephone Company.[2]

The Post Office Takeover of the Network

The telephone system continued to develop at quite a slow pace, with the NTC being denied wayleave rights but in turn allowing no other company to use its own trunk lines. Even after the expiration of the Bell and Edison patents which it held, the NTC retained an advantageous position in the industry, and grew from strength to strength by absorbing the majority of its undersized competitors. The Post Office had made several statements to the effect that the creation of a telecommunications monopoly was not in the public interest, and that the role of the state was to supplement rather than supercede private enterprise, but the ascendancy of the NTC, and its control of the trunk network which threatened the telegraph, increased

pressure for the Post Office to establish a publicly owned system with which to challenge this potential monopoly. Treasury restrictionism still denied the Post Office the ability to assume control of the telephone network in toto, but on 22nd May 1892 the Postmaster General, Sir James Fergusson, announced that the government would purchase all existing trunk lines from the NTC. The NTC would thereafter be confined to local "exchange areas". The government also decided that local authorities would be given the power to veto wayleave powers previously conferred upon the NTC by the Postmaster General.

A Bill was passed in Parliament to provide the Post Office with £1 million to purchase and further develop the trunk system of the UK network. The negotiations concerning this transfer of the trunk system were held between the Post Office and the NTC over several years, and the transfer was not completed until 1896. The negotiated settlement required the Post Office to make a payment of £459,000 to the NTC, ie the equivalent of £15 10s per mile of wire and implying a plant value of £23 per telephone.[3] In subsequent years, the NTC would retain its effective monopoly over the provision of local services.

Continual discontentment with conditions within the telecommunications industry led the House of Commons to appoint a Select Committee, in 1898, which subsequently criticised the telephone service offered in Britain. The Committee found that although the Post Office's trunk system was the most extensive in Europe, the privately owned local exchange service was relatively backward and there was little scope for improvement unless the private monopoly over local exchanges was removed. Competition in the local network between the NTC and the Post Office or local authorities was advocated, and the 1899 Telegraph Act consequently provided the Post Office with £2m, from consolidated funds, to enable it to compete. This Act also gave local authorities permission to establish their own local telephone networks, under licence from the Post Office, and to finance the necessary investment by borrowing against the rates. Several authorities had previously expressed dissatisfaction with the telephone service offered in their particular districts, and had petitioned the Government for the right to control their local

networks but, out of 1334 eligible councils, only 60 applied for a licence and only 13 applications were accepted. Six licences were eventually issued to the local authorities in Glasgow, Brighton, Hull, Swansea, Portsmouth and Tunbridge Wells but, with the exception of Hull[4] these authorities had overestimated the expected profits, underestimated operational costs, and failed to survive for any significant length of time.

After it was established that the Post Office would be taking the entire network into public ownership in 1912, extensive negotiations between the Post Office and the NTC became necessary as the latter, having already spent over £9 million on network development, clearly had no inclination to expand or improve its network prior to the takeover. An agreement between the Post Office and the NTC was laid before Parliament in 1905, but the industry remained unavoidably "frozen" until the takeover was completed in 1912. Table 2.1 illustrates the growth of the Post Office's telephone network until this time, and particularly highlights the natural growth achieved by the Post Office, and growth achieved through takeover or amalgamation. The most significant level of growth was achieved in 1907/8 as a consequence of the Post Office's takeover of the local authority networks in Glasgow and Brighton.

The purchase of the NTC's network, in 1912, cost the Post Office £12,470,264 but was expected to end the indecision and compromise of the previous thirty years[5]. From 1st January 1912 the Post Office assumed complete control over the operation of the UK telecommunications network and the provision of most customer premises equipment.

TABLE 2.1 - THE POST OFFICE TAKEOVER OF THE TELEPHONE NETWORK (1895 - 1912)

YEAR	No. of telephones rented by the Post Office in: PROVINCES	LONDON	TOTAL	NET.INC.	GROWTH %
1895/6	1842	-	1842	-	-
1896/7	1863	-	1863	21	1.14
1897/8	1957	-	1957	94	5.05
1898/9	2132	-	2132	175	8.94
1899/0	2246	-	2246	114	5.37
1900/1	2686	-	2686	440	19.59
1901/2	3891	-	3891	1205	44.86
1902/3	5218	9122	14340	-	-
1903/4	6847	n/a	-	-	-
1904/5	8644	n/a	-	-	-
1905/6	11469	33380	44849	-	-
1906/7	13232	41244	54476	9627	21.47
1907/8	29829 [a]	49270	79099	24623	45.20
1908/9	30937	55807	86744	7645	9.67
1909/10	33330	64966	98296	11552	13.32
1910/11	42388 [b]	79342[b]	121730	23434	23.84
1911/12	471972 [c]	232009[c]	703981	-	-

SOURCE: REPORTS OF THE POSTMASTER GENERAL ON THE POST OFFICE (VARIOUS YEARS)

a: includes phones taken over from Glasgow and Brighton Local Authorities.

b: includes the takeover of private wires.

c: includes takeover of NTC network.

(III) CO-OPERATION BETWEEN EQUIPMENT MANUFACTURERS

The domestic manufacture of telecommunications equipment began in earnest subsequent to the Post Office assuming full control of the UK network. The recognition of the almost certain ascendancy of the telephone over the telegraph had resulted in the Post Office giving positive encouragement to a new branch of electrical manufacturing. As the operator of the only national telecommunications network in the UK, the Post Office would receive all revenue arising from calls made by subscribers. However, subscribers can only access the network, and complete calls, if the network incorporates suitable exchange technology, and if subscriber apparatus is of an adequate standard. If the Post Office was to achieve high levels of revenue from the telecommunications network, it would have to ensure the development and supply of good quality equipment.

Strowger switching equipment had been invented in the United States in 1889, but was not adopted by the Post Office until 1922, when a successful development programme, between the Post Office and the Automatic Telephone Manufacturing Company, produced the "Director" exchange. This product, based on Strowger technology, faced an almost guaranteed market, and offered considerable increases in employment and productivity within the manufacturing firm. Such favourable consequences of joint development led both the Post Office and the manufacturers to view future "competitive" development programmes as disadvantageous. Given the industry's reliance on extremely complex technology, only interactive research between the Post Office and the manufacturers appeared fruitful. In response, the Post Office signed several "Bulk Supply Agreements" (BSAs) which were primarily designed to spread product development and manufacture between the major suppliers of that time ie GEC, The Automatic Telephone Manufacturing Company, Siemens, STC[6] and Ericsson.

The BSAs initially appeared to be so successful, that a Bulk Contracts Committee was formed in 1928. This Committee was to be served by a permanent secretariat, and was designed to ensure that engineers from selected manufacturers could work closely with Post

Office engineers in any future development projects. The Committee had further to ensure that contracts were distributed evenly and that all relevant patents were pooled.

Under the terms of the Bulk Supply Agreements, equipment manufacturers had the advantage of planning on the basis of 5-year orders placed by the Post Office. These orders were most commonly distributed on the basis of the relative manufacturing capability of each firm. However, each manufacturer was obliged to supply products to the Post Office at common prices which were lower than would apply under competitive conditions. The Post Office itself determined the prices it would pay for equipment ordered, and set these on the basis of the lowest tender offered for each individual product. As the primary buyer in the market, the Post Office set prices at the level of cost plus a fixed percentage, ie at levels which were at least 8% lower than would have been quoted by manufacturers operating under more competitive conditions.

The BSAs were designed to run for five years, but prices could be renegotiated after thirty months. Any supplier who successfully improved his production conditions during the contracted period could potentially achieve a higher level of profit for the remainder of the existing agreement's life, but it was the Post Office who would benefit, from a lower price, in the next contract period.

The level of state and industrial co-operation associated with the BSAs was designed to stimulate R&D effort. It was believed that suitable technological development could best be achieved through co-operation between the primary buyer and selected manufacturers, and this would also eliminate the wasteful duplication of R&D programmes. The cost of R&D undertaken by the manufacturers participating in this scheme was included as an "overhead" in the Post Office's cost investigations. However, although the intention behind this co-operation was to eliminate the waste of resources associated with large but competitive development programmes, these programmes had three important consequences.

The first of these consequences was the provision of additional funds, from the Post Office, for R&D work undertaken by selected manufacturers. The second consequence was the guarantee of large

volume production for chosen products - this gave considerable cost advantages, through economies of scale, to the manufacturers. However the third effect was not so favourable; given that the Post Office had no apparent need to make significant purchases outside the "Ring" of manufacturers, these firms were effectively protected against the entry of new competition, and had little incentive to minimise costs or to work with maximum efficiency in terms of either manufacture or product development. No information has been published regarding the product prices paid by the Post Office itself; indeed the Postmaster General even refused to inform Parliament on this matter. But one fact, which has been generally confirmed, is that the cost advantages, made available to the manufacturers operating within this particular market structure, were sufficiently large to result in product prices falling below the levels prevailing in international markets. There can be little doubt that the operation of the BSAs helped to stimulate British exports from this particular sector of the industry.

The 1920s and 1930s

After 1912 the Post Office represented the only bridge between the manufacturing industry and the public, but was notoriously slow at selling its own services. The manufacturers had consequently formed the Telephone Development Association (TDA) in 1924, with a remit to promote the telephone to the public and to remove the effects of Treasury restrictionism from the industry. The TDA argued that Treasury control was forcing the Post Office to deal only with its immediate requirements, ie with little consideration for future development, and persuaded the government to approve the promotion and advertising of the telephone.

Although it could not make a move without prior Post Office approval, the TDA spent £4000 on press advertising in its first 14 months of operation[7] and successfully altered the residential user's attitude towards the telephone. The attitudes of "business" users of telecommunications products and services were more significantly influenced during the Wall Street Crash. This event not only increased

Post Office revenue by almost £360 per hour (in 1930 prices), but also convinced many business users of the indispensability of a telephone service in general, and a transatlantic one in particular.

In the 1920s and 1930s the technological advantages of an increased level of automation, and the economic advantages of an increased level of promotion, did little to ease the problems being faced because the Post Office remained a civil service department, and had no financial autonomy. The Post Office required large amounts of capital to replace old equipment with Strowger technology and there was, consequently, much discussion about "hiving-off" the telephone section of the Post Office, to free it from Treasury control. The arguments supporting this proposal, at this particular time, were remarkably similar to those which would be given fifty years later, ie in favour of splitting the Post Office's postal and telecommunications services, and subsequently privatising British Telecom.

Although criticism was building up against the Post Office as a whole, this was mostly with regard to the telecommunications side of its business. The service was in the process of being transformed from manual to automatic operation, but development still appeared to be retarded and the Post Office appeared to be indifferent to consumer requirements. Telephone charges were also judged to be too high. These points were considered in depth by the Bridgeman Committee which was appointed in 1932. The Committee's report criticised both the internal structure of the Post Office, and its continued role as a "Revenue Department" of the Exchequer. It rejected the idea, advocated by the telecommunications industry, that the Post Office should be transformed into a public corporation, but proposed significant changes in its financial arrangements. These changes were both welcomed and implemented, and resulted in the Post Office being henceforth obliged to pay only a fixed annual sum to the Treasury, plus 50% of any surplus it earned, while retaining the other 50% of profits for its own use.

With regard to the organisation of the Post Office, the Bridgeman report suggested that a functional board be established. This board would be presided over by the Postmaster General, and would cover activities such as finance and research. In response, Post Office

headquarters were quickly reorganised into three major departments ie a) postal services, b) telecommunications and c) personnel. Seven supplementary departments were also created, and a system of regional administration was established for the first time since 1912, ie the year in which the Post Office had abolished the district system previously employed by the NTC.

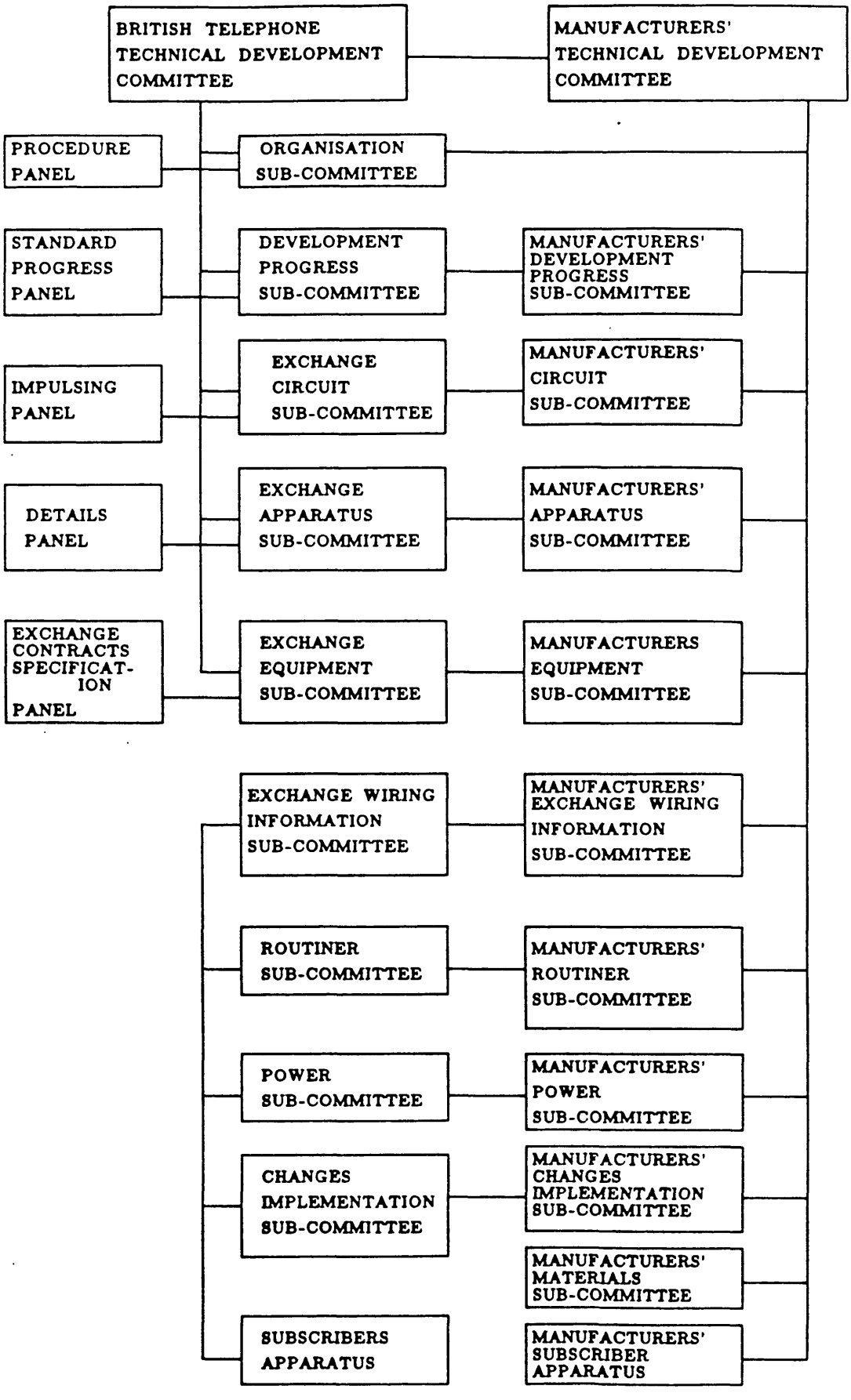
The BTTDC and MTDC

The Bridgeman Report had proposed the establishment of a close working partnership between the Post Office and manufacturers, through which their efforts could be fully coordinated. The BSAs and the Bulk Contract Committee consequently remained in existence, but two new organisations, of apparently significant importance, were established in 1933 ie 1) the British Telephone Technical Development Committee (BTTDC) and 2) The Manufacturers Technical Development Committee (MTDC). These organisations were established with the structures illustrated in Diagram 2.1.

The BTTDC was formed as a joint technical committee under the chairmanship of an Assistant Engineer-in-Chief to the Post Office. This committee had a mandate to influence the technical development of the telephone, and to promote product standardisation as far as was practical. Each manufacturer was to be kept informed of all work being undertaken, and could therefore contribute to technical development in such a way that all wasteful duplication of R&D effort was eliminated, but high quality products were still ensured. Running on parallel lines to the BTTDC, the Manufacturers' Technical Development Committee (MTDC) met under the chairmanship of the Manufacturers' Secretary. This committee was established to cover such topics as technical policy, development and technical routine. The MTDC basically provided manufacturers with a forum in which they could discuss any relevant aspects of technical policy, and was structured in such a way as to encourage the devolution of work to specialist committees.

The "Telephone Ring" was the name given to the group of approved manufacturers who supplied most of the telecommunications equipment

DIAGRAM 2.1 TELEPHONE DEVELOPMENT COMMITTEES (1933-1969)



demanded in Britain until the end of the 1960s. In 1936, membership of the Ring was determined, for the following 20 years, when the Pheonix Telephone & Electric Works Ltd, the Plessey Company and the Telephone Manufacturing Company Ltd joined the existing five members, ie AT&E, Ericsson, GEC, Siemens and STC, to supply subscriber equipment and common componentry. This effective cartel established the Telecommunication Engineering and Manufacturing Association (TEMA) in 1943, to "encourage, develop and protect" the telecommunications engineering and manufacturing industry. TEMA was designed to represent the views of the equipment suppliers in any negotiations between the manufacturers and the Post Office or government.

Increased Levels of Demand

Almost immediately after the Second World War a restructuring of the Post Office's telecommunications tariffs caused unprecedented levels of demand for telecommunication services (see Table 2.2). In general, the growth in demand for telecommunications products and services is best represented by an ogive shaped curve. This type of curve is most suitable because it reflects the slow initial introduction of the product, the period of rapid acceleration, first experienced after the Second World War, and the decreasing rate of growth as the market approaches saturation.

The increased levels of demand which were witnessed at this time were primarily due to a significant increase in the size of the residential market. This market had overtaken the business market, in volume terms, in 1940, and then experienced a "snowball" type effect whereby any growth in the number of existing customers further increased the usefulness and desirability of the telephone for other potential subscribers. The presence of sufficient spare capacity inferred that this increased demand would not necessarily entail an equal increase in the Post Office's subsequent demand for telephone exchanges, but entailed an increase in the Post Office's labour requirements and in its demand for telephone apparatus.

The inability of the Post Office to source sufficient volumes of

TABLE 2.2 - THE UK INSTALLED TELEPHONE BASE 1925 - 80 [a]

Year	PRIMARY INSTRUMENTS (000)				EXTENSION INSTRUMENTS (000)				TOTAL STATIONS (000)			
	Business	%	Residential	%	Business	%	Residential	%	Number [b]	Business %	Residential %	No.of stations per head of population
1925									1285	75.4	19.6	2.8
1930									1896	69.8	26.0	4.1
1935	837	55.6	603	40.1	742	87.5	106	12.5	2388	66.1	29.7	5.1
1940	963	46.7	1016	49.3	1014	83.5	201	16.5	3339	59.2	36.5	7.1
1945	1044	46.8	1096	49.2	1398	89.2	170	10.8	3889	62.8	32.6	8.2
1950	1455	46.4	1588	50.6	1696	87.2	249	12.8	5171	60.9	35.5	10.2
1955	1690	42.2	2198	54.8	2066	86.3	328	13.7	6491	57.9	38.9	12.7
1960	1855	38.8	2792	58.4	2530	85.3	437	14.7	7856	55.8	41.1	15.0
1965	2124	35.2	3755	62.3	3224	84.8	577	15.2	9980	53.6	43.4	18.3
1970	2491	29.1	5888	68.9	4336	83.1	880	16.9	13959	48.9	48.5	25.1
1975	2984	23.5	9520	75.0	5808	78.7	1570	21.3	20389	43.1	54.4	36.4
1980	3422	19.5	13955	79.3	6380	72.7	2401	27.3	26737	36.7	61.2	47.7

a. figures include those for Kingston-Upon-Hull
b. total stations = primary instruments + extensions + call office stations + BT service stations + private circuit stations

subscriber apparatus gave rise to waiting lists of almost 500,000 in the 1950's. To reduce these lists, the Post Office increased its tariffs in 1956, while simultaneously restructuring these, to resemble costs more closely and to increase revenue. However, although the new tariff levels had some effect on the "growth" of demand for both telephones and telephone calls, the waiting list remained unacceptably long. This in turn encouraged calls for greater commercial and financial freedom for the Post Office, with at least some measure of investment autonomy.

The JERC

This particular period in the development of the telecommunications industry was one of extremely close co-operation between the Post Office and the manufacturers. The Post Office, and its five major suppliers of exchange equipment, were especially convinced of the need to work closely to design and develop a high standard electronic switching system which could be installed throughout the network. In response to the need for co-operation, both manufacturers and civil servants established the Joint Electronic Research Committee (JERC) in 1956. An extract from the TEMA report of 1956/7 suggests:

> "This joint research and development arrangement is a matter of considerable satisfaction to the industry and they would like to put on record their appreciation of the strong and statesmanlike attitude taken by the Post Office at this time...it is good to see a demonstration of a very natural arrangement for co-operation between the Post Office and its contractors, who have worked together for some time to produce the highly efficient communication system which this country enjoys. It would, indeed, be difficult to imagine an arrangement which was more in the public interest."

However, plans regarding the development of suitable electronic technology were to be hindered by the "stop-go" economic policies of the ruling Conservative government. The JERC's project subsequently failed, and the Post Office was forced to face the 1960s, which were

expected to be characterised by extremely high levels of demand, with no suitable exchange technology which could be sourced from domestic manufacturers.

(IV) THE 1960s AND 1970s

At the beginning of the 1960s the Post Office was concerned about the relatively slow development of the telephone in Britain, which it blamed on a "lack of telephone consciousness on the part of the public". However, the Post Office was simultaneously reluctant to stimulate demand in any specific area of the market, for fear of repercussions in those sectors where the waiting list was already too high.

After a relatively successful trial period from 1956, the 1961 Post Office Act established the Post Office as a revenue earning department of the Civil Service. This made the Post Office subject to the financial discipline facing nationalised industries and an 8% target of net return was imposed over five years to 1967/8. Constitutionally, the Post Office remained a Government Department with a Minister answerable to Parliament.

The new, statutory obligation placed on the Post Office, ie that it must publish annual accounts, and the subsequent scrutiny of these by both the Auditor General and the Public Accounts Committee, led to two major issues being widely discussed ie:

a) the obvious disparity between the profitable telecommunications side of the Post Office's business and the heavily subsidised postal service, which had the controlling hand at this time and
b) the fact that the Post Office still bought the majority of its telecommunications equipment from what were essentially the same firms as had signed the first Bulk Supply Agreement nearly forty years beforehand.

With regard to the first issue, the possible splitting of the Post Office, into two distinct organisations, was discussed seriously but not implemented. With regard to the second issue, there was particular concern over changing market structure. The Pheonix Telephone Company had been bought, in 1960, by a consortium of the established firms (ie AEI, ATE, Ericsson, GEC and Plessey), in a move designed to prevent the entry of new firms through the takeover of established manufacturers. Later Pye, a well established electrical firm, gained entry to the market by acquiring the Telephone Manufacturing Company

(TMC), but was subsequently taken over itself by Philips. In 1961, ATE, Ericsson and Plessey merged, and in 1967 GEC acquired AEI and later took control of Marconi through a merger with English Electric. The end result of this merger and takeover activity was an equipment supply industry consisting of only four major participants ie GEC, Plessey, STC and Pye-TMC.

While the above structural changes were taking place, a row was simmering over product pricing under the terms of the BSAs. Under the terms of the agreement signed in April 1963, the Post Office could buy up to 25% of telephone equipment from non-BSA manufacturers but it had still chosen to buy almost 85% of its requirements through the BSAs. In the case of telephone dials, this resulted in the Post Office paying 25s for each dial (in 1963 prices), even though other UK manufacturers charged only 21s, and the average price in Europe was only 15s.[8] Not only was the Post Office apparently paying 20% more than was strictly necessary, but such high prices adversely affected exports; by this time BSA members were exporting only 15% of output, compared to 25% just a few years before.

In 1963 the BSAs had fixed prices at levels which allowed the most efficient firms to achieve an average profit margin of 10.5% on cost in the case of subscriber apparatus, and 8.25% in the case of exchange equipment. However, when the Post Office discovered it could buy items outside the Ring at prices which were 25% lower, it made a bid to terminate these agreements. The Postmaster General, Tony Benn, was in favour of terminating the customer apparatus agreements, although he was equally keen to retain those dealing with exchange equipment, but the manufacturers argued that to break the Ring would be to damage the high level of state and industrial co-operation which had been achieved. The Post Office's bid failed at this time, and no further moves could be made towards achieving greater levels of competition until the existing BSAs lapsed.

The 1969 Post Office Act

The mid-60s were characterised by another unforseen level of growth

in demand, which further delayed a reduction in the customer waiting list. So many problems were arising that the Telephone Users' Association (TUA) was formed simply to receive complaints and to promote consumer reaction to the service provided by the Post Office. The Labour government was particularly concerned about the high levels of unsatisfied demand, long delays in equipment delivery and the dramatic decrease in exports. It believed these problems would be alleviated if competition between manufacturers was increased, but was unable to secure more competitive conditions prior to 1968 ie when the existing BSAs were due to be terminated. Change also appeared to be necessary within the Post Office itself, and in 1966 the Postmaster General consequently announced steps to transform the Post Office into a "public corporation". This move was designed to give the Post Office a structure which would better suit the needs of the market. The relevant Act was passed in 1969, after the demise of the BSAs, and attempted to reconcile the structure of the Post Office with that of the "mixed" domestic economy.

The Post Office Corporation was not to be headed by the Postmaster General, who had previously been answerable to Parliament for all Post Office activities, but the post of Minister of Posts and Telecommunications was created. This Minister would be responsible for the appointment of the Chairman and both full and part-time members of the Corporation's board, and could make appointments from either inside or outwith the telecommunications industry.

In terms of its general operation, the 1969 Act gave the Post Office a statutory monopoly over the provision of:

a) Royal Mail;
b) the carriage of packets and small parcels;
c) the provision of agency offices for Government business such as the payment of pensions etc;
d) Giro banking;
e) telecommunications;
f) telegrams, and
g) data processing facilities.

Both Posts and Telecommunications were to be run as distinct organisations with their own management and staff, and were only to be

"united" in so far as they shared a common board of directors. The 1969 Act also established the Post Office User's National Council (POUNC) as a body designed to protect the consumer.

The success of the above Act required that the Post Office be granted considerable financial freedom. It was therefore decided that the Post Office would establish its own prices, although these would be subject to the financial obligations facing other nationalised industries, ie a sufficient margin between income and expenditure would have to be achieved to ensure adequate reserves. The Post Office would only be able to borrow over the long term from the government itself, and even short term borrowing would have to receive prior approval by the appointed Minister.

The intention of the 1969 Act was to give postal and telecommunication services relative freedom of operation in their respective markets, ie co-operating or competing with each other as prevailing conditions demanded. In the telecommunications market the Post Office had been granted a statutory monoply over the provision of all aspects of an integrated service, including the network of telephone exchanges, transmission lines and subscriber apparatus. The only exceptions to the monopoly were a) the geographical area covered by the Hull Telephone Department, which continued to operate an independent local authority network, and b) products or services demanded by business users intending to establish internal or private networks.

In offering its services to the public the Post Office would have to consider several obligations placed upon it ie :

a) to meet the country's social, industrial and commercial needs;
b) to satisfy all "reasonable" demand;
c) to both improve and develop the nation's telecommunication system;
d) to be aware of both efficiency and economy, and
e) to adequately cover several specified costs from revenue.

After its transformation into a public corporation the Post Office remained the sole supplier of most telecommunications equipment and services. This enabled the Post Office to act quite ruthlessly in its procurement of suitable products, especially since the demise of the Bulk Supply Agreements had damaged the close relationship between the

Post Office and its suppliers. The Joint Electrical Research Association agreement had lapsed by this time, as had the British Telephone Technical Development Committee and general market sharing agreements. However, although the Post Office successfully introduced a small element of competition into equipment supply, it still recognised the need for considerable levels of co-operation, and chose to continue financing several R&D projects contracted to the domestic manufacturers.

Problems Facing the Post Office

Decisions which had been taken in the post-war period were still relevant in the early 1970s, partly because of the long life-span of some telecommunications products. The previously persistent failure of the industry to react quickly enough to changing market and technological conditions resulted, through cumulative effects, in the Telecommunications division recording losses in both 1972/3 and 1973/4. These losses were, however, partially due to the counter inflation policies of the Conservative Government, and were consequently written off by the Treasury making appropriate "compensation payments". But, even given this fact, any loss recorded by the Post Office was generally regarded as unacceptable, and was taken to suggest that a "Department of State" structure was unsuitable for the provider of the nation's postal and telecommunication services.

By 1974 the Post Office had become the largest employer in any of the service industries, with a staff exceeding 415,000,[9] but there were serious differences between its two major divisions of Posts and Telecommunications ie:

(A) Posts, employing 42% of employees, was labour intensive in operation and required little capital investment ie only £300 per worker per annum throughout the 1970s (at 1970 prices), whereas Telecommunications was capital intensive and required almost £2000 per worker per annum if it was to to benefit from both economies of scale, and the falling level of real costs which was made

possible by new technology. All investment undertaken by the Post Office was financed by the government or by internally generated profits and restricted borrowing in private capital markets. These funds had to be divided between both Posts and Telecommunications and, although the former did not command a significant share of Post Office investment, it undoubtedly deprived the latter of funds it might otherwise have had.

(B) Another apparent problem in the 1970s was Telecommunications' ability to achieve the targeted 8% net return on assets with relative ease, while Posts returned persistent losses. Telecommunications operated a standardised pricing structure, although call charges varied with distance, but Posts had chosen to treat distance as irrelevant and was consequently undertaking a considerable amount of cross-subsidisation, ie the revenue received from the delivery of letters over short distances helped to finance the cost of longer distance delivery.

(C) The labour intensity of Posts also made it particularly sensitive to the high levels of wage inflation which characterised the 1970s, whereas Telecommunications had the apparent advantages of being capital intensive, and consequently less sensitive to such inflationary pressures, and exhibiting relatively lower price elasticities of demand. This latter advantage, discussed further in Chapter 5, made it easier to pass cost increases onto the consumer.

(D) Telecommunications was responsible for a continually increasing proportion of total Post Office income, whereas the contribution from Posts generally declined, in percentage terms, throughout the 1970s. The proportion of investment expenditure directed towards Telecommunications was also increasing steadily, whilst that directed towards Posts was being reduced. Within the Post Office as a whole, Telecommunications was gaining in importance, but Posts was declining to such an extent that it could possibly retard the growth of other services.

The undesirable consequences of the above four points resulted in pressure for the introduction of independent management for these two major divisions within the Post Office.

Problems Facing Manufacturers and Consumers

The Post Office's stranglehold over the telecommunications equipment manufacturing industry, and its irregular placement of product orders, caused considerable problems for manufacturers of exchange and customer premises equipment during the 1970s. The growth in demand which had prevailed throughout the 1960s had encouraged manufacturers to produce at full capacity, but demand was being slowly satisfied in the 1970s, and growth in the manufacturers' capacity levels consequently peaked in 1973/4, then fell by almost 30% over the next two years.[10] The Post Office further reduced its equipment requirements to such an extent that orders for exchange equipment in 1975/6 fell to less than 40% of their 1971/2 level. The manufacturers suffered a large drop in output and their employment levels decreased by an average of 40%. The firms which had previously been party to the BSAs were unhappy, not only about the drop in demand, but also because their traditionally protected domestic market was being concurrently attacked by several foreign manufacturers.

The 1970s were also characterised by growing consumer dissatisfaction as a consequence of there being little choice of products or service from the Post Office, and no alternative source of supply. Residential consumers far outnumbered business users but, because they had no say in product specification, most products were over-specified and over-engineered for their needs. It was not until 1977 that the Post Office took its first steps to resolve this problem of consumer dissatisfaction, and it did this by contracting several new firms, some of them foreign, to supply new models of handset. Not only was product variety increased by this move, but the Post Office effectively created what is now known as the "decorative" handset market.

The dissatisfaction of business users with the products offered to them was expressed more forcefully, even though these users were fewer in number than residential consumers. The Post Office was also keener to accomodate the views of business users, because this group provided

a disproportionately large share of its total revenue. To resolve the conflict, it was decided that the supply of business products involving less than 120 extension lines would remain monopolised by the Post Office, but that the market for larger products would become more competitive. Consumers in this latter market consequently benefitted from the introduction of new, more sophisticated, products but these were invariably introduced by foreign competitors.

Most of the problems facing the telecommunications industry in the 1970s stemmed from too slow a reaction to technical change. The potential benefits of the new technology could only be realised through large research programmes, but the Post Office had repeatedly failed to direct the necessary funds towards the most suitable projects. As late as 1976, 85% of the installed exchange network, and over half of its net expansion, still consisted of Strowger technology, even though this was being treated as obsolete in most other countries. The continued use of Strowger in the UK's domestic network not only affected the variety and quality of services which could be offered, but also limited the scope for technological innovation in CPE products.

The Carter Report

The problems faced by the Post Office, manufacturers and consumers resulted in general discontentment both in and around the industry. In response to this, Mr C Carter was elected, in November 1975, to chair a committee which would to review the Post Office under the terms of reference:

> "to examine the performance and main features of the organisation and the use to which it put its own resources and assets, to consider whether any changes would better enable it to perform its functions under the 1969 Post Office Act, to assess the policies, prospects and social significance of the postal business, including methods of financing it as a self-supporting public service, and to consider whether the 1969 Post Office Act placed undue restrictions on the activities of the Post Office".

The committee found that many of the promises contained within the 1969 Post Office Act had not been fulfilled. In July 1977, it presented its recommendations for improvement in the form of a Command Paper (Cmnd 6850) which recognised the two necessary objectives of the Post Office to be the modernisation of the network and an improvement in the declining postal service. Some responsibility for existing problems was placed on the government's continued ownership of the Post Office, and its use of a rate of return target. The Carter Committee found the latter concept to be inappropriate because the sheer size of the Post Office implied that a considerable level of profits would have to be achieved, simply to attain a respectable rate of return.

The Committee believed that the Post Office's strongly centralised and traditional management structure inhibited its ability to react to events in the market, and to deal with specific consumer requirements. Links existed between Parliament, government ministers and the corporation board of the Post Office, but none of the bodies involved fully understood the extent or the strength of their power. This gave rise to considerable levels of uncertainty, and these were further increased by the conflicting needs of Posts and Telecommunications. The Post Office's combined organisation of these two divisions required chains of command which were simply too long ie both Posts and Telecommunications were operated as independent businesses, but they had still to be linked through centralised management at the board level. The resulting overload of duties facing this board was judged to have inhibited its sound strategic policy making. As a consequence of this, the UK's telecommunications system had grown to only half its expected saturation level, in terms of exchange connections, and traffic per user had reached only one third of the level achieved in the USA.

The Carter Committee expected that further growth in the residential market would provide opportunities for decreasing costs and prices, but only if suitable exchange technology could be found. Any additions made to the telecommunications network must be progressive in nature, and designed to overlay and interact with the

existing system, and the Carter Committee consequently judged that the UK's latest exchange technology project, ie System X, would either "make or break" the domestic industry.

The Committee studied the apparent suitability of the Post Office's monopolistic control over the telecommunications market, and was convinced that this situation was disadvantageous. Costs appeared to be higher than necessary, and the UK was lagging behind foreign competitors in terms of general efficiency and the variety of services offered. Bearing this in mind the Carter Committee made the following eight recommendations:

1) that the Post Office be split into two separate corporations - one dealing with postal and giro services, and the other with telecommunications and data processing;
2) that within the new "telecommunications" section, more power be given to local operating units; a suitable area organisation would possibly involve four divisions which would be controlled by the Area Telephone Manager ie :
   a) planning and works;
   b) customer services;
   c) finance and management accounting, and
   d) personnel.

   These divisions would be compatible with the existing organisation at regional level and with the structure of the business headquarters;
3) that a "Policy Council" be established and given the resources and powers necessary to advise the Secretary of State for Industry on postal and telecommunication affairs;
4) that "profit" be rejected as a measure of efficiency - the Committee proposed that some form of cost control would better serve the consumer;
5) that improvements be made in transmitting information ie the receipt of adequate and regular information would enable the Post Office to react more speedily to market conditions, and would thereby potentially reduce the demand fluctuations facing the equipment manufacturers who would possibly be able to improve their export record;

6) that the Post Office and the manufacturers of "System X" establish a joint stock company to solve the problems experienced in managing this particular project - however the Committee recognised that this move would only be successful if a common strategy was agreed upon by all concerned;

7) that the Post Office should not exercise its right to manufacture equipment, ie self-manufacture would deteriorate the Post Office's relations with traditional manufacturers and would adversely affect supplies of any products it chose not to manufacture itself;

8) that some form of market liberalisation be introduced in the case of equipment supply, as a means of meeting the new sophisticated requirements of business users - it was proposed that this liberalisation be "cautious and controlled" in nature, and that it form part of a comprehensive study into the possible effects of breaking the Post Office's monopoly. The liberalisation experiment would ideally be performed under the control of the Secretary of State, and he would remain responsible for the protection of the domestic telecommunications network. The Carter Committee considered that a liberalisation policy would benefit consumers, who would face a much wider variety of products, and would oblige domestic manufacturers to become more competitive in the UK and to subsequently improve their position in the world market.

The Labour government took no action on the above recommendations and discontentment on the part of consumers and manufacturers continued on technological, economic and political grounds.

Market Size in 1980

By 1980, the market was of significant size with an installed base of almost 27m telephones (see Table 2.2), of which 12.8% and 52.2% were primary business and residential instruments respectively. A further 23.9% of the market was composed of business extensions and residential extensions accounted for 9.0%.

Residential primary instruments had exhibited most growth since

1935, followed by residential extensions, business extensions and finally by business primary instruments which had increased only 4-fold, in volume terms, over the 45 year period. Growth in all sectors of the market had been restricted during the war years but rose rapidly thereafter. Residential connexions[11] increased at the average annual rate of 15.4% over 10 years from 1965-75, compared to the equivalent figure of only 4.0% in the case of business connexions. This phenomenal rate of growth doubled the number of stations per head of population from 18.3 in 1965 to 36.4 in 1975, and by 1980 it had further increased to 47.7.

Although the UK network had grown to a considerable absolute size under Post Office ownership, a better indication of the success of such control is obtained by comparing international figures. In terms of absolute system size the UK lay sixth behind the USA, Japan, the USSR, FR Germany and France in 1980 but, because system sizes are largely determined by population, it is more meaningful to compare measures of penetration. In terms of connexions per 100 population the UK drops to 14th place behind countries such as Sweden, the USA, Switzerland, Denmark, Canada, Finland, FR Germany and Norway.[12] This measure can be biased, in so far as a large business sector increases the number of telephones and hence the penetration level, but using a more satisfactory measure, ie that of connexions per 100 households, the UK falls even further behind in terms of rank.

(V) EVALUATION AND CONCLUSION

The aim of the above outline of the history of the UK's telecommunications industry was to highlight the political, economic and technological developments which occurred between the inception of the industry, in 1876, and the announcement of liberalisation policy in 1980.

One of the most important political developments occurred in 1912, when the Post Office assumed control of the entire telecommunications network, with the exception only of the area covered by the Hull Telephone Company. This latter company remains in operation to this day and, subsequent to the privatisation of British Telecom, controls the only publicly owned section of the network.

The ownership of the telecommunications network is of considerable importance to the CPE market. The owner of the network receives all revenue collected from calls made, determines the technology to be employed in the network, and consequently in the products manufactured for attachment, and largely determines the channels through which products can be distributed from manufacturers to end users.

As the owner of the network, and the receiver of all revenue associated with successful calls, the Post Office had to ensure that all products connected to the network were of a sufficiently high standard. Not only could poor quality products entail a drop in call revenue, but the possibility of injury to consumers, Post Office employees, or the network itself had also to be considered. Obviously, the Post Office wished to ensure that products attached to its network were of an extremely high standard, and it attempted to do this through the establishment of Bulk Supply Agreements. These agreements effectively divided the Post Office's demand for products between eight selected manufacturers and shielded these firms from competitive pressures. This, however, had the unintended consequence of reducing the need for these firms to maximise efficiency. Even after the demise of these agreements the Post Office remained relatively loyal to the same firms and continued to source most of its product requirements from them, even though these could have been obtained more cheaply

elsewhere.

Through the Bulk Supply Agreements the Post Office not only guaranteed large scale orders to its selected partners, but also co-ordinated their research work and ensured that the products developed by each firm were compatible with the most recent developments in transmission and switching technology. Not only did the Post Office act as a co-ordinator, but it also helped finance research projects. In some respects, the BSAs were a good means of financing R&D and ensuring that only high standard products were attached to the Post Office's network. However, these same agreements shielded firms from the competitive pressures which often encourage R&D in so far as they transformed a competitive oligopoly into a collusive one. As far as the consumer is concerned, the advances and cost saving achieved, through the non-duplication of effort, must be weighed against the possibility that the reduction in competitive pressure also reduced the advances achieved in R&D.

The major technological development in this industry was the introduction of electronic, and then digital, technology. This technology encouraged the introduction of many sophisticated products, but the delay in introducing this technology into the exchange network also delayed consumers in attaining the benefits of such products. This led to considerable levels of discontentment among consumers in general, but especially among business users.

Although it was generally agreed that the telecommunications industry had grown and developed under the Post Office's monopoly regime, international comparisons suggested, throughout the 1970s, that there was considerable scope for improvement. The consensus of opinion, which was reflected by the recommendations of the Carter Committee, was that this improvement would best be achieved under a more competitive regime.

In May 1979, a Conservative government was returned to Parliament on the basis of a manifesto which strongly supported the idea of free competition and a reduction in market intervention. This government supported liberalisation and privatisation programmes for several of the public utilities, but was especially attracted by the opportunity of introducing such a policy into the telecommunications market. In

July 1980, Sir Keith Joseph announced the introduction of a Bill to liberalise the provision of at least some telecommunications products and services, and a Bill regarding privatisation was introduced two years later. The following chapter outlines the measures contained within these Bills, and the subsequent Acts, and compares these with the liberalisation measures which had been already introduced into the telecommunications market in the United States.

NOTES

1. Figures sourced from Pitt (1980), Chapter 2.

2. Figures sourced from the Post Office.

3. Figures sourced from the Post Office.

4. The Hull Telephone Company has retained control over its local area exchange network and remains in operation, to this day, as the only publicly owned section of the UK's telecommunications network.

5. Figures sourced from Pitt (1980), Chapter 2.

6. STC was initially a subsidiary of Western Electric ie the world's largest manufacturer of telecommunications equipment, and part of the AT&T organisation. However, STC was subsequently sold to ITT.

7. Figures sourced from the Post Office.

8. Figures sourced from POEU (1964).

9. Figures sourced from Channon (1978).

10. Figures from Cripps & Godley (1978).

11. Primary instruments are those connected to an exchange line and the terms "primary instrument" and "connexion" can, therefore, be used synonymously.

12. This ranking of countries has been constructed on the basis of data received from British Telecom.

CHAPTER THREE : LIBERALISATION POLICY (1980-84)

(I) PREFACE

In July 1980 Sir Keith Joseph announced a Bill to liberalise the provision of some products and services within the telecommunications market, but there was still some uncertainty as to the policy measures which would be introduced. Undoubtedly, the government's policy was influenced, to some extent, by events in the liberalised US market - this provided the only example of such a policy having been already introduced.

In this chapter the liberalisation of the US telecommunications market is discussed, with a view to later determining the extent to which the relevant events influenced the UK government in its own policy formation. This is followed by a discussion of liberalisation, and privatisation, as these were introduced into the domestic telecommunications market through the 1981 and 1984 Telecommunications Acts.

(II) LIBERALISATION OF THE US TELECOMMUNICATIONS MARKET

In the United States telecommunications services were traditionally provided on a private basis by American Telephone and Telegraph (AT&T) which had secured a monopoly over the transmission of long distance calls. This company had also achieved a significant degree of integration and owned not only Western Electric, ie arguably the world's largest telecommunications equipment manufacturer, but also the Bell Operating Companies. These latter companies had established monopolies over the provision of local telecommunications services throughout the country.

The liberalisation of the US market began in 1949. In that year, the Justice Department brought an anti-trust suit against AT&T, on the basis that the links between Western Electric, AT&T and the Bell Operating Companies contravened the Sherman Act[1] and contributed significantly to Western Electric's monopolisation of the market for telecommunications equipment. A settlement was reached, between AT&T and the Justice Department, through the 1956 Consent Decree. This Decree stated that henceforth:

1) Western Electric would only manufacture equipment for the regulated markets in which AT&T and the Bell Operating Companies operated;
2) AT&T would be limited to operating inside the regulated common carrier market, ie that for basic telecommunications services, and would not offer any enhanced services such as data processing, and
3) a liberal form of licencing would be introduced to prevent the Bell Company from protecting its market through its control of relevant patents.

Liberalisation of the Provision of Telecommunications Services

The 1956 Consent Decree gave more power to the regulatory body of the telecommunications market, ie the Federal Communications Commission (FCC), and subsequently paved the way for liberalisation. In 1959 the FCC's "Above 890" decision introduced private competition into the provision of "point to point" telecommunications services,

using frequencies above 890 MHz. This implied that large companies could establish and control internal voice communication systems, although they could not share these private systems or resell excess capacity. Although it had initially been intended that these private networks would be used only for internal communications, this was not to be the case. In December 1963, the MCI Data Transfer Corporation applied, to the FCC, for permission to construct a microwave link between two specific points in Chicago and St.Louis. This link was not, however, to be constructed for internal or private use, but was actually designed to satisfy the requirements of several medium sized customers. The MCI Corporation was immediately accused of "cream skimming", because its chosen route was an especially profitable one, and the FCC decided to investigate the matter fully. In August 1969 the FCC recommended that the service proposed by MCI be approved.

Inspired by MCI's success, several companies applied for similar authorisation and, in May 1971, the FCC decided to issue a general licence to facilitate an increase in competition. Later, in 1976, the FCC introduced a "Shared Use and Resale Decision". This extended the ability of telecommunications users to share transmission lines, on a non-profit basis, by including leased lines and long distance facilities. This decision clearly represented an attempt to open up the long distance market to yet more competition.

Before competition could be introduced successfully, the FCC had to find an acceptable solution to the problem of the interconnection fees payable to AT&T. No independent network operator could offer a service without having permission to interconnect with AT&T's network, but naturally the latter company required payment for providing this service. In December 1978 an apparently satisfactory solution was reached whereby AT&T would charge independent companies $19.83 per access line per annum, plus an extra time-based charge for usage. This decision effectively enabled relatively small sized firms to compete with AT&T in the direct-dial long-distance market, because AT&T could no longer deny such firms the right to interconnect with its own network. The increased level of competition was subsequently expected to exert considerable downward pressure on prices.

Liberalisation of the Equipment Market

Traditionally the US telecommunications industry supplied CPE products, on a rental basis, through the local Bell Telephone Companies. These companies were responsible for the approval of any equipment which they decided to supply, but they sourced products almost exclusively from Western Electric. Even the non-Bell telephone companies, ie recent market entrants, had established integrated manufacturing facilities and only required supplies from independent equipment manufacturers to satisfy excess demand in the short-term.

In 1948 "Hush-a-Phone" introduced a rubber cap which could be placed over the mouthpiece of a telephone to muffle the background noises otherwise picked up in transmission. AT&T would not approve this device, and actively sought to prevent its use. The dispute beteen AT&T and Hush-a-Phone was fought through the courts with the latter company winning victory, in November 1956, through a judgement which hinged on the crucial point that the device would not affect other subcribers. As a consequence of this decision, AT&T was thereafter restricted to rejecting only the items of equipment which it could prove to be harmful to the public. AT&T was also required to file new tariffs which took into consideration the fact that many items of subscriber apparatus would now be privately supplied.

In 1958 the Carter Electronics Corporation, a small importer of telephone handsets, began to market "Carterphone", ie an accoustic coupler which facilitated the connection of mobile radio telephone systems to the national network. AT&T objected to this product, on the basis that it provided an actual connection between telephone lines, and took its case to the FCC. In 1968, the FCC decided in favour of Carterphone. This decision provided the precedent for what became known as the "interconnect" industry, and effectively gave subscribers the choice of either renting equipment from local telephone companies, or purchasing these from a third party.

AT&T successfully persuaded the FCC of the need for "Direct Access Arrangements" (DAAs) which would provide a link between the network and any item of customer premises equipment which was privately supplied. The DAA was designed to operate as a safety valve which

would prevent any faults in the customer's equipment from harming either AT&T's network or its network employees. However, the price of this equipment, which involved both an installation charge and a monthly rental fee, placed AT&T's competitors at a significant price disadvantage. One DAA, at a fixed price, was required for each multiple configuration of telephones, and this resulted in little incentive, on the part of equipment suppliers, to manufacture and supply products suitable for residential consumers. These users generally employed few extension instruments, and consequently viewed the cost of a DAA, and therefore the cost of non-AT&T supplied products, as being relatively prohibitive. Business users, however, found non-AT&T products attractive, especially if they had already installed key-telephone systems or PABXs, because the cost of the necessary DAA was invariably spread over relatively more items of equipment than was the case in the residential sector.

In the early years of competition, foreign firms gained a significant foothold in the market until domestic firms successfully entered with their own designs of equipment. By 1973/4 there were 36 models of key-telephone systems, offered by 14 companies, and a further 3 models were supplied by Western Electric. In the PABX market 150 models of product were produced by 27 manufacturers, in addition to the 13 models produced and supplied by Western Electric. The "interconnect" market for CPE products had grown considerably, especially over the first five years of competition, and the new entrants had achieved a 3.7% share of the market as a whole.[2]

Although competition had been successfully introduced into the market, the FCC appreciated the need for an improved policy covering the attachment of non-AT&T or Bell supplied equipment, and chose to establish product standards. The introduction of these standards enabled the FCC to ban the necessary purchase of DAAs in 1975. A product registration and certification programme was implemented in October 1977, through which products were required, as outlined in "Part 68" of FCC rules, to be designed in such a way as to protect the user, the network and network employees from harm. All other aspects of product performance would be left for determination within the market itself. The FCC's decision to encourage the introduction of

plug-in jacks further facilitated the installation of non-AT&T products, and was so successful that telephones were effectively transformed into consumer products and many sales were made as a result of "impulse" buying. In 1978 almost 1m telephone units were bought from department stores and electronic retail outlets, and this figure subsequently doubled to 2m units in 1979.[3]

One final feature of liberalisation in the US telecommunications equipment market was the FCC's "Computer II" decision, in 1980, which placed subscriber equipment, and any communication services which involved the use of data processing, outside the bounds of its regulation. The conditions of the 1956 Consent Decree were then reversed when AT&T was granted freedom to enter such unregulated markets through a new subsidiary. AT&T consequently established this new subsidiary and named it "American Bell".

Divestiture

Although the divestiture of AT&T occurred after liberalisation policy was underway in the UK, this represents an event of some considerable importance in the US telecommunications market and is, therefore, included in this summary of US policy.

At the beginning of the 1980s, AT&T was involved, either directly or through its subsidiaries, in most aspects of telecommunications. AT&T itself competed in the market for long distance transmission, its Bell Operating Companies controlled monopolies over the provision of local services throughout the country, Western Electric remained one of the leading manufacturers of telecommunications equipment, and significant research was undertaken by Bell Laboratories.

AT&T's apparent abuse of its dominant position in the telecommunications market caused the Anti-Trust Division of the Justice Department to bring a legal suit against the company in 1974, and between that time and the beginning of the 1980s a further 48 anti-trust suits were brought by companies in the private sector. Eventually AT&T, which had successfully fought against divestiture on several occasions, accepted such a proposal as an out of court

settlement for a major anti-trust suit.

The divestiture settlement was designed in such a way that it enabled AT&T to move into unregulated, and hence more profitable, sectors of the market, although in return the company had to jettison its 22 Bell Operating Companies. Divestiture freed AT&T from any obligation to subsidise the traditionally unprofitable provision of local services, and effectively transformed the company into a long-distance operator.

After 1st January 1984, the Bell Operating Companies were to be reorganised into seven regional holding companies, each of which would be responsible for the provision of local telecommunications services, exchange access services, cellular radio and Yellow Pages. Each share held in AT&T before divestiture was to be replaced by one share in the new AT&T company, plus one share in each of the regional operating companies.

Under the terms of the divestiture agreement, the installed base of telecommunications equipment was to remain in the ownership of AT&T, although the company would have to compete with the Bell Operating Companies for future sales of subscriber apparatus. AT&T subsequently established AT&T Information Services in compliance with the restriction that, although it was free to move into unregulated markets, this could only be done through an arm's length subsidiary. AT&T also established AT&T International, as a wholly owned subsidiary, in an effort to exploit its new freedom to move into overseas markets.

Relevance of Policy for the UK Market

The above developments in the US telecommunications market are of relevance to the UK in so far as the US market has continually represented, not only a sharp contrast to the UK market, but a point of reference by which to judge the relative success of the UK industry. The US was the first country to introduce any form of liberalisation into its telecommunications market and both the way in which this was achieved, and the apparent consequences, were therefore

of considerable interest to policy makers in Britain.

The apparent success of liberalisation in the US market clearly provided a stimulus for the introduction of competition in the UK. However, when UK policy measures were finally announced, in 1980/81, the extent to which these had been directly influenced by US policy measures was questionable. Whereas competition had been introduced gradually into the US market, as the consequence of many court decisions made over a 20-30 year period, the UK government hoped to introduced competition almost immediately. The policy measures designed to achieve liberalisation in the UK had, therefore, to be determined in advance, and there would be little scope for flexibility once the liberalisation process was initiated. The US experience of competition appears to have influenced the government more with regard to its decision to introduce competition than with regard to the practical means of doing this.

The liberalisation and privatisation measures introduced into the UK market, through the 1981 and 1984 Telecommunications Acts, are outlined in section (III) below. Some consideration is given to the measures designed to liberalise the telecommunications network and the services available via that network, because these issues are both pertinent to the liberalisation of the CPE market. The ownership of the network may potentially affect the channels through which products are distributed to consumers, while the telecom services made available can influence decisions regarding the technology which must be incorporated in CPE products, and the facilities which these must offer. The privatisation of BT is of relevance in so far as BT remains the primary buyer of CPE products from domestic firms and controls what is, arguably, the most attractive channel of product distribution.

(III) LIBERALISATION IN THE UK

The Beesley Report

Following Sir Keith Joseph's announcement, that the government intended to relax BT's monopoly in some sectors of the domestic telecommunications market, it was decided that a study would be undertaken to determine the expected consequences of this move in one particular sector, ie the provision of telecommunications services. No study was deemed necessary, at least initially, in the case of the CPE market.

In September 1980, Professor M Beesley, of the London Business School, was commissioned to :

> "examine the scope for, and means of realising, profitable leasing of the network to users who would have unrestricted use of the capacity to provide services".

Beesley's report[4] was returned to the Secretary of State in January 1981, and contained the following recommendations:

1) that there should be no restriction on the freedom of companies to offer telecommunications services to third parties, ie in the provision of value added network services (VANS);
2) that the consumer benefits arising from the increase in competition, advocated in (1) above, would outweigh BT's corresponding loss of revenue, and any attempt to constrain BT's pricing and investment decisions, in a competitive regime, was consequently unfair;
3) that BT should retain its power to price leased circuits in an independent manner, even though consumers would subsequently have freedom of choice regarding the employment of these circuits;
4) that BT be free to compete in all non-voice markets, subject to any regulatory measures introduced by either the government or the EEC.

Beesley concluded that the ability of network operators, to offer both voice and data facilities simultaneously, would give rise to

considerable benefits for the consumer. However, he considered that some problems would undoubtedly be encountered in introducing the new technology relevant to this issue, especially in such a rapidly expanding market. The entry of new firms into the telecommunications market, particularly through the use of satellite technology, would cause greater problems in a small market, such as the UK, than would be expected in the case of larger sized markets, such as the US. These problems were expected to be greater because of the shorter transmission distances involved, but Beesley considered that the use of optical fibres represented an especially attractive technology for small potential entrants. Optical fibres also provided an economically viable alternative to the use of satellites.

Beesley proposed that new entry, into the market for telecommunications services, would not only force the confrontation of old and new technology within that market, but would also provide a greater impetus for the development of new subscriber products, and this would further increase consumer choice.

In examining the question of market regulation, Beesley concluded that the style of regulatory approach adopted in the US would be particularly unsuitable for adoption in the UK. He proposed that constraints placed upon BT's investment and pricing decisions would not only hinder the achievement of true "liberalisation" but would also be illogical and inconsistent with the objective of free competition. Beesley consequently argued that it would be inefficient to prevent BT from moving its prices towards costs, or to restrain its capital expenditure in any way. If it was considered necessary that some form of regulatory system be adopted, then Beesley argued that this should focus on the removal of impediments facing the emerging competition, and not on the use of rules to encourage behaviour modification on the part of BT.

The 1981 Telecommunications Act

The Beesley report was the only one commissioned by the government prior to its Telecommunications Bill being presented to Parliament and

many of its recommendations were consequently included in the Telecommunications Act, passed in October 1981. This Act was chiefly designed to give the government the power and flexibility necessary, to enable it to implement a liberalisation policy at its own discretion. The Post Office had already been split into two distinct divisions, ie Posts and Telecommunications, subsequent to Sir Keith Joseph's first policy announcement in July 1980, but it was not until the Telecommunications Act was passed, in October 1981, that the British Telecommunications Corporation (BT) came into existence and the period of liberalisation finally began.

The three major areas of the telecommunications market affected by the 1981 Act were:

1) the supply of subscriber apparatus (ie customer premises equipment)
2) the operation of the national network, and
3) the provision of services over the telecommunications network.

In Chapter 4 the externalities associated with the liberalisation of the telecommunications market are discussed in depth. At this point, however, it is necessary to discuss one of the most important aspects of policy to liberalise the CPE market ie the establishment of a suitable approvals authority.

Under public ownership, and controlling a monopoly over UK telecommunications, the Post Office undertook all product approvals; products manufactured by different firms were attached to one network, compatibility had, therefore, to be ensured, and this remained the responsibility of the Post Office itself. It was also in the interests of the Post Office to ensure that all approved products maintained high standards; faulty products would lead to a decrease in call revenue in addition to high maintenance costs and the detrimental effects of consumer dissatisfaction.

In the potentialy competitive environment following liberalisation, high product standards must still be achieved if BT is to be protected from the loss of revenue, and other costs, associated with poor quality products. However, given that liberalisation itself removed BT's monopoly over the operation of the national network, and that BT was to be sold to private shareholders, another means of ensuring product standards and compatibility was required.

This same problem arose in the United States where AT&T's network revenue was initially protected by the introduction of Direct Access Arrangements (DAA) and, later, by the introduction of product standards and a suitable test and certification procedure. A similar decision was required in the UK but, in this case, the option of an adaptor was immediately rejected in favour of a certification procedure, to be operated by an independent approvals authority. The 1981 Telecommunications Act legislated that technical standards be formulated to facilitate the transfer of responsibility for product approval from BT to the British Approvals Board for Telecommunications (BABT), incorporated in May 1982 as a non-profit making company limited by guarantee. Between November 1981 and July 1983 a timetable was to be enforced which would increasingly liberalise the market until all categories of attachment, except the first telephone connected to any exchange line, could be supplied privately.[5] The success of liberalisation policy required that BT be placed under an obligation to attach all privately supplied equipment to its network, and only by demanding high product standards could this be undertaken without the risk of injury to either consumers or BT employees, or the risk of damage to BT's network.

The government decided that BT would retain its monopoly over the on-line testing of any apparatus which was already installed. However, following another progressive timetable, equipment suppliers would be given the freedom to maintain all types of CPE product, except call routing systems[6] and any PABX products which were installed before the liberalisation policy took effect.

The above measures were designed to place BT in competition, with many other firms, in the supply, installation and maintenance of most forms of customer equipment. The time-tabled implementation of this particular aspect of policy, over 2-3 years, was a deliberate measure of policy, and was designed :

a) to enable consumers to adapt gradually to the much wider choice of product which would be presented to them;
b) to enable BT to make the necessary alterations to its organisational structure and market strategy, and
c) to enable the incumbent equipment manufacturers, and suppliers, to

prepare suitable products and marketing policies to ensure survival under more competitive conditions.

With regard to the operation of the national network, the 1981 Act provided the government with the power to licence new networks which would provide alternative, but complementary, services to those already offered on a national basis by BT. It was originally expected that such a competing network would choose to employ satellite transmission, but this was not to be the case. Mercury Communications Ltd, ie the company selected by the government to compete with BT, initially rejected the use of satellites, and selected microwaves and optical fibre technology instead.

Under the terms of the 1981 Act, the publicly owned Kingston-upon-Hull Telephone Company was granted the retention of its own local area network capabilities. However, this company would also have to face, at least potentially, the same threat of competition as BT. This particular section of the Act also gave the government the power to licence firms to provide the nation's first cellular mobile radio network. The government subsequently decided to licence two rival consortia[7] when the market for cellular radio services was introduced in 1985.

The provision of services over the telecommunications network constituted the only area of the market for which the government had commissioned a formal study of alternative measures, and their expected outcomes, prior to liberalisation. As a result of his study, discussed above, Professor M Beesley had proposed that the "resale" of network capacity be made possible. However, the government decided to reject this proposal and chose, instead, to introduce a limited measure of liberalisation - by licencing any Value Added Network services which were not already offered by BT. Any supplier of such network services, who had been appropriately licenced by the Secretary of State, could not be refused access to BT's network.

In addition to the above measures the 1981 Act introduced legislation designed to extend BT's flexibility in its securance of finance. This same legislation also provided the Treasury with the powers it required to facilitate its disposal of shares held in Cable

& Wireless Ltd. This latter company provided telecommunications services, but had previously been limited to operations overseas. Once it was itself "privatised", Cable & Wireless became one of the three founder members of Mercury Communications Ltd, ie the sole competitor to BT in the operation of a national telecommunications network. Initially the ownership of Mercury was divided as 40 : 40 : 20 between Cable & Wireless, British Petroleum and Barclay's Merchant Bank, but Mercury eventually became a wholly owned subsidiary of Cable & Wireless, in August 1984.

The Littlechild Report

In 1982 the government decided to introduce a Telecommunications Bill which was primarily designed to facilitate the sale of British Telecom. Associated with such a move, however, was the requirement to establish a regulatory authority which would oversee the telecommunications industry after BT was sold to private shareholders. Professor SC Littlechild was commissioned, in October 1982, to study some of the alternative schemes which the proposed regulatory authority could adopt, in attempting to control BT's profitability. Some form of regulation was expected to be necessary, as a means of protecting consumers from the consequences of BT's eagerness to amass an attractive level of profits for its new shareholders. In designing a suitable regulatory scheme, the intention was not only to prevent BT from abusing its dominant position in the market, but to simultaneously encourage high levels of both efficiency and innovation. The regulatory scheme which was adopted would also be expected to ensure that the net proceeds from the sale of BT were maximised, and to facilitate the successful operation of BT as a commercial organisation.

In his report, submitted to the Secretary of State, Littlechild (1983) recommended that a "local tariff reduction" scheme be introduced as the best means of achieving the above targets. However, Littlechild also stated, quite clearly, that the success of any form of regulation would be conditional upon the degree of competition in

the telecommunications market being significantly increased. His particular recommendation, for the required regulatory scheme, was that an (RPI-x)% regulatory formula be employed, ie that BT's price increases would not be permitted to exceed the annual percentage increase in the Retail Price Index (RPI) minus some specific number "x". It was subsequently decided that x would take the value "3".

As stated above, Littlechild recognised an apparent need for more competition within the liberalised telecommunications market. Towards this end, Littlechild himself made seven recommendations in his report to the Secretary of State, ie :

1) that cable television companies be permitted to compete with BT and Mercury, in the switching of interactive services between cable television networks;
2) that more of the spectrum be made available for telecommunications, to give scope for increased and more effective competition;
3) that the entry of new network operators, employing different technologies from those employed by BT and Mercury, should be actively encouraged;
4) that large companies, with extensive private networks, should be allowed to share their facilities among closed user groups,
5) that BT should lose its monopoly over the supply and installation of the first telephone connected to any exchange line,
6) that unrestricted resale should be introduced in the case of BT's circuits for voice telephony, and
7) that competition should be particularly encouraged in the market dealing with international business.

Just as some of the recommendations made by Beesley were incorporated into the 1981 Telecommunications Act, so too were some of Littlechild's recommendations subsequently included in the 1984 Act. The relevant Bill was first introduced into Parliament in July 1982, but was delayed by preparations for the general election. The return of a Conservative government, in May 1983, ensured the re-introduction of the Bill, but it was only after a stormy passage through Parliament that this Bill received Royal Assent in April 1984.

The 1984 Telecommunications Act

The government introduced the 1984 Telecommunications Act with the dual purpose of transferring BT to the private sector, and introducing further competition into the telecommunications market.

Section 1 of this Act contained the necessary legislation to enable the Secretary of State to appoint a "Director General of Telecommunications"[8] who would be supported by the Office of Telecommunications (Oftel). This office was created specifically to oversee and regulate the telecommunications market.

Section 2 of the 1984 Act introduced the licences which were designed to effectively terminate BT's exclusive privilege to operate the UK's only telecommunications system. The three major licences, granted to BT, Mercury and the Kingston-upon-Hull Telephone Company, were published in July 1984, subsequently debated in the Houses of Commons and Lords, and became effective from August of that year. In accordance with the government's intention of ensuring the widespread provision of telecommunication services, and a suitable level of competition in the market, the licence granted to BT required :

1) that it provide telecommunications services, including rural and international services, throughout the whole of the UK, with the exception of the area covered by the Kingston-upon-Hull Telephone Department;
2) that it satisfy all reasonable demand for its services;
3) that it provide certain obligatory services, such as facilities for the disabled, directory enquiries, public call facilities and emergency services;
4) that it permit the connection of other licenced systems to its network, to enable the users of competing systems to interconnect with the national network;
5) that it permit the connection of independently approved apparatus (CPE) to its network, and
6) that it provide the Director General of Telecommunications with whatever information he should request concerning its activities.

The above licence also included some provisions designed to ensure

that BT did not abuse its dominant position in the market. No operator, except Mercury and the Kingston-upon-Hull Telephone Department, would be licenced until November 1990. If these three operators continued to meet their licence conditions, and remained both solvent and operational, then these three licences would only be revoked, with 10 years notice, after August 1999.

Under the terms of the 1984 Act, licences were also granted to two national cellular mobile radio telephone networks. These licences contained the specific requirement that each company offer services to at least 90% of the domestic population by 1990.

The government refused to accept Littlechild's recommendations, regarding the resale of capacity on BT circuits and the creation of yet another network to compete with BT, Mercury and Hull. However, policy developments subsequent to this Act have included permission, for certain business users, to link premises together using inland private circuits. Licences for private circuits are now granted to individuals whose proposals, for their subsequent use, appear to significantly enhance the performance of a "closed group" of telecommunications users.

Other recommendations, made by Littlechild, have been implemented subsequent to the 1984 Telecommunications Act. Mercury has recently been granted access to international circuits and, in the case of subscriber apparatus, non-BT suppliers have been given permission to provide the first telephone connected to any exchange line. This latter decision, ie the liberalisation of the "primary" instrument market, was implemented in January 1985. The provision of competitive maintenance services, for CPE products, has also been extended, and presently covers a much greater variety of apparatus than was the case initially.

Undoubtedly the most controversial section of the 1984 Act was "Part V". This provided for the transfer of BT's business to that of a public limited company, subject to the Companies Act and no longer immune to legal action, instigated by consumers claiming a breach of contract. In August 1984, the total property, rights and liabilities, of the previous corporation, were invested in a new company, ie BT plc, in the first step towards the government's sale of 51% of its

shares in BT. This represented the largest flotation of its type and, to be successful, the sale of shares had to be especially attractive to "small" investors. In designing the practical details of the planned flotation, the government had the benefit of recent experience in privatising Cable & Wireless, and also called upon six brokers, and the London Business School, to act as financial advisors.

The sale of BT was successful and 2.3 million applications were received, for 3,012 million shares, at a price which gave BT a market capitalisation value of £8.8 billion.[9] When trading opened, on 3rd December 1984, BT's share price increased dramatically, and had doubled by the end of that month. This high share price encouraged many individuals to sell their holdings, which consequently enabled many large investors to increase theirs. In May 1985, the distribution of shares was as outlined in Table 3.1.

The joint effect of both the 1981 and 1984 Telecommunications Acts was the creation of a new political and economic structure in the telecommunications industry, as illustrated in Diagram 3.1. In the case of the customer premises equipment market, the major alteration, to the prevailing structure, was provided by the creation, and subsequent operation, of both Oftel and BABT. These two organisations were established, respectively, as the industry's regulatory and equipment approval bodies.

The Office of Telecommunications

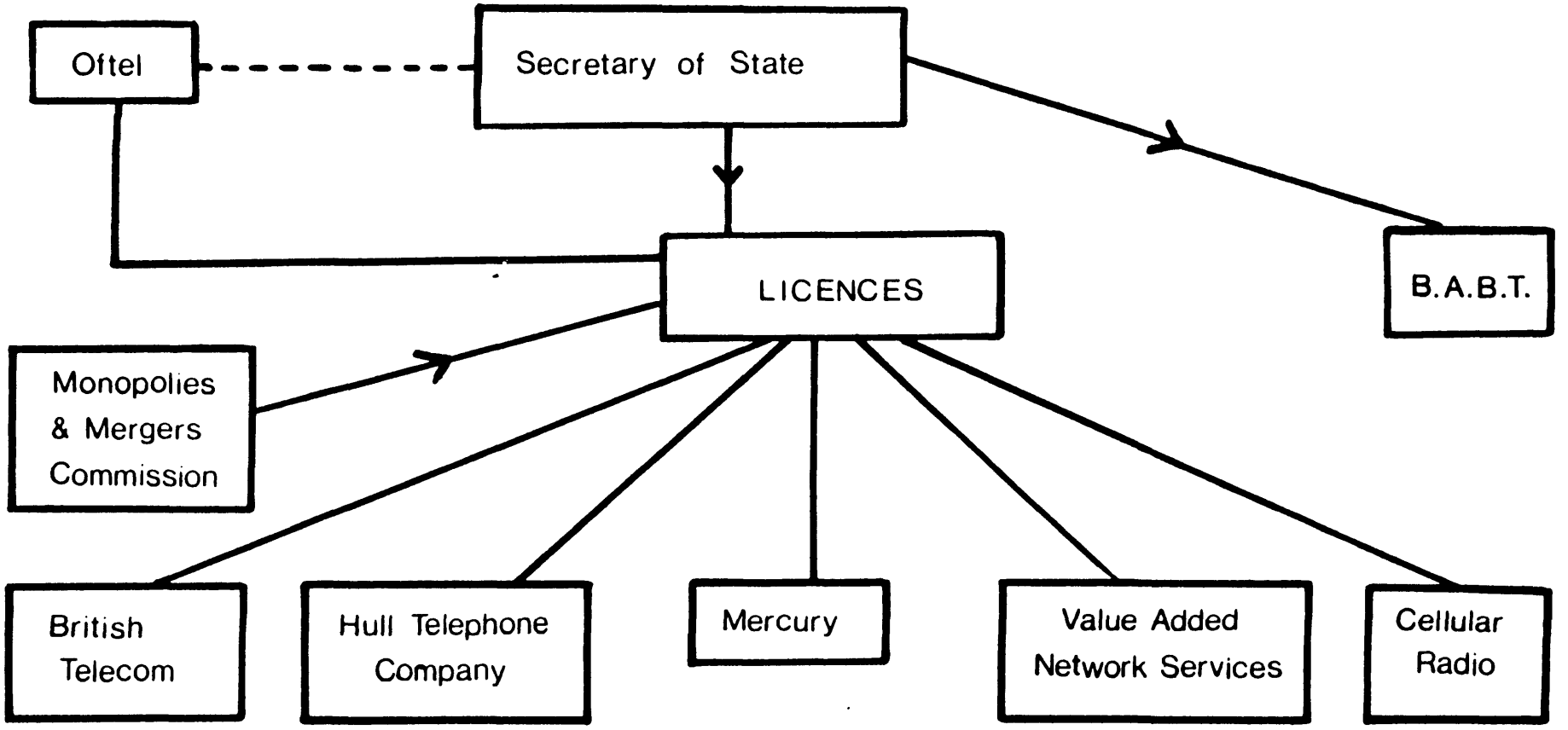
The need for some form of regulatory authority became apparent immediately the decision to privatise BT had been made. A new legal situation had been effectively created, and this made it necessary to distance the regulation of BT from political control. The 1984 Telecommunications Act consequently established the Office of Telecommunications (Oftel) as a non-ministerial government department. Oftel was modelled on the Office of Fair Trading, and a Director General was appointed to control the day to day operations of the authority. The Director General was also obliged to report to Parliament and to advise the Secretary of State on any relevant issues

TABLE 3.1 - BT ORDINARY SHARE OWNERSHIP (MAY 1985)

	No. of Shareholders	Average Holding	Total Holding (m)	Percentage of total shares
HM Government	1	2,988 m	2988	49.8
Employee Share Ownership Scheme	1	53 m	53	0.9
Others	10	-	0.002	-
Pension Funds	734	267,030	196	3.2
Insurance Companies	530	452,830	240	4.0
Banks	7,949	3,774	30	0.5
Other Corporate Bodies	22,373	74,733	1672	27.9
Individuals	1,661,381	494	821	13.7

Source: BT Report & Accounts 1986.

Diagram 3.1 Political Structure of the Telecommunications Industry (1985)



pertaining to the telecommunications industry. Oftel is financed through licence fees collected from BT, Mercury and Kingston-upon-Hull, and these guaranteed an income of £3million in 1985.[10]

Oftel is responsible for approving and licencing telecommunications systems, promoting and maintaining effective competition in the market, and promoting the interests of consumers. It is expected to investigate complaints made by consumers, with regard to the provision of telecommunications services or apparatus, and must do this with reference to the Fair Trading Act of 1973, and the Competition Act of 1980. Oftel must also advise the Secretary of State on the standards to be adopted, in the case of subscriber apparatus, and must act as an arbitrator in any disputes arising between the manufacturers of CPE products and BABT, ie the product approvals authority.

If any firm in the telecommunications industry is found guilty of breaching the conditions of its particular licence, then Oftel will initially adopt an informal approach to the problem. However, if that approach fails, Oftel will subsequently take the legal step of issuing a "Formal Order" against the company in question. If the matter still remains unresolved, the offending company can be taken to court, and prosecuted under the relevant Telecommunications Act. If the company is found guilty, Oftel can claim any necessary damages.

Although both the concept and design of Oftel have been generally accepted, fears have been expressed that this organisation has not been granted either the strength or the authority necessary for effective regulation of the telecommunications industry. There has been widespread criticism, of Oftel, on the grounds that it is both undermanned and underfinanced. By the spring of 1985, Oftel was employing more that 100 staff,[11] but many of its employees still appeared to have insufficient knowledge of telecommunications in general, and the idiosyncracies of the telecommunications market in particular.

The British Approvals Board For Telecommunications

A second regulatory authority has been created to operate within

the liberalised telecommunications industry, ie the British Approvals Board for Telecommunications (BABT). This body was created before Oftel, through the 1981 Telecommunications Act, and was established as a wholly owned subsidiary, of the British Electrotechnical Approvals Board (BEAB), in May 1982.

The successful liberalisation of the supply and maintenance of telecommunications apparatus requires an independent product approval authority, such as BABT, to assume the duties previously performed by BT itself. To this end, it was necessary to establish suitable standards to which products would be tested, and this duty was allocated to the British Standards Institute (BSI).

The government shared the financial cost, of establishing BABT, with the incumbent manufacturers and BT. All "interested parties" were to be represented on this particular authority's board of management, including BEAB, The British Radio and Electronic Equipment Manufacturers Association (BEEMA), BSI, BT, the Department of Trade & Industry, the Electricity Council, the Electronic Engineering Association (EEA) and TEMA. It was also expected that Oftel would be represented at some future date.

BABT is similar in design to its parent company, BEAB. It is not designed to be profit-making, and it receives its income from equipment test fees, to which a 12.5% mark-up is applied,[12] and annual payments for the renewal of all approval certificates. BEAB is given payment, by BABT, in exchange for undertaking nearly all of the latter organisation's administrative work.

Although the concept of an independent testing house was generally welcomed, BABT has faced many problems, and has been severely criticised. One major problem has arisen as a consequence of the mixed technological nature of the UK's network, which has made product testing relatively more difficult than it would otherwise be. In writing the appropriate product standards, BSI adopted its favoured consensus type approach, but this turned out to be considerably time consuming, and encouraged the participation of many more people, and organisations, than was strictly necessary. A second problem, related to the decision to adopt a consensus type approach, was that many of the eligible participants simply lacked suitable technical knowledge.

These two problems caused significant delays in writing the appropriate technical standards to which CPE products would be tested.

Like Oftel, BABT has apparently suffered from several problems associated with general underfunding and undermanning, but also from the particular problem of a lack of suitably qualified engineers. Also, having no test facilities of its own, BABT must subcontract product testing to either BSI or BT, and the latter option has been strongly objected to by the manufacturers of the products in question.

In response to many of the criticisms made with regard to the approval of CPE products, the 1984 Telecommunications Act placed the power of product approval into the hands of the Dept. of Trade & Industry. BABT was itself granted a more advisory role. "Interim" approvals have also been introduced, as a temporary measure, until BABT appears to be capable of assuming its intended role, and the bottleneck of products awaiting approval has disappeared. Under the conditions of interim approval schemes, a manufacturer must apply, to the Secretary of State, for inclusion in a "trawl" of products to be tested. In the case of products imported into the UK by foreign manufacturers, UK "agents" must be appointed before such products will be considered for inclusion in the trawl.[13] The selected products are then tested, by BABT, only with regard to safety. The manufacturers must themselves declare that their products successfully achieve the standards required with respect to all other aspects of product operation.

In another effort to speed up the approvals process, BABT has introduced a "Special Deposit Scheme". This scheme is designed to eliminate delays arising as a consequence of BABT having to await the necessary payment from manufacturers before it commences product testing. Under this scheme, manufacturers are required to deposit an agreed sum with BABT, who will then deduct the cost of testing as this is incurred. BABT also receives the benefit of interest payments, throughout the testing period, on any sum deposited by the manufacturers. The approval fees charged by BABT are dependent on the length of time taken, rather than the amount of work done, and, in 1984/5, averaged approximately £10-30,000 in the case of a telephone handset, £35,000 for key-telephone systems and £250,000 for a PABX.[14]

An alternative method of product approval is available through the Manufacturers' Dedicated Test Laboratory Scheme. However, this option is really relevant only to the incumbent firms in this market, because participants in the scheme must have suitable test equipment already installed. BABT engineers must be present at any product tests which are undertaken in approved laboratories, and participants must agree to an annual inspection of test equipment, by BABT. The advantage of this scheme is that it enables manufacturers to test products more rapidly than if products were submitted direct to BABT. The cost of product testing is no longer chargeable by BABT, but the high cost of installing suitable test equipment prevents significant cost savings from being achieved by the participants. This latter point is more fully discussed in Chapters 5-7 below.

(IV) EVALUATION AND CONCLUSION

The major aim of this chapter has been to outline the apparent influences on liberalisation policy, and the final measures introduced into the UK telecommunications market. In section (II) the introduction of competition into the US market was outlined. This policy undoubtedly influenced the decision to liberalise the provision of telecommunications products and services in the UK, in so far as it confirmed that competition was feasible in most sectors of the market, and highlighted the costs and benefits which were most likely to occur. However, one significant difference exists between the two attempts to introduce competition — in the US market, competition has been allowed to increase gradually, through a series of court decisions made over 25 years, but, in the UK, competition was to be introduced almost overnight in some sectors, and subject to a 3-4 year timetable in the case of CPE products. The government had also to consider the possibility that the very size and nature of the US market simply made it a more suitable candidate for the introduction of competition. If this is indeed the case, then the introduction of similar measures in the UK would have little, or no, beneficial effects.

The measures introduced into the UK market included :

a) the introduction of a competing telephone network;
b) the incremental liberalisation of the supply, installation and maintenance of consumer apparatus;
c) the establishment of a market offering competitive cellular radio services;
d) the licensing of services deemed to constitute "added value" over the provision of the basic telephone service, and
e) the privatisation of the incumbent network operator.

With regard to competition in the telephone network itself, the UK government decided to licence only one competitor, ie Mercury, who would eventually compete with BT, or Hull, in the provision of both local and long-distance services. The US market, however, is characterised by a considerable level of competition in the case of

long-distance services, while local services are provided by a series of monopolies.

In the CPE market, policy has been introduced, in the UK, along fairly similar lines to the measures previously introduced in the US. In both cases, it has been deemed necessary that products be "approved" before they are released onto the market. However, as shall be discussed further in Chapters 5-7 below, this approval is relatively easier, and cheaper, to attain in the US than in the UK.

The measures recently introduced by the UK government, reflect a brave attempt to introduce competition, into an industry which is simultaneously adapting to the effects of rapid technological change. However, there must be some doubt as to whether these measures have actually gone far enough. In particular, the policy has been widely criticised for failing to implement some of the recommendations made by both Beesley and Littlechild. Beesley (1981) advocated the complete resale of network capacity, with no restriction on freedom to offer services to third parties, but this has not been implemented. He also criticised any constraint on BT's pricing policy, but the government has chosen to regulate BT through an (RPI-x)% formula. This formula is designed to limit price increases, to a level of percentage growth which is lower than the rate of inflation.

Littlechild (1983) has also recommended further measures of liberalisation, and has been critical of some measures, already introduced, which he judges to limit rather than encourage competition. The first such criticism has been directed at the government's insistence that Mercury should offer the only new public telephone system, at least until the end of the decade. Littlechild sees no reason why the government should limit the number of competitors in this market, and believes that both technological and market conditions would ensure a better solution.

Littlechild has also been critical of the government's decision to licence only two companies to provide cellular radio telephony services, especially since BT is a member of one of the consortia involved. Again, he suggests that technological conditions, and the market itself, would better determine the most appropriate number of competitors.

A third criticism concerns the decision that either BT or Mercury should provide for the switching of all interactive services between cable TV networks. Littlechild suggests that a more appropriate measure would be to enable the cable TV companies to provide their own switching services and to possibly extend this, at a later date, to entry into the more general market.

Consideration of the above points suggests that the government could have introduced more competition, at least into some particular sectors of the market. However, it is obviously difficult to introduce competition into any market, and some criticism, regarding whether the measures introduced have gone too far or not far enough, must always be expected. Bleazard (1982) believes that recent events will be viewed as a "watershed in the history of UK telecommunications", and will encourage a major reshaping of the industry, over the period to the end of the century. But whether this actually occurs, or not, surely depends upon the extent to which the government's liberalisation measures successfully encourage competition, the extent to which that competition is restricted by factors inherent within the telecommunications market itself, and the behaviour of competing firms.

The following chapter contains a theoretical discussion of liberalisation, from the benefits of a perfectly competitive market to the reasons why it may be impossible to achieve such a structure. On the basis of this theory, three major hypotheses are constructed, and are subsequently employed, in Chapters 5-7 below, to test the economic impact of liberalisation in the market sector dealing with the manufacture and provision of CPE products.

NOTES

1. The Sherman Act was introduced, in the US, in 1890. This Act legislates that any contract, combination or conspiracy which restrains trade or commerce is illegal. There are no specified exemption clauses to this Act - all exemptions must themselves be legislated.

2. Figure sourced from the Federal Communications Commission.

3. Figure sourced from the Federal Communications Commission.

4. See Beesley, M.E. (1981a).

5. The initial timetable was not adhered to. Delays in writing the appropriate standards, to which products would be tested, and in implementing the testing and approvals procedure, resulted in the timetable being inappropriate. It was decided that some measures which had already been introduced should be further extended, and the timetable was amended as necessary. On the recommendation of Professor SC Littlechild, one particular decision, ie to allow BT to retain its monopoly over the provision of primary instruments, was subsequently reversed once suitable product standards had been introduced.

6. Call routing apparatus is a general term for subscriber equipment such as key-telephone systems and PABX.

7. Licences were given to two consortia to provide cellular radio telecommunications services ie BT-Securicor and Racal-Millicom. These licences required that services be offered by March 1985, and that 90% of the population have access to such services by the end of 1986. Neither of the two network operators can have direct contact with consumers - both must appoint agents to sell the required telephone apparatus to consumers, install and maintain that equipment, and subsequently bill the consumer for calls made.

8. Sir Bryan Carsberg was appointed Director General of Telecommunications, for a three year period from July 1984.

9. Figure sourced from British Telecom.

10. Figure sourced from Oftel.

11. Figure sourced from Oftel.

12. Figure sourced from BABT.

13. The role of agent firms is discussed further in Chapters 5 and 6.

14. Figure sourced from BABT.

CHAPTER FOUR : MARKET THEORY AND HYPOTHESES

(I) PREFACE

The aim of this chapter is to outline the economic theory most relevant to the government's decision to liberalise the market for CPE products and, on the basis of that theory, to construct three hypotheses designed to test the impact of liberalisation on market structure, the conduct of market participants, and performance, as measured on the basis of international competitiveness.

The presentation of theory commences in section (I) with an outline of the model of perfect competition, arguably the ultimate goal of any attempt to introduce competition, but proceeds to examine the more realistic models of oligopoly, workable competition and the recently proposed theory of contestability.

The most common limitations to the achievement of any of the above market solutions are imposed by the presence of externalities and market concentration among producers or consumers. In this particular market there are two major structural problems which must be considered - the first is the presence of considerable economies of scale, which invariably leads to high levels of supplier concentration, and the second is the high level of buyer concentration, produced as a result of BT's position in the market. These, and all other limitations to achieving a competitive solution, are discussed in Section (III).

Section (IV) of this chapter studies the major features of the government's policy to liberalise the telecommunications market and, on the basis of the above theoretical discussion, questions whether this policy will lead to increased competition. Finally, section (V) evaluates the discussion of the theory of markets, relevant to the issue of liberalisation, and outlines the grounds upon which the three major hypotheses of this study have been constructed. These hypotheses, presented immediately below, will be tested, in Chapters 5-7, with relevance to the large PABX market, the small business system market and the market for telephone handsets.

Hypothesis 1 : the government has successfully introduced, through the particular measures it has adopted for this purpose, a socially efficient level of competition;

Hypothesis 2 : the interacting strategies of the competing groups will lead to a prevalence of non-price, as opposed to price, competition;

Hypothesis 3 : liberalisation in their domestic market is not expected to increase the international competitiveness of the incumbent firms.

(II) MARKET THEORY

The Competitive Model

Markets provide the forum through which the opposing forces of supply and demand determine both the prices at which goods will be offered, and the quantities to be traded. The model of perfect competition is particularly attractive, in so far as it requires that no single firm, or consumer, holds any degree of power over the market, yet the system behaves in a systematic and purposeful manner. The perfect market solution implies the elimination of all economic waste, and technical inefficiency, and each firm is consequently encouraged, through signals provided by the appropriate input prices, to find the production process which minimises costs of production.

The ideal economic structure, in which each market is perfectly competitive, facilitates the economy in its attempt to reach a position of Pareto optimality. At such a point :

a) everything produced within the economy is subsequently consumed;
b) all inputs, available within the economy, are employed, and
c) no alteration, to the existing allocation of resources, can even potentially make one individual better off, without necessarily lowering the welfare of another.

Gravelle & Rees (1981) have extended the model of Pareto optimality to the case of a market economy in which there are two consumers (a,b), who are simultaneously demanding two goods (1,2) and supplying two inputs (ia, ib). Four conditions must be met before Pareto optimality can be achieved in this model ie :

(1) consumers attempt to maximise their utility, subject to a budget constraint, and will make consumption choices such that every consumer has the same marginal rate of substitution (MRS) between any two goods. This MRS is equal, in value, to the ratio of prices ie :

$$MRS_a(1,2) = P(1)/P(2) = MRS_b(1,2) \qquad (4.1)$$

The consumer's budget constraint is effectively determined by his supply of inputs, and each consumer must therefore attempt to set the MRS between each good and each input equal to the ratio of the input price to the price of the consumption good. In the case of consumer "a" who is buying good "1" and simultaneously selling input "ia" :

$$MRS_a(1,ia) = \frac{Wa}{P(1)} \qquad (4.2)$$

where "Wa" is the payment, made to the consumer, for the supply of input "ia".

(2) Firms in this market will supply products to consumers, but produce these products using inputs supplied by the consumer. In equilibrium, the choice of the firm will be such that :

$$P(1) = \frac{Wa}{MP(1,ia)} = \frac{Wb}{MP(1,ib)} \qquad (4.3)$$

$$\text{and } P(2) = \frac{Wa}{MP(2,ia)} = \frac{Wb}{MP(2,ib)} \qquad (4.4)$$

where, for example, MP(1,ia) is the marginal product of input "ia" (ie the input supplied by consumer "a") in producing good "1". This condition confirms that firms will set the prices of final goods, P(1) and P(2), equal to the marginal cost of producing these. The firm consequently attempts to employ combinations of inputs such that the marginal rate of technical substitution (MRTS) between any two inputs is equal to the ratio of input prices ie :

$$MRTS_{ia,ib} = \frac{MP(1,ia)}{MP(1,ib)} = \frac{Wa}{Wb} = \frac{MP(2,ia)}{MP(2,ib)} \qquad (4.5)$$

(3) Every firm, operating under perfectly competitive conditions, faces identical input prices. From equations (4.3) and (4.4) :

$$P(1) = \frac{Wa}{MP(1,ia)} \quad \text{and} \quad P(2) = \frac{Wa}{MP(2,ia)}$$

$$P(1) = \frac{Wb}{MP(1,ib)} \quad \text{and} \quad P(2) = \frac{Wb}{MP(2,ib)}$$

$$\text{and so } \frac{P(1)}{P(2)} = \frac{MP(2,ia)}{MP(1,ia)} = \frac{MP(2,ib)}{MP(1,ib)}$$

The marginal rate of transformation (MRT), between the production of goods 1 and 2, which is determined by the slope of the production possibility curve, will be equal to the price ratio of final goods, ie from equations (4.1), (4.3) and (4.4) :

$$MRS_a(1,2) = \frac{P(1)}{P(2)} = \frac{MP(2,ia)}{MP(1,ia)} = \frac{MP(2,ib)}{MP(1,ib)} = MRT \qquad (4.6)$$

(4) The final condition for Pareto optimality requires that the total consumption of each good is equal to total production, and that every unit of input which is supplied will also be employed in production. Taking the case of consumer "a", supplying input "ia" and demanding a final good "1", optimality requires that :

$$MRS_a(1,ia) = \frac{Wa}{P(1)} \qquad (4.7)$$

where $MRS_a(1,ia)$ is the MRS between consumption good "1" and input good "ia". From (4.3) :

$$P(1) = \frac{Wa}{MP(1,ia)}$$

and so $MRS_a(1,ia) = MP(1,ia)$, if the condition is satisfied.

Gravelle & Rees emphasise that, although these four conditions are necessary for the achievement of Pareto optimality, they are not sufficient, unless it can be established that :

a) both indifference curves and production isoquants are convex to the origin, and
b) there are diminishing returns to scale in the production of both

goods.

Perfect competition leads to a market solution which satisfies the Pareto optimum conditions ie :

a) the MRS, between any two goods, is equal;

b) the MRT, between inputs, is equal, and

c) the MRT, in production, is equal to the MRS in consumption.

However, although attaining this point implies an efficient and optimal allocation of resources, some consideration must be given to the associated distribution of income. This distribution may, in fact, be unacceptable. The satisfaction of Pareto conditions generally leads the economy to a point on the welfare frontier, but this need not represent the true "optimum". The optimum point can be determined only after the social welfare function has been defined.

The conditions necessary for the achievement of a perfectly competitive market structure are extremely difficult to meet, and may not even be necessary for the attainment of the benefits of competitive market solutions. The possibility, that these benefits may be obtainable even when the market structure diverges from its optimum, is propounded in the models of workable competition and contestability. These models impose less stringent market conditions, and are consequently deemed to be more realistic than the model of perfect competition. However, before discussing these particular models of market structure, some consideration must be given to the possibility that firms will choose not to act as isolated units, and to give recognition to the presence of at least some degree of interdependence between themselves and their competitors.

Oligopoly and Conjectural Variations

Oligopoly is generally defined as "competition between the few", but it can be reasonably argued that an oligopolistic situation exists whenever the market participants recognise and respond to the competitive interdependence which exists. If this argument is upheld then an "oligopoly" need not incorporate only a few large-scale sellers but may include a wide diversity of firm in terms of both

actual size and experience of the relevant market.

Oligopoly can best be described as a situation of "strategic interdependence" where firms are producing substitute goods which are close but not perfect in nature and will react to competitors' strategic moves concerning, in particular, price, output, investment, product quality, R&D and advertising. However, although each competitor in the market recognises the extent of the interdependence, unless the oligopoly solution is collusive in nature we assume neither communication nor co-operation between firms. A solution to the oligopoly market problem can only be attained if we can satisfactorily estimate the competitive reaction of one firm to another firm's strategic move ie its "conjectural variation".

The usual way to model oligopoly is to take the limiting case of a duopoly, ie to assume two firms producing close substitutes for each others products, but which bear little or no resemblance to the output of other firms. Then

$$P_1 = D_1(q_1, q_2) \text{ and } P_2 = D_2(q_1, q_2) \qquad (4.8)$$

where P_1 = Firm 1's product price
P_2 = Firm 2's product price
q_1 = Firm 1's product output
q_2 = Firm 2's product output

Since the goods in the market are all substitutes,

$$\frac{\partial P_1}{\partial q_2} < 0 \quad \text{and} \quad \frac{\partial p_2}{\partial q_1} < 0$$

ie, given a fixed level of output from Firm 1, any reduction in the output level of Firm 2 (ie q_2), due to an increase in price, will shift Firm 1's demand curve in an upwards direction and enable it to sell its own output at a higher price. The opposite case holds when Firm 1 increases its price level first and Firm 2 maintains its level of output.

A second, expected, condition is that

$$\frac{\partial p_1}{\partial q_1} < 0 \text{ and } \frac{\partial p_2}{\partial q_2} < 0$$

ie the demand curve for each firm, in isolation, has a negative slope.

So far, the assumption has been made that an alteration in the output of one firm would leave the output of the second firm unchanged, but this need not be the case and is quite unlikely in practice. What we must consider, therefore, is the total effect on Firm 1's output, given that Firm 2 can also alter both its price and output levels, ie

$$\frac{dp_1}{dq_1} = \frac{\partial p_1}{\partial q_1} + \frac{\partial p_1}{\partial q_2}\left(\frac{dq_2}{dq_1}\right)$$

where

$\partial p_1/\partial q_1$ measures the negative slope of the firm's own demand curve;

$\partial q_1/\partial q_2$ measures the extent to which the two products are substitites and

dq_2/dq_1 subjectively measures the competitive reaction which Firm 2 makes in response to Firm 1's output decision - this term is the conjectural variation of Firm 1, with respect to output, and must be determined before the dupoly or oligopoly problem can be solved.

The most common solutions to the oligoply problem are derived from three different assumptions concerning the value of dq_i/dq_j where i,j are firms participating in a duopolistic market. In the case of the Cournot model (where output changes are at issue) we assume that each firm sets its conjectural variation equal to zero:

$$dq_2/dq_1 = dq_1/dq_2 = 0$$

This model has a stable equilibrium solution only if certain conditions are satisfied regarding the slopes of the marginal cost curves of the two participating firms and the value of the cross-derivative of demand between the two outputs.

The Cournot model is criticised for assuming that the two firms never recognise their interdependence. A more satisfactory proposition

is, consequently, the "leader-follower" model proposed by von Stackelberg. In this model "leaders" recognise the interdependence between firms and have positive conjectural variations, whereas the "followers" retain the zero-value conjectural variations which are relevant to the Cournot model. This model, consequently, may have a Cournot equilibrium solution if both firms act as followers, an indeterminate outcome if both firms act as leaders, and is most stable if one firm acts as a leader while the other chooses to act passively - the equilibrium solution can then be determined only if a suitable value can be assigned to the leader's conjectural variation.

This model represents an improvement over the Cournot solution but still requires that one firm act, willingly or not, as a "follower". The kinked demand curve model proposed by Sweezy, in 1939, improves on this situation by assuming that each firm's conjectural variation is zero in the case of a price increase or output decrease, but is positive in the case of a price decrease or an increase in output. These assumptions give rise to a kink in the firm's demand curve and discontinuity in its marginal revenue curve, and go at least some way towards providing a satisfactory explanation for the concept of price rigidity. However, the model fails to provide for any response to price increases and output decreases, and cannot explain the determination of the initial price and output decisions of each firm.

The most questionable assumption of the above models is that firms fail to communicate. If, however, firms appreciate their interdependence, then communication, and possible co-operation, represent the optimal competitive strategy. This strategy is optimal in so far as a collusive oligopoly, in which firms co-ordinate their price and output decisions to maximise joint profits, results in a higher level of total industry profit than could be achieved if firms retained total independence. But, although such rewards are available if full collusion is achieved, this may not be reliable as :

a) there may be a persistant failure to agree on price and output terms, or on the distribution of joint profits between the participating firms;
b) government policy may legislate against collusive behaviour and effectively force collusions underground;

c) the collusion may not be stable over time due to internal pressures encouraging each member to cheat by reducing prices or to invest in increased capacity, or external pressures arising from demand fluctuations or technological change.

The above three factors persistently work against the collusive solution to the oligopoly problem, but cannot prevent some such form of solution from being achieved. For this reason oligopolistic markets retain a significant tendency towards collusion, which becomes more likely as the number of market competitors decreases and their relative sizes increase.

Workable Competition

Clark (1940) rejected all models of market structure and, in particular, the model of perfect competition which he termed "an unreal or ideal standard". He proposed their replacement with the model of "workable" competition which focuses on conduct and performance rather than on structure itself. Like the model of oligopoly, Clark's model recognised both the tendency for markets to be inhabited by a few large-scale firms and the associated tendency towards collusion between at least some of market participants. He consequently proposed that competition will be "workable" if the following conditions are satisfied :

a) in the case of markets characterised by a few large producers, there is enough product heterogeneity to cause each firm to have some uncertainty regarding the reactions of its competitors;
b) the slope of the demand curve is steep enough to enable an entrepreneur to cover average costs, and
c) there is a real threat of potential competition, and the possibility of substitution between the commodities concerned.

The concept of workable competition stresses that markets should be treated individually, and that the relevant goal to be achieved is the highest level of competition possible, within the contraints provided

by those aspects of structure and conduct which cannot be altered. By treating each market as an individual concept, and consequently ignoring the possibility of interdependence between firms, this model effectively assumes that the theory of second best is not applicable.

The main threat to the achievement of workable competition, with regard to the conduct of firms, comes from the possibility of collusion between some of the firms, exclusive dealing and predatory pricing etc. The presence of any such mode of behaviour will result in firm performance being less satisfactory than would otherwise be the case, and may consequently provide a suitable case for regulation.

If the government does decide to undertake market intervention, it must first define suitable performance levels, in terms of efficiency, profit levels and product differentiation, and must subsequently test actual performance against these standards. If the industry is not working competitively, the government, or its appointed regulatory body, will question why firms are behaving as they are. If this behaviour cannot be justified, the government can regulate the culprit firms through the use of legal or administrative sanctions. Equally, if competition is "workable" at present, but the government fears that market conditions will soon alter, it can again employ some form of regulation by, for example, adopting a merger policy to limit potential increases in monopoly power.

The concept of workable competition is important in so far as it moves away from the static general equilibrium approach, previously incorporated into the model of perfect competition. This model adopts a more dynamic attitude, and recognises the importance of both entry barriers, and the relative ease with which new firms can enter the industry. In the model of workable competition, government policy, and market intervention, become relevant, but are not strictly necessary. In many cases workable competition will prevail, and firms will attain adequate levels of performance as a result of market conditions, rather than enforced behaviour. However, although workable competition may result in the achievement of allocative efficiency, the market solution is unlikely to be as favourable as that achieved under perfect competition.

In addition to ensuring allocative efficiency, a corollary of

perfect competition is that firms will operate with maximum X-efficiency, ie they will undertake all activities, both technological and managerial, at minimum cost. However, as market structure diverges from that associated with perfect competition, firms become insulated from the competitive forces which oblige them to operate efficiently, and X-inefficiency may result.

Leibenstein (1966) coined the term "X-efficiency" to describe the situation in which inputs or factors of production are allocated correctly, but are not employed as efficiently as possible. Leibenstein's basic hypothesis was that neither individuals, nor firms, nor industries are ever as productive as they could be. He argued that, in particular, each firm's labour contracts are necessarily incomplete, in so far as they fail to specify the level of "effectiveness" required from each individual. This implies that the individual must be positively motivated before he will supply maximum effort - and this may only be achievable through monitoring, at cost to the firm.

With regard to external motivation, Leibenstein argued that a lack of competition in the market will encourage slack within the firm, ie production will not be undertaken at minimum cost. Firms, lacking external motivation, will become relatively more concerned with keeping costs in line with, or preferably just below, the industry average, and will not seek to minimise costs. Under these conditions, firms will fail to achieve least cost production, and the market solution will be unsatisfactory in comparison with that pertaining to perfect competition.

Comanor and Leibenstein (1969) hypothesised that the introduction of competition into a market where there is little external motivation will have an important effect on costs because :

a) the process of competition will itself eliminate high cost producers who would only be allowed to stay in business if protected by considerable market power, and
b) competition puts pressure on profits and disciplines management and employees to utilise their inputs more effectively and to increase effort. This argument is similar to that proposed by Cyert & March (1963) in which they introduced the concept of "organisational

slack" to explain the process whereby costs rise above their minimum levels.

If competition is introduced into a market then Comanor and Leibenstein argue that two possible effects would be witnessed ie the elimination of monopoly rents and the reduction of unit costs. The elimination of monopoly rents would be achieved through an improvement in allocative efficiency and the reduction in unit costs would follow from an increase in X-efficiency, given that inputs employed monopolistically are generally more inefficient than those employed competitively. The monopoly, therefore, has higher unit costs to produce a restricted level of output and there is scope for competition to lower not only prices, but also costs of production - even if the output level remains unchanged.

One consideration which is rarely mentioned concerns the problem of second best in any move from monopoly to competition. Competition will not necessarily improve welfare if the resources now allocated to the competitive industry are necessarily drawn from areas where they are already in short supply, because allocative efficiency is not necessarily increased. However, the total welfare gain following a move from monopoly to competition is still likely to be positive given the expected improvements in X-efficiency which are independent of the reallocation of resources. Even if the problem of second best is considerable - and this depends upon the interdependence among industries, the degree of monopoly in sectors related to the one being made more competitive, and the prevailing input-output relationships - the welfare gain associated with reduced unit costs is expected to outweigh the second best problem and produce an overall improvement of welfare position.

However, although competition is expected to encourage an increase in X-efficiency over the monopoly position, Leibenstein (1975) hypothesises that the move to relatively "competitive" market structures will not eliminate X-inefficiency within firms if :

a) the body of entrepreneurs capable of entering the industry is small and not competitive enough to organise firms to produce at costs which are lower than those achieved by the incumbents - in this

case the number of firms leaving the industry may exceed the number of entrants and pressures on performance will recede;

b) firms are sheltered by some form of government regulation or if they operate on the basis of cost-plus contracts;

c) buyers have an apparent inability to understand the nature of the product in question;

d) there are organisational deficiencies which cause the transmission of signals for performance or incentives to become blurred as they pass through the hierarchy of the firm, or

e) even with a large number of sellers, the environment creates a weak level of motivation for entrepreneurs to enter the market and organise low cost production, compared to entropy effects. Leibenstein argues that there is no reason for entrepreneurship to be sufficiently strong, or sufficiently motivated by the environment, to minimize the prevalent entropy effect.

Contestable Markets

A more recent attempt to model market behaviour has resulted in the theory of "contestable" markets. This model is quite similar to the model of workable competition, and again places emphasis on the presence of entry barriers and the ease of entry. However, the model of contestable markets is not as limited as the model of workable competition, in so far as it rejects the latter's requirement that there be at least some degree of rivalry between competitors.

The model of contestable markets was introduced by Baumol (1982) in response to the limited applicability of more traditional theory. The most novel feature of this model is that it treats both incumbents and entrants symmetrically and consequently proposes that potential entry will discipline established firms. Even the established firms which hold some degree of monopoly power will be disciplined, and this may be to such an extent that a competitive solution is achieved. The main conclusion of this model is that, given unimpeded entry to, and exit from, any market, a perfectly competitive market structure is not a necessary pre-condition for the attainment of the benefits associated

with such a structure.

The concept of perfect contestability places considerable emphasis on the existence of "potential" competition and perfectly reversible entry. Sunk costs must, therefore, be absent, and it is assumed that neither fixed nor variable costs can inhibit the operation of the market in any way. Firms can therefore exit from a contestable market without cost, and can subsequently sell, or reuse, the capital previously employed in that market, without incurring any loss above normal costs and depreciation. Potential entrants must be capable of calculating the cost of entry into a potentially profitable market, and the cost of exit, should the incumbents take retaliatory action.

If entrants and incumbents have access to identical technology, then they will each face similar cost functions, and both entry and exit will be costless, in the presence of constant returns to scale. The incumbent firms will not price above average cost, for fear of being undercut by a potential entrant. But, in selecting a slightly lower price, a potential entrant may be willing to accept a relatively lower level of economic profit than the incumbent. If the established firm retains its prices above the minimum level of marginal cost, the entrant firm has the potential to lower that price, and remain profitable, ie by eliminating any unprofitable marginal units which were previously supplied by the incumbent.

The crucial feature of this model is the vulnerability of markets to "hit and run" tactics by temporary entrants. Even transient profit opportunities can be exploited by entrant firms who are willing to enter with a price which is lower than that charged by the incumbents, collect temporary profits, then exit before the incumbent can successfully retaliate. The incumbents, who are aware of this discipline imposed by the potential entrants, will lower prices until these converge on the perfectly competitive level.

This model does not require that existing competitors, ie the incumbents, be either small or numerous, and does not require that they produce homogeneous goods. All perfectly competitive markets are perfectly contestable by definition, but the converse does not hold, ie perfect contestability is a more general concept than perfect competition.

The welfare characteristics of perfectly contestable markets are admirable. Any positive level of profit, earned by the incumbent firms, will be recognised as encouraging the entrants to adopt "hit and run" tactics. Even under monopoly, or duopoly, conditions the incumbents will be disciplined to such an extent that they are encouraged to employ Ramsey optimal prices. Contestability also discourages cross-subsidisation in pricing and inefficiency in production or industrial organisation; the excess costs associated with such conditions are seen to present an opportunity for profitable entry. Only the market structure which minimizes total costs, for the equilibrium level of total market output, is feasible in the long run. Any other market structure will be altered gradually, through the entry and displacement of firms, until the equilibrium structure is eventually attained.

The requirement that there be zero sunk costs in a perfectly contestable market, prevents this model from being much more realistic than perfect competition. However, this model retains the significant advantage of being more widely applicable. Baumol (1982) states that any market characterized by "almost" zero sunk costs will behave in an "almost" perfectly contestable manner. If sunk costs are introduced, but are small in magnitude, then the associated alteration to the equilibrium position will also be small, but only if potential entrants can establish contracts to supply consumers at relatively lower prices. If established firms lower their prices to prevent these contracts being established, there will be no entry into the market, but lower prices will prevail throughout. The extent to which prices fall will be partially determined by the sunk costs which entrants must incur. If capital has a salvage price which is less than its initial purchase price, then potential entrants will price according to their average cost curves over the time period during which contracts are designed to run. This price is likely to be higher than the true average cost, if some of the economic value of the entrant's production plant is being dissipated.

The theory of contestability provides a more flexible standard for "desirable" industrial organisation than is proposed under the traditional theory of perfect competition, or the more recent theory

of workable competition. but may be too far removed from reality. In particular, the model fails to recognise fixed costs as a barrier to entry, or as an obstacle to the achievement of perfect contestability. In practice, both fixed and sunk costs frequently overlap and, even on their own, fixed costs can present considerable barriers. Fixed costs only fail to present a barrier when potential entrants can completely match the output of established firms.

If sunk costs vary with market share then small firms may find it relatively easy to overcome these barriers, whereas the barriers facing larger scale entrants will be considerably greater. Given that small firms are unlikely to threaten the incumbents seriously, their entry may be more or less ignored, but it is unlikely that entry on a much larger scale will not be impeded.

Sunk costs generally constitute a significant barrier to exit, but the theory of perfect contestablility attempts to cope, with this problem, by requiring only that entry and exit are rapid enough to avoid retaliatory responses by the incumbents. This has the advantage of removing the requirement that entry and exit be instantaneous, but consequently implies that the incumbents react at a slower pace than either entrants or consumers. This implication appears to be unrealistic at the best of times, but particularly if the established firms have considerable market experience, and have relied upon rapid reaction times for their very existence.

In some respects the model of contestable markets can be argued to lack generality, while being based on contradictory assumptions. The model requires cases in which production costs are non-decreasing but these are impossible to find unless :

a) sunk costs are present in the short run, or
b) indivisibilities or diseconomies of scale are present in the longer term.

The existence of a U-shaped average cost curve is questionable, but is, in fact, necessary if both marginal cost pricing and zero profits are to be achieved simultaneously. L-shaped cost curves can provide a range of output over which the necessary conditions are satisfied, ie the horizontal section of the curve, but the question of set up costs, and the specificity of capital, will make hit and run tactics almost

impossible to implement under such conditions. The validity of the perfectly contestable model must, therefore, be placed in some doubt.

In many cases, and particularly in the telecommunications CPE market, the theory of contestability cannot provide a "true" reflection of market behaviour, because sunk costs are present. However, even in such cases the model of contestability remains useful in so far as it introduces the idea of games theory.

Games Theory

Games theory involves the analysis of two possible situations. In the first case, any gain made by one player in the market is assumed equal to the total loss among the other players. In the second case, the market players initially co-operate, in an attempt to maximise their joint pay-off, but subsequently disagree over the division of the pay-off. The first case is most appropriate to the question of liberalisation, where the "game" is played between the incumbent firms and the new entrants, with the incumbents employing any advantages they commence the game with, and selecting appropriate market strategies, to discourage entry by potential rivals.

Caves & Porter (1977) stress the indeterminacy surrounding entry decisions, and argue that the final decision is influenced by many factors, including :

a) the expected profits after entry;
b) the presence of "natural" barriers to entry;
c) the expected return achieved by the incumbent firms;
d) the expected behaviour of other potential entrants, both now and in the future;
e) the resources available, and
f) the cost of information.

The incumbents have a choice of strategies designed to deter entry, including product differentiation and vertical integration etc, and the barriers they attempt to raise, as part of the game being played out between potential entrants and incumbents, will be significantly

endogenous. Caves & Porter argue that, because of this, an indeterminate oligopolistic game faces the potential entrants. This game is viewed as very similar to that facing the present competitors inside the market.

In the discussion of contestable markets, it was proposed that incumbents may choose to fight only large scale entry. If this is so, the incumbents may do this by threatening to increase output levels, should entry occur. However, the threat must appear credible. This credibility is best achieved if the established firm makes a prior commitment, eg if the firm undertakes some irrevocable investment. Spence (1977) suggests that such commitment provides the optimal strategy for the incumbents, because potential entrants will then judge entry to be unprofitable and will withdraw from the game. A suitable commitment must be made early in the proceedings, and must be irreversible eg an investment in sunk capacity, advertising or product differentiation. Although the incumbent has the advantage of making the first move on this game, the cost of making the commitment consequently lowers his profits to below pre-entry market level.

Any reputation attributed to the incumbent, regarding its strategy in previous games, will help to establish credibility in later games but, in the case of the telecommunications CPE market, the initial effects of liberalisation represent only the first round. New entrants, especially those involved in the same industry but in foreign markets, may have an indirect advantage, in so far as the incumbent firms have no previous experience of deterring entry. Traditionally, the incumbents have been protected from such games. These firms were party to the Bulk Supply Agreements, discussed in Chapter 2 above, and benefitted from the Post Office's statutory monopoly over the telecommunications market.

(III) LIMITATIONS TO THE PERFECT SOLUTION

By introducing a liberalisation policy into the CPE market the government appears to have been aiming, ideally, for the achievement of allocative efficiency. Given that "perfect competition" can never be attained as such, this objective may be best achieved if some form of workable competition or contestability results, both of which entail many of the benefits associated with perfect competition. In practice, however, markets commonly fail to achieve allocative efficiency, due to the existence of externalities, or some degree of market power on either the buyers' or sellers' side of the market. These problems will now be discussed, firstly in theoretical terms, and secondly, in section (IV) below, with respect to their relevance in the telecommunications CPE market.

The Presence of Externalities

An externality is any variable which places the utility of one decision maker under the effective control of another. Such a situation need not, however, be unfavourable, ie some externalities are "beneficial" or "reciprocal" in nature; but even these will prevent a market from becoming perfectly competitive, and consequently prevent the achievement of Pareto optimality.

Externalities can occur on either the production or demand side of the market, and may even provide a link between the two in particular cases. However, the basic problem remains the same - some costs and benefits are not adequately reflected in market prices, and are not taken into account in decisions regarding supply or demand.

In the CPE market there are three major sources of externality, each of which will determine the ability of competitive forces to take the market to the point of Pareto optimality. The first of these problems is dicussed by Katz & Shapiro (1985) who raise the issue of externalities and competition when products are consumed through the use of a network. In many such cases, it is the manufacturers

themselves who must decide whether to manufacture products which are compatible with those supplied by competitors. If compatibility costs are purely fixed costs, then Katz & Shapiro propose that any move towards total compatibility, which raises industry profits, will be socially beneficial. But, in the absence of side payments, firms will only adopt compatible standards if they benefit, individually, from such a move.

Public policy, through patents and copyright laws, can attempt to influence the decisions of each firm. If patents are strictly and broadly enforced, then the joint adoption of an industry standard is not only feasible, but is quite simple to impose. However, if patents are loosely enforced or narrowly applied, then an industry standard will be almost impossible to impose and an alternative is required. Such an alternative is most commonly provided by the construction of an "adaptor" which enables each firms' products to be attached to the same network.

In the case of the attachment of CPE products to the telecommunications network, the issue is not only one of monitoring adequate standards, but is also one of protecting BT. As the owner of a national telecommunications network, at the time of liberalisation, BT's own revenue could be affected by the functionality of the products attached by consumers. Once the decision to liberalise the CPE market had been taken, some safeguards to protect BT's network revenue were necessarily proposed. BT should not lose revenue as a consequence of products not distributed by itself, being faulty or of a low standard. For this reason the approvals authority, or the sale of some form of intermediate adaptor, is a necessary accompaniment to liberalisation. As discussed in Chapter 3 above, BABT has been established to help alleviate this particular problem. In the absence of BABT, or if that organisation should fail to operate effectively, the possible supply of low quality products to consumers could :

a) prove harmful to the consumer of the product;
b) prevent the smooth operation of the telecommunications network and lead to a decrease in BT's revenue;
c) endanger network employees, and
d) affect other consumers if, for example, the use of such products

resulted in low quality communications.

On the production side of the market an externality exists which can be either beneficial or detrimental in nature, and which is related to the question of patent pooling. The Post Office, and its selected manufacturers, traditionally advocated patent pooling, and joint research. This strategy ensured that all relevant technical knowledge was made available to each manufacturer, regardless of which firm had undertaken the associated R&D. This strategy was arguably beneficial, and consequently presents an example of a favourable externality. However, under liberalised market conditions, BT has recently attempted to use its dominant power, to its own advantage, by requesting the intellectual property rights of any products it would distribute to end users. This policy was enacted, admittedly for a short time, against the wishes of the manufacturers. It can therefore be argued to have given rise to a detrimental externality, in so far as the benefits of research were not necessarily amassed by the firm who had invested the necessary expenditure and effort, or by its own choice of partners. However, as in the case above, this externality is no longer of much relevance to the market - it ceased to be a matter of concern when BT removed its request, that it be supplied with the intellectual property rights, as a pre-condition to distributing products to end users.

On the consumption side of the market one further externality is indirectly relevant to the CPE market and concerns the connection of additional subscribers to the network. This particular externality can be either beneficial or detrimental in nature. At the margin, each additional subscriber increases the use other subscribers can make of the network, and consequently increases the value, not only of subscriber apparatus, but also the network itself. A case can, therefore, be made for charging relatively lower connection and rental fees from especially valuable consumers. However, the connection of each additional subscriber also leads towards congestion, which may result in poor quality services, or even the breakdown of some sections of the network. In this respect each additional subscriber is imposing a "cost" on existing consumers, but does not pay the appropriate level of compensation.

Externalities are, therefore, present in the CPE market, but are not significant enough to have much effect. These externalities only affect the conduct of market participants, have never seriously threatened market structure, and have been dealt with, quite effectively, through policy. The presence of BABT should prevent the supply of poor quality products, BT has removed its request for intellectual propery rights and, although the connection of additional subscribers may still lead to congestion, this also entails the bonus of increasing the potential use of the telephone to all subscribers. Externalities, in this particular market, would not appear to provide any significant threat to the achievement of allocative efficiency.

Absolute Cost Advantages

A second reason for the non-achievement of Pareto optimality stems from the presence of at least some degree of monopoly power on either the buyers' or suppliers' side of the market. In the latter case monopoly power is most likely to arise through the existence of entry barriers, which were previously raised via statutory limitations in the CPE market. However, liberalisation has effectively removed any statutory barriers, leaving only those created through cost advantages, economies of scale and product differentiation.

Absolute cost advantages may be enjoyed by established firms who;

a) have access to superior factors of production, or production technology, including patents and specialised "know-how" which is not readily available;
b) benefit from buyer preferences which oblige entrants to undertake relatively more promotional expenditure to achieve an equivalent degree of effectiveness, or
c) either control supplies of some necessary inputs or else obtain these, or investment funds, at favourable prices.

These conditions enable established firms to price above average cost, by an amount equivalent to the difference between the incumbents' costs and those of potential entrants. Entry under such

conditions is difficult, but the barriers may be, at least potentially, overcome by firms diversifying from other markets. These firms have the advantage of possibly undertaking vertical integration, or sharing a common production line between two or more products.

Stigler (1968) stated that absolute cost advantages constitute the largest form of entry barrier. However, Bain (1956) had argued that these barriers would not be important unless :

a) major patents are involved;
b) the capital costs of entry are extremely high, or
c) all supplies of raw materials are controlled by the established firms.

Cost advantages are frequently obtained as the result of R&D programmes which have concentrated on process, as opposed to product, development. Such programmes are generally favoured by the relatively larger sized market participants, as these firms stand to gain most from the successful exploitation of economies of scale, or the introduction of lower cost production techniques. Large firms also tend to have better access to the funds which must first be invested in R&D.

Abernathy and Townsend (1975) outline three models of process change which appear to be applicable to the liberalised CPE market ie

a) "Process Rationalisation" - where standard production methods are adopted, manufacturing processes become routinised, and at least one part of the process becomes stable enough to justify further expenditure on the development or introduction of more automated or specialised equipment;
b) "Systematic Technological Development" - which involves a combination of process rationalisation, the achievement of some degree of stability in product design and the application of more advanced technology, and
c) "Process Realignment" - where productivity gains can be achieved from improvements made to the relevant input materials, process technology and labour skills, and where some product characteristics will become tailored to suit the process technology employed.

Each of these three models will apply, in turn, to the manufacture of subscriber apparatus under competitive market conditions. However, these models are of more relevance to the conditions under which the larger firms operate. Smaller firms, in almost any market, are unlikely to place much importance on the introduction of process developments. These firms will be more interested in product developments, as these may enable them to capture market niches in which they can exert at least some degree of monopoly power.

Economies of Scale

A second source of entry barrier is provided by economies of scale, the presence of which is illustrated by a downward sloping average cost curve. Scale economies imply that firms must achieve output levels which are large, in both absolute terms and relative to the size of the market, and that established firms can price above average cost, without incurring entry. The magnitude of any such barrier, assuming the Sylos Postulate holds, will be determined by :

a) the elasticity of demand at any price;
b) the rate at which the average cost curve is declining;
c) the level of output at which economies of scale are exhausted, and
d) absolute market size, ie this barrier appears relatively larger in small volume markets, such as the UK, for any given level of technology and production techniques.

Stigler chose not to define economies of scale as a barrier to entry, because new entrants face the same basic cost functions as established firms. However, regardless of whether a "barrier" is actually created, new entrants, facing such conditions, must choose between entry at a suboptimal level of output, which may entail considerable cost disadvantages, or entry at the optimal level. This latter option will require a considerable amount of promotional expenditure, to ensure adequate sales, and is full of risk for new entrants, especially if established firms are likely to lower prices in retaliation. The optimal strategy for new entrants may

consequently be one of initial entry on a relatively small scale, accompanied by continual marketing expenditure. This expenditure must be designed to facilitate growth, but may, itself, be subject to economies of scale.

This particular barrier is best overcome by entrants who only "distribute" products, ie who supply imported, or domestically produced, substitutes for the output of the incumbent firms.

Product Differentiation

The most controversial barrier to entry is that of product differentiation, which is especially prevalent in the market for consumer goods. To illustrate the concept of product differentiation, Chamberlin (1937) defined each individual's utility function in terms of "characteristics", rather than goods. Given that these characteristics need not be defined as "good" or "bad", the consumers' indifference mapping takes the form of closed, rather than open, curves. The shape of each contour reflects the extent to which a consumer is willing to trade off between the characteristics available, and the introduction of an income constraint restricts the choice of product facing each consumer.

Prices can be introduced into Chamberlin's model, but only on the assumption that the disutility incurred by consumers, as they move from the optimal point, can be adequately "priced". Any price reduction, by one firm, will have most effect on the sales of those products which are located nearest in characteristic space, and may encourage some form of retaliation. Eventually, the effects of the initial price reduction will spread throughout the entire industry and, although market shares may remain unaltered, profits will be generally reduced.

Lancaster's (1966) analysis of product differentiation, later developed by Archibald and Rosenbluth (1975) differs from Chamberlin's by treating characteristics as goods, rather than qualities, and focusing on the demand for these characteristics. Substitution in consumption still exists in this model, but each group of products is

assumed to share particular characteristics, absent from other products, and pricing policies are assumed to reflect the considered importance of these characteristics. Firms operating in differentiated markets will consequently attempt to deter entry by completely covering the characteristics space with products, ie the only gaps left will be too small to support a profitable level of output, at acceptable market prices.

The presence of product differentiation may result in significant entry barriers in those markets where :

a) some degree of buyer preference for existing products has been established, perhaps through previous marketing expenditure;
b) some particular product designs are clearly superior, or
c) some firms control independent, and effective, channels of distribution to the market.

This barrier is raised because consumer loyalty will only be broken at considerable cost, ie established firms are effectively given an absolute cost advantage. The barrier is further increased if consumers are either exceedingly loyal, or else relatively inert. Entrants facing such barriers must either undertake significant levels of investment, into sales and distribution, or else set prices below those of the established firms. Both strategies are problematical and expensive, but the necessary investment, in sales promotion, may be reduced in the case of entrants diversifying from established positions in other markets.

The controversy surrounding this barrier concerns which definitions of product differentiation constitute a barrier to entry. Chamberlin defined product differentiation as "real or imagined differences in the characteristics of competing products", or a downward sloping average revenue curve due to the introduction of a monopoly element in competition. However, Bain later defined this concept as "a higher demand curve at any given price", and deemed the barriers created, by product differentiation, to be at least equally important to those created by economies of scale.

The most comprehensive analysis of this topic has been presented by Cubbin (1982) who suggests that product differentiation will encourage

entry if defined as :

a) differences in the characteristics of competing goods;

b) low cross-elasticities of demand, or

c) a steeply downward sloping average revenue curve;

but will impede entry when defined as :

d) substantial advertising expenditure;

e) an absolute demand advantage, or

f) an absolute advertising advantage.

Stigler does not recognise the possibility of entry barriers existing because of product differentiation itself, but accepts that advertising can create barriers if entrants must subsequently incur relatively higher expenditure, than the established firms, to achieve an equivalent level of sales, given comparable prices. Schmalensee (1974) proposes that, although advertising can create brand loyalty, this does not constitute a barrier to entry if an equivalent level of advertising, by entrants, would produce an equivalent degree of loyalty, and a comparable level of sales. He states that not even brand loyalty, which has been created by advertising, will constitute an effective barrier, unless capital markets are imperfect and new entrants have insufficient funds to undertake the necessary product promotion. It may, consequently, be more profitable for established firms to cease advertising altogether. However Demsetz (1982) has illustrated that market entry is more difficult in the absence of advertising, because consumers must then base their product choices on the history of each individual market participant. This would invariably favour the established firms.

It is generally accepted that advertising, soley to create an entry barrier, will be relatively more successful in highly concentrated industries, and that firms entering through diversification, from established positions in other markets, will have a considerable advantage over "new" entrants, in terms of overcoming this particular barrier.

Research and Development

The fact, that product differentiation is frequently achieved as a result of successful R&D projects, makes R&D an important strategic weapon in any competitive market. Kamien and Schwartz (1982) have established that, regardless of industry structure, the total reward for a major product innovation will increase with the elasticity of the industry demand curve, ie the more elastic the demand curve, the greater the incentive to innovate. Since the availability of substitutes will partially determine a product's elasticity, the incentive to innovate will be greatest when products have close substitutes, ie when products perform the same basic functions, and differ only with respect to additional features or appearance.

Neoclassical theory attempted to analyse the "direction" rather than "intensity" of innovative activity. This approach favoured an analysis of the search for new processes, to facilitate cost reduction, and treated technology as exogenously determined. In contrast to this approach, however, Cyert & March (1963) and Penrose (1959) introduced theories which treat R&D as a residual. These "behavioural" theories recognise that firms are attempting to alter their environment, and are generally not content to simply respond, in a passive manner, to stimuli from their immediate surroundings.

The behavioural approach to the question of R&D recognises the limited decision making capacity of any firm and, correspondingly, proposes "satisficing" rather than maximisation. In these models, the search for innovation is most often stimulated by a discrepancy between the levels of achievement and aspiration. These models may fail to provide a comprehensive explanation of R&D and innovation, but they successfully fill some of the gaps left by neoclassical theory.

The basic problem, with both the Neoclassical and behavioural schools of thought, is their apparent inability to deal with the whole concept of resource allocation and technical change, although both schools recognise the importance of technical change itself. The Austrian school of thought, and the work of Schumpeter in particular, presents an approach which appears to be more satisfactory. The Austrian school views the market as a "process" rather than as a

configuration of prices, qualities and quantities which are consistent with each other and produce a market equilibrium solution. To develop this theory of market process this school focuses on the frequently neglected role of the "entrepreneur".

Kirzner (1975b)defines entrepreneurial knowledge as "a rarefied, abstract type of knowledge - the knowledge of where to obtain information (or other resources) and how to deploy it". For entrepreneurial incentives to operate successfully it is necessary for those who perceive opportunities to benefit, and the market provides adequate incentives. Entrepreneurial alertness is stimulated by the lure of profits. Profits, consequently, remain the prime objective of the market process.

Hayek (1955) stated that in disequilibrium man's knowledge is imperfect and some individuals are making mistakes, but no one errs in an equilibrium situation. He therefore views the attempted move from disequilibrium to equilibrium as the process through which men gradually learn to avoid mistakes, and through which their actions become increasingly co-ordinated.

The Austrian school view "competition" as an active process rather than a structural state. This process involves the continual search for new knowledge, with success being rewarded by temporary, supernormal profits. The R&D work undertaken by any firm provides the potential opportunity to find a better technique of production in the next period, although new techniques will only be applied if they improve on the present productivity of the firm.

Nelson & Winter (1978) argue that firms are unable to optimize in a formal sense because their decision problems are too complicated to be fully comprehended. Because of this firms adopt three major decision rules ie

a) given their present technological techniques and constant returns to scale, firms produce at capacity levels regardless of the level of prices;
b) investment will be triggered if product price is such that firms earn more than a target mark-up over production costs and is limited only by finance;
c) the amount spent by firms on R&D is proportional to their size as

measured by capital stock.

This last decision concords with Schumpeter's (1942) suggestion that there is a positive relationship between firm size and innovation given that :

a) only large firms can bear the cost of modern-day R&D programmes;
b) large, diversified firms can absorb project failures by innovating widely, and
c) firms need some degree of market power to reap the rewards of their innovation, ie small firms may contribute significantly to the number of "inventions" relevant to any market, but it is more commonly the larger firms who bring these inventions to commercial fruition.

Two major hypotheses arise from Schumpeter's theory. First is the suggestion of a positive relationship between innovation and monopoly power, and second is the belief that large firms are proportionately more innovative than smaller firms. Galbraith (1952) has further reinforced Schumpeter's theory by claiming that firms, in oligopolistic industries, will frequently appreciate the mutually destructive nature of price competition and consequently favour competition through innovation. Galbraith has also suggested that the "era of the cheap invention" is over, and that successful R&D projects, in the future, will be those undertaken by the relatively larger firms. These firms generally favour process development over product development; because product innovations are likely to encounter price competition from the established goods which are being effectively replaced, and may, therefore, be less profitable than process innovation.

Schumpeterian competition has implications which go further than suggesting which firms will be winners or losers. Under such conditions, the achievement of growth clearly confers advantages which increase the probability of further success, whereas the non-achievement of growth, and decline in particular, will breed technological obsolescence and increases the probability of a further decline. For this reason, ie given that growth leads to further growth, there is a tendency for the competitive process to lead to

increased levels of concentration, but this will be subject to a natural limit. Once firms have grown to a size at which they can dominate the market their search for new knowledge will decrease and the firm will begin to decline.

Nelson & Winter argue that the entry of new firms into the market can exert considerable influence over the behaviour of present participants within this model. If entrants are small in size they will adopt a role comparable to the small incumbent firms - in this case the informational economies of scale still favour the larger competitors and the entrant will find survival difficult to secure. However, if entrants come into the market on a large scale, as technological leaders, and are motivated by subtle, long-term strategic calculations (rather than the simple profit motive) then the incumbents no longer hold such a dominant position in the market and the search for knowledge will continue.

International Competition

The introduction of large, foreign firms into the domestic market has some interesting theoretical implications. Small domestic entrants are likely to be entrepreneurial type firms, attracted by potential profits, perhaps even from a hit-and-run type strategy, and willing to niche-fill. These firms will provide little threat to the established, large scale incumbents and little effort will be made to deter them. However, the competitive "game" played between the incumbents and small domestic firms, based on the extent of their interdependence, is likely to be very different from that being played between the incumbents and larger scale foreign firms. This latter game will be played on two levels ie the first stage of the game will involve an attempt to deter entry, perhaps involving some commitment to signal to potential entrants that the Sylos Postulate will hold. If this particular game plan fails as far as the incumbents are concerned, then the second stage may involve oligopolistic competition between market participants. Once entry has been established the form of the oligopolistic game played inside the market will alter significantly

and, in the extreme, Dixit & Stern (1981) argue that the performance of domestic firms may be so adversely affected that it becomes more appropriate to regard foreign firms as being in a position of leadership relative to a competitive "fringe" of small domestic firms. The success of the foreign firms will be influenced significantly by their strategic choice of how to supply products to the market they are entering.

Dixit & Stern argue that, for transnational firms, the question of where to locate production is distinct from ownership. If the market price of their factors of production, in the newly competitive market, equals their social opportunity cost then there is no concern for the level of production as such. But if factor prices differ from social opportunity costs then there is a cause for concern - policy makers in the market opened to competition may have welfare objectives such as employment which are not sufficiently captured in expressions of deadweight loss in the product market.

If Firm "i" faces constant marginal costs "ci" for the delivery of a product to a particular market recently opened to competition, and the firm's own sources of supply are indexed by "j", then "c_{ij} is the constant marginal cost of supplying the market from source j. Firm i must select the quantities x_{ij} of supplies from various sources to minimise:

$$\sum_j c_{ij}\, x_{ij} \text{ subject to } \sum_j x_{ij} = x_i.$$

Dixit & Stern argue that this is achieved by choosing only one non-zero x_{ij}, ie that for the source with the least cost among the c_{ij}; in this case the smallest cost is simply c_i. The decision taken by the firm regarding its source of product is, consequently, purely theoretical in nature, and is independent of the oligopolistic structure of the product market. For this reason a country's cost-benefit analysis of industrial production policy can be conducted independently of its domestic regulatory policy, although the goverment may decide to impose a link between the location of production and the right to supply a market.

There are three major choices facing foreign firms with regard to

production and product distribution. The first option is to locate production in the market opened to competition. Such production is located in a subsidiary which becomes part of a huge global operation and which must participate in the company's strategy to maximise global profits - for this reason the competitive strategy of these firms may differ significantly from what would be the case for an independent firm, whether of domestic or foreign ownership.

The second possibility concerns the establishment of a joint venture with a domestic firm - this can confer significant advantages regarding ease of entry into the market, depending on the relevant experience of the domestic firm, and the establishment of distributional channels etc. It may also provide the optimal strategy in cases where particular technological considerations are significant, in that the domestic partner can constribute the necesary information and know-how regarding technical peculiarities and standards etc, enabling the foreign partner to suitably adapt his product at a faster and cheaper rate than would be possible otherwise. However, a joint venture does restrain the competitive strategy of a foreign entrant in so far as the objectives and goals of both firms must be co-ordinated before a suitable strategy can be prepared. For this reason the joint venture subsidiary will not necesarily conduct itself in the manner consistent with the maximisation of global profits for the foreign competitor.

The third, and possibly simplest, option for the foreign firm involves the direct export of products into the competitive market. In this case the product in question can be manufactured either within the home country of the foreign firm, or offshore. Product distribution can also be by direct export or, as is sometimes required by policy, through "agent" firms in the newly competitive market. Either way the product reaches the market at a relatively low cost in comparison to the above options of subsidiary or joint venture production, and also gives rise to the possibility of simply off-loading excess capacity ie "dumping" products onto the market. Again the competitive strategy of these firms will differ significantly from that adopted by other foreign firms.

The nature of the oligopolistic game being played both between

incumbents and entrants and between the present market participants at any time is likely to suggest the adoption of several, quite distinct, competitive strategies. The effect of such competition on domestic firms in general, but on the incumbents in particular, is indeterminate. Within the newly competitive market the outcome will depend on the extent to which the incumbents can deter entry and, subsequently, on the scale of such entry and its ownership of technological advantages. If foreign firms enter on a large scale, holding significant technological advantages and not motivated purely by profits in this particular market, then the concept of competition as a "search" process suggests that the incumbents will be motivated to retain their initially dominant position through intensive R&D programmes, and considerable levels of advertising to bring new developments to the attention of consumers. However, there is also the very real danger that the foreign entrants will immediately replace the incumbents as the dominant group, effectively relegating the incumbents, and hence the domestic industry, to the competitive fringe. In this latter case competition will not have increased the international competitiveness of domestic firms and will have given rise to negative welfare effects.

The Presence of Monopoly Power Among Buyers

Galbraith (1952) argues that seller concentration encourages buyer concentration, as a restraint against unfavourable market power, and this may lead, ultimately, to "bilateral oligopsony". The dominant buyers, in any market, will use their monopsonistic power to encourage reciprocal dealing, but will also encourage sellers to hold product prices close to the competitive level. This latter strategy introduces the possibility of achieving an efficient allocation of resources, ie the attraction of large volume orders may encourage suppliers to agree to price concessions, in the knowledge that they will save the costs of locating and securing potential consumers. However, even the most powerful of buyers must expect to pay higher prices to a few oligopolistic sellers, than to many small, competitive sellers, unless

these larger manufacturers can significantly exploit economies of scale, and the buyer can influence price. Only in this case will the market solution entail an efficent allocation of resources.

The upper price limit to any contracts negotiated, between concentrated buyers and sellers, will be equivalent to that which would be set by a monopoly supplier or collusive oligopoly facing competitive buyers. The lower limit will, in turn, equal that which would be set by a monopoly buyer facing competitive suppliers. The respective bargaining power of both buyers and sellers will determine the final outcome of negotiations, ie only those buyers who hold considerable market power will benefit from reduced prices; and only in markets containing a few large buyers, with equivalent market power, will price concessions be offered universally. If one buyer in the market is also a monopolistic supplier, further along the chain of production and distribution, he will internalise most of the benefits he achieves, unless the fear of new entry into his monopolised market is sufficient to encourage him to pass on at least some cost reductions to his own consumers. One problem which frequently arises is that negotiations, between concentrated buyers and sellers, lead to a lower level of output than would have occurred under more competitive conditions.

The Problem of the Second Best

The existence of any one of the above problems will prevent the first best position from being attained. Under such conditions, the government may decide to directly intervene to correct these problems through direct regulation, taxation or subsidisation, or even nationalisation. However, if a government does decide upon such a strategy, it will invariably face the problem of second best. If some sector of the economy fails to achieve the perfectly competitive equilibrium position, then optimality may require that other sectors also adopt positions which diverge from the perfectly competitive solution. The achievement of a true second best solution to a market problem will require so much control, and extremely complicated

measures of intervention, that the required policy will be almost impossible to execute. It is especially difficult to ensure that policy reflects the dynamic nature of competition, and does not enforce a static and rigid industry structure. Policy may, therefore, be rejected as impracticable.

Given that consumers have relatively more confidence, over time, in both competition and industrial flexibility, a market structure which facilitates the freedom of entry and exit of firms is generally viewed as leading to a better solution, to the individual market problem, than could be obtained through more detailed regulation. In response to this, contemporary government policy appears to favour the achievement of high levels of competition in individual sectors, even though the problem of second best is being effectively ignored. This form of government policy focuses on the dynamic, as opposed to static, market conditions, and gives relatively more weight to "loosening up" the system than to attaining static perfection.

Entry and Social Efficiency

The above discussion has highlighted the problems faced by policy attempting to achieve "allocative efficiency" by encouraging entry into a previously closed market. Given that perfect competition cannot be attained, and that allocative efficiency is also unlikely, the question remains of how much entry is optimal? Traditional theory has tended to assume that "more" competition is more socially desirable than less, but is this still the case when markets are characterised by increasing returns and imperfect competition?

Perry (1984) suggests that the presence of economies of scale invariably leads to considerable problems in any attempt to evaluate industry structure. Such economies can be more fully exploited with fewer market participants, but this undoubtedly leads to imperfect competition and the free market outcome, ie if entry is unrestricted, will represent a compromise position in which some economies of scale remain unexploited but participants are relatively few in number and have little need to behave competitively.

To ascertain the "optimal" structural equilibrium Perry suggests that equilibrium industry output should first be defined for any number of firms; the number of firms should then be increased until each firm is making profits which are just non-negative. Such a market structure is the "optimum" in so far as it determines the number of firms maximising consumer-plus-producer surplus "subject to the industry output equilibrium for any given number of firms".

The optimal structure of any industry may give rise to more or fewer firms than would participate in a free market equilibrium. If the optimal structure requires more firms then large competitors should be split, mergers should be prohibited and subsidies should be designed to encourage further entry and discourage exit. If the optimal structure requires fewer firms than the free market equilibrium then mergers should be encouraged and further entry should be prevented. This latter case is the most common because any efficiency gains arising from having a few firms more fully exploit economies of scale will offset the dead-weight loss in consumer surplus because competition has been effectively reduced and prices will increase. In general, therefore, the reduction in output which occurs when the number of participants is reduced is minor in comparison to the increase in output per firm due to exploitation of economies of scale. Perry suggests that if no further entry is desired, the government should issue licences or set an "entry fee" which is equal to firm profits at the structural optimum - free entry will then produce the optimum number of firms and will also ensure that only the most efficient firms enter the market.

This analysis was presented only for the case of homogeneous products and has been extended by Mankiw & Whinston (1986) who analyse the particular case in which firms incur fixed set-up costs on entry into a market. They argue that if entry by one firm causes the incumbents to reduce their level of output, ie the "business-stealing effect", then entry is more desirable to the entrant than to society and there is, consequently, a tendency towards excessive entry in homogeneous product markets. Only if firms act as price-takers after entry will free entry result in the socially efficient number of firms, despite the business-stealing effect. If, however, the post-

entry price is greater than marginal cost, and the business stealing effect exists, then entry will be more attractive than is socially warranted.

Given an excessive level of entry, Mankiw & Whinston argue that the welfare loss due to free entry will decline as the socially optimal number of firms increases and, because of this, the excess number of firms in the market is not an adequate measure of welfare loss. Again the government should raise the cost of entry by introducing some form of entry tax, such as a licence fee, and should make no attempt to remove any artificial entry barriers surrounding the market.

The need for entry restrictions has been found to lessen in two cases ie a) where fixed set-up costs become small in size and b) in the presence of product differentiation. Product diversity may reverse the bias towards excessive entry because the marginal entrant adds to product variety but does not, himself, capture the resulting gain in social surplus as profits. Entry in this case can be excessive, insufficient or optimal, although Mankiw & Whinston believe an efficient level of entry remains unlikely.

Spence (1976) states that product differentiation involves a set of real economic choices given that there are increasing returns in the development, production, marketing and distributional activities of firms; however the full range of possibilities is neither feasible nor desirable in the presence of increasing returns to scale. Spence argues that the entry of each additional product will have two effects ie a) increase the surplus from the new product, and b) lower demand for existing products, leading to a contraction in output. The gains from new entry are, therefore, the profits and consumer surplus obtained from the new product, while the losses arise from the reduction in profits and surpluses from existing products. If products are close substitutes and their cross-elasticities are high, then Spence argues that the additional surplus created by the producer entering the market is outweighed by the loss due to the contraction in output of the existing firms, ie a product's marginal contribution to welfare is measured as the additional surplus it adds, minus the cost of producing it.

Assuming that products are substitutes, that they involve both

fixed and variable costs, and that the market equilibria are Nash equilibria in quantities, Spence argues that from the social point of view the fixed component of cost can be regarded as an entry fee for introducing an additional product, and that there will be too many products if there are high own price elasticities of demand and cross-elasticities between products. In monopolistically competitive markets prices are typically above marginal cost and the solution to the second best problem includes a trade-off between the increasing number of products and the inefficiency due to non-marginal cost pricing.

In contrast to Spence's view, Dixit & Stiglitz (1977) suggest that, in a monopolistically competitive market, free entry can result in too little entry relative to the social optimum. They argue that any product should be produced if its costs can be covered by the sum of revenues and a properly defined measure of consumer surplus. However, if scale economies are present then resources are saved by producing larger quantities of fewer goods, but this implies less variety and, consequently, some welfare loss. In the Chamberlinian equilibrium in monopolistically competitive markets each firm operates to the left of the minimum point on their average cost curves and excess capacity is generally held to exist, ie encouraging an increase in output to the point where economies of scale are exhausted. If, however, further product variety is desirable, then such a move is not optimal or socially desirable and the market remains characterised by insufficient levels of differentiation and of entry.

(IV) COMPETITION IN THE TELECOMMUNICATIONS MARKET

The ultimate aim of government policy in the telecommunications market has been the privatisation of British Telecom; but for this policy to be successful it was first necessary to introduce a significant degree of competition into several sectors of the market. This strategy was designed to prevent privatisation simply transforming a public monopoly into a private one; a result which would entail serious, and undesirable, welfare consequences.

The measures through which the government has attempted to liberalise the telecommunications market have been outlined, in Chapter 3 above, and focus upon :

a) the supply of subscriber apparatus;
b) the operation of national telecommunications networks, and
c) the provision of services over such networks.

This particular study concentrates on the market for subscriber apparatus, in which liberalisation was increasingly introduced according to a timetable, dating from November 1981 but incomplete by the summer of 1985. Legislation has entitled manufacturers to compete with BT in the sale of products to end users, both through independent supply and supply undertaken through selected distributors. By breaking down BT's monopolistic control over the equipment markets, and permitting more competition in, for example, the large PABX market, the government has aimed for an ultimate position of Pareto optimality but is, however, unlikely to achieve this. Government policy must not only ensure that BT cannot continue to monopolise the market, but must also aim to eliminate any barriers which the incumbent firms, ie the suppliers of products to the Post Office in the pre-liberalisation era, may erect to deter potential entrants. Unless this is achieved the liberalisation of the market might result in an insignificant improvement in welfare, compared with that attained in the pre-liberalisation era.

Several limitations to the effectiveness of competition can arise from the existence of externalities but, in the case of the telecommunications market, these are not expected to be too important,

and the relevant limitations are more likely to arise as the result of a natural movement towards concentration, on the part of both buyers and sellers. On the producers' side of the market, even after liberalisation has been introduced, concentration is likely to arise from several sources including absolute cost advantages, economies of scale and product differentiation. Absolute cost advantages arising from access to superior factors, or superior technology, will be applicable to the incumbent firms in the CPE market, ie those firms which supplied BT before liberalisation, through an association dating back to the Bulk Supply Agreements.

The incumbent firms have the advantage of already employing most of the suitably skilled labour in this market, leaving entrants to choose between "poaching" such employees, by offering suitably high rewards, or bearing the cost, and time lags, involved in providing suitable training programmes for labour which is available. The incumbent firms also stand to benefit from ownership of superior production technology which was installed, prior to liberalisation, on the basis of knowledge amassed from BT, and which was often financed, at least to some extent, by BT itself.

Absolute cost advantages may also be achievable by firms which are large, and experienced enough, to finance and benefit from R&D projects which focus on process technology. The achievement of lower costs of production will encourage competition through price reductions, which many new entrants cannot match, and even the threat of such conduct may be sufficient to deter entrants who require post-entry profitability.

With regard to barriers arising from economies of scale, it again appears that these will be significant, in the CPE market, where the incumbent firms have the benefit of production already being established at large volumes. In theory, any firm which wins a suitably large contract from BT stands to benefit from economies of scale, and foreign firms may achieve significant economies of scale through volume production abroad. This barrier will, however, still present a considerable obstacle to small potential entrants, effectively restricting them to market sectors or niches where they are unlikely to meet sizeable domestic or foreign producers.

A third barrier arises in the form of product differentiation which may be achieved, in the CPE market, through advertising or R&D. Cubbin (1982) has illustrated that product differentiation, achieved through products reflecting different characteristics, low cross-elasticities of demand or steeply downward sloping demand curves, will actually encourage competition. This must surely apply in the CPE market where many firms are expected to be content to fill specialised niches, in characteristics space, or to offer particular product features which are so relevant to some groups of consumers that the cross-elasticity of demand is extremely low. In the latter case the demand curve will slope downward, suggesting some degree of monopoly power, but entry will not necessarily be discouraged.

Cubbin has suggested that product differentiation will constitute an entry barrier when achieved through substantial advertising expenditure, an absolute demand advantage or an absolute advertising advantage, and such a barrier is likely to be of significant magnitude in the CPE market. BT clearly holds any advantage to be obtained from high levels of advertising expenditure, but some of the associated benefits are being passed onto its suppliers. If advertising results in an outward shift in the demand curve facing BT, then BT will, in turn, demand greater volumes of products from its suppliers, and the demand curve facing these firms will also move to the right. In the short term at least, the incumbent firms not only benefit from assured, and fairly high, levels of demand for products from BT, but they also hold an absolute advertising advantage over their competitors. BT's advertising campaigns enable its chief suppliers, ie the incumbent firms, to promote products for a relatively lower level of self-financed advertising expenditure than would be the case for newcomers.

With regard to product differentiation which is achieved through R&D expenditure, the incumbents have some advantage through holding the patents on several of the established or traditional product designs, whereas new entrants must finance development projects which are designed to create products capable of filling unexploited market niches. These products must be designed to a suitably high standard to pass BABT's strict product requirements. Large firm size should also

enable the incumbents to exploit the benefits of economies of scale in R&D itself which, in addition to the high threshold levels of effective R&D expenditure in this particular market, may constitute yet another sizeable barrier to entry by small firms. This barrier is not expected to provide such a significant deterrent to large, foreign competitors however; these firms also hold many relevant patents, have suitable product ranges already established, and can simply select the particular products which appear to be most suitable for distribution in the UK market.

The problem of concentration on the consumers' side of the CPE market will also restrict the success with which competition can be introduced through government policy if BT remains the dominant consumer of CPE products post liberalisation, even though its market power may be weakened to some extent. In the liberalised market, BT will no longer be so closely involved with manufacturers in terms of co-ordinating product development and bulk supply orders as it used to be. But, with more potential suppliers, BT's dominance should enable it to play one manufacturer off against another, to elicit both price concessions and specifically desired product developments. The extent of this buyer power will be greatest when demand in the CPE market is slack, but will be asymmetric in nature, ie there will be little opportunity for retaliation by the manufacturers when demand, for their products, is high. The only manufacturers in this particular market who are unlikely to yield to BT's significant purchasing power, will be those whose products exhibit exceptionally strong degrees of brand acceptance.

(V) EVALUATION AND HYPOTHESES

In the light of the above discussion of relevant economic theory, it is the intention of this thesis to construct three hypotheses through which the impact of liberalisation on market structure, participant conduct and competitive performance can be tested.

Theory suggests that a market such as that for CPE will never be perfectly competitive - the two major structural defects being the presence of significant economies of scale and considerable concentration on the buyers' side of the market. Given that perfect competition cannot be achieved, the optimal solution will probably entail some form of "workable" competition through which it may be possible to attain allocative efficiency. This requires enough product heterogeneity inside the market to produce some uncertainty regarding competitor reaction, and the real threat of potential competition, ie the conduct of each participant will be influenced by firms both inside and outside the market.

The theory of contestability suggests that the incumbents may be capable of only deterring small entrants, but that they may not wish to do so if entrants are content to niche-fill and do not provide a serious threat. This suggests that many entrants will simply compose what can be viewed as a "competitive fringe" and that the number of participants need not give a good indication of market structure. It also raises the question of how much entry is "optimal" and whether the opportunities to differentiate products will actually encourage too many entrants for the market to be optimal with regard to social efficiency.

On the basis of these considerations the first hypothesis to be tested can be presented as :

Hypothesis 1 : The government has successfully introduced, through the particular measures it has adopted for this purpose, a socially efficient level of competition.

To test this particular hypothesis consideration will be given to the

presence and height of entry barriers, raised by both the incumbents and through policy itself, the apparent success of these barriers in deterring both large and small scale entrants, the present number of participants within the market and the apparent structure of the market itself.

Any alteration to the structure of the market entails consequences for the behaviour of participants. The Austrian school of thought views competition as a "search" process through which firms seek new knowledge which will enable them to increase profitability in the next period. Given a positive relation between growth and innovation, the competitive process is expected to initially increase market concentration, but only up to some point at which the dominant firms decide there is little need for more effort. This, consequently, raises the question of the identity of the dominant firms. If the incumbent firms remain dominant and all entrants locate in a competitive fringe then there will be little increase in R&D or advertising. If no group emerges immediately as "dominant" then the competitive process will encourage high levels of both R&D and advertising from those firms competing for dominance, and a significant amount of product differentiation from the smaller scale participants relegated to the fringe and intent on the exploitation of market niches. The strategies adopted by foreign entrants will be significantly influenced by their selected method of product production and distribution but, given that their motive is unlikely to be one of simply securing maximum profits in this particular market, non-price competition is expected to prevail over price competition. The increasing returns which characterise this market, and the imperfect market structure, remove the need for minimum costs and marginal cost pricing and suggest that the second hypothesis be presented as :

Hypothesis 2 : the interacting strategies of the competing groups will lead to a prevalence of non-price, as opposed to price, competition.

The third hypothesis, which aims to test the effect of liberalisation on the international competitiveness of domestic firms,

is clearly related to Hypotheses 1 and 2. If market structure does not alter significantly, perhaps due to the entry barriers being sufficently high or the incumbents' competitive reactions being suitably deterring, then the incumbents will retain their dominant position in the market. This reduces the pressure for such firms to continue the "search" process by introducing non-price competitive moves, or to increase efficiency and hence their ability to compete on price. Such conditions in the domestic market are not conducive to good performance in the international markets where both price and non-price competition prevail.

An alternative scenario places the new foreign entrants in the dominant group, and forces the displaced incumbents to compose part of the competitive fringe. In this case the benefits of the search process would be amassed by foreign competitors while the performance of domestic firms would be expected to deteriorate. One of the most significant disadvantages then faced by the incumbents would be the loss of economies of scale as output levels decrease. Costs would necessarily rise making any effort at price competition almost futile, while the lack of innovative success associated with negative growth suggests an increasing disadvantage in non-price competition. The only conditions under which international competitiveness will increase are those which would prevail if both foreign entrants and incumbent firms are equally matched and the competitive process produces increases in both efficiency and the level of beneficial innovation. However, given that two scenarios suggest a decrease in performance by domestic firms, the third hypothesis is best presented as :

Hypothesis 3 : liberalisation in their domestic market is not expected to increase the international competitiveness of the incumbent firms.

By testing the above three hypotheses, it is the intention of this thesis to capture the effects of liberalisation in the CPE market, with regard to market structure, participant conduct and the relative performance of domestic firms. These hypotheses will be tested, via case study analysis, in Chapters 5-7 below. These chapters deal with three distinct sectors of the CPE markets for large PABX (Chapter 5),

small business system equipment (Chapter 6) and telephone handsets (Chapter 7). The differences which prevail in the nature of these products, and in their respective markets, are expected to produce dissimilar results. The particular methodological approach selected for this analysis, ie the selection of "competing groups", the use of a questionnaire-interview procedure for the collection of data, and the adoption of a case study type approach, are discussed in Part A of Chapter 5 below.

CHAPTER FIVE : AN ANALYSIS OF PRODUCT MARKETS AND COMPETING COMPANIES : THE MARKET FOR LARGE PABX

PART (A) : PRODUCT MARKETS AND COMPETING GROUPS

(I) PREFACE

In Chapter 4 above, three hypotheses were constructed on the basis of economic theory relevant to the concept of liberalisation. The following three chapters will test these hypotheses in three individual markets ie those for large PABX, small business systems and telephone handsets. In Chapter 8 the effects of liberalisation are further discussed with regard to the CPE market as a whole.

In section (II) of this particular chapter, the firms participating in the study are categorised on the basis of both commercial background and products manufactured. In Part (B) below, case study results are presented for the large PABX market and, in Chapters 6 and 7, similar case studies are presented for small business products and telephone handsets. All three case study chapters deal exclusively with the markets for "approved" equipment ie products which have been granted appropriate licences by BT, BABT or the Secretary of State.

The primary aim of the questionnaire and interview procedure employed in this research has been to determine the apparent success of liberalisation, with regard to both consumers and manufacturers, almost three years after the policy was first introduced. During the autumn/winter of 1984/5, interviews were completed with 26 firms of various commercial and ownership backgrounds. This sample of firms closely approximated the population at that time, and was constructed with reference to the lists of approved equipment licence holders, initially published by the Dept. of Trade & Industry but later published by Oftel. Some bias may exist, consequently, in so far as the selected participants were either established in the market prior to liberalisation, and subsequently received automatic product approval, or were among the first of the new entrants. Such bias is, however, almost unavoidable in this type of study, and may be of

interest in itself, in so far as it highlights the type of firm attracted to a "liberalised" market, ie one characterised by high levels of risk and uncertainty.

Interviews were conducted with a representative of each participating firm; in most cases this was the managing director himself, but otherwise a suitably qualified sales executive and/or technical advisor was generally able to provide the information requested. Each interview was conducted on the basis of the structured questionnaire detailed in Appendix 5.1. Although some categories of question were clearly of more relevance to particular groups of firms, this method facilitated the collection of substantial amounts of qualitative and quantitative data and gave respondents some freedom to concentrate on the particular aspects of liberalisation which were most relevant to their business.

Collecting data through the use of an interview and questionnaire procedure raises several methodological issues. Some of these, however, can be eliminated as insignificant problems in this particular study. One of these concerns the interview procedure itself. By conducting all the interviews myself, several potential problems were immediately eliminated including :

a) the possibility of the interviewer changing the wording of questions and, consequently, influencing their interpretation, and
b) unfaithful reporting of results.

Some problems are not so easily eliminated and consideration has, therefore, had to be given to the fact that

a) questions may be unintentionally structured in such a way as to be leading, loaded or suggestive,
b) the order in which questions are asked may influence the replies of respondents.

To some extent these problems will always be present but, in an effort to reduce the problems caused, two significant steps were taken in this study. The first was to reintroduce important topics later in the draft questionnaire, so that the first replies could be confirmed or queried as necessary. The second step involved a thorough examination of the questionnaire, and the results obtained, after the first three interviews had been completed. This "pilot" study

highlighted aspects of the questionnaire which required revision, although only minimal alterations were required.

Despite these attempts to remove any bias from the questionnaire and interview procedure, some problems remain outwith the control of the interviewer. Because an interview procedure was employed, the problem of careless replies by respondents can be reduced if the interviewer repeats the question, or rephrases it to clarify its meaning, although it is important not to "lead" the respondent in any way. A problem which is more difficult to overcome, however, is that of unwillingness to answer particular questions. This problem was not a serious one in this study; liberalisation was highly topical when interviews were carried out and most firms were willing to discuss the major issues in depth if some degree of confidentiality was ensured. The need to preserve confidentiality, and the way in which this has been executed in this particular study, are both discussed below.

The final, and greatest problem encountered in a study of this nature concerns the validity of respondents' replies. Because the market is so new, as are many of the issues discussed, it is almost impossible to validate much of the data received. For this reason the conclusions of this study rely heavily upon the truthfulness of respondents. The structure of the questionnaire allowed some tests of consistency in replies but validity cannot be guaranteed - especially when there is so little published information pertaining to the market in question.

In some respects there is an element of bias in this study in so far as respondents asked to give their impressions and opinions were, of course, suppliers. Little attention is given to the specific views of consumers. This is especially noticeable with respect to opinions on BABT and the approvals process. Equipment suppliers are inclined to view BABT as a body which raises excessive barriers to entry. Consumers in the market, on the other hand, might welcome an organisation such as BABT, and approve the rigorous testing of all products prior to their release onto the market.

Given that the competitive market is still relatively new, the data and views expressed by participants are regarded as commercially sensitive. Although willing to divulge the fact that they have

participated in this study, most firms expressed reluctance to be identified, by name, in the subsequent analysis. To retain commercial secrecy, the participants are identified in detail then split into six distinct groups on the basis of ownership patterns and commercial backgrounds. The case studies subsequently analyse the average group behaviour, rather than that of an individual firm but, on the basis of the research undertaken, there is sufficient evidence to suggest that the members of any such grouping have adopted similar market conduct. This finding justifies the employed method of analysis, and suggests that neither the presentation of data, nor the conclusions reached when the hypotheses are tested, are restricted by this particular approach. The conclusion to each market study employs statistical data to test for significant relationships between views/conduct/performance and market presence, and also displays the information on the basis of firm type. The three hypotheses constructed in Chapter 4 are subsequently tested on the basis of the interview material and the statistics presented.

(II) THE SAMPLE OF PARTICIPATING FIRMS

The sample of firms participating in this study can be identified and categorised as follows:

The Large Incumbent Firms

This group of firms consists of the major domestic manufacturers in the pre-liberalisation era, who had been party to the Bulk Supply Agreements outlined in Chapter 2 above :

GEC Telecommunications Ltd became directly involved in telecommunications when it assumed control of the General Electrical Apparatus Company in 1900. By the time the Post Office assumed full control of the network in 1912, GEC had amassed sufficient experience to become one of its established suppliers. In 1967, GEC acquired a competing telecommunications equipment manufacturer, AEI, in a controversial move which was investigated by the Monopolies and Mergers Commission but allowed to proceed. GEC further consolidated its position as one of the world's largest electrical manufacturers, when it merged with English Electric in 1968. This latter move gave GEC full control of Marconi, which is now a significant member of GEC's "Electronic, Automation and Telecommunications" Division, and undertakes telecommunications related work for the Ministry of Defence.

Strategically GEC is renowned for displaying a low growth rate whilst accumulating a cash mountain through consolidation. The organisation is significantly diversified, and covers activities in power engineering, industrial products, cables and wire products, components and consumer electrical products in addition to its telecommunications related work. Telecommunications, however, increased in relative importance as GEC's industrial and consumer product divisions declined throughout the 1970's. GEC presently manufactures and supplies a complete range of subscriber apparatus,

and is a major supplier of exchange equipment. In 1984 GEC's Telecommunications Division employed almost 2760 people and achieved a turnover of £90 million.

Plessey Office Systems is a subsidiary of the Plessey Company, which did not enter the telecommunications market until after the Second World War. A major turning point for this firm occurred in August 1961 when it merged with LM Ericsson and ATE, both of which were established telecommunications companies.

Plessey is less diversified than GEC and appears to have favoured vertical rather than horizontal integration in so far as its subsidiaries supply semiconductors, plastic mouldings, connectors, transformers and optical fibres etc. The major advantage of such a vertically integrated structure, at least with regard to the manufacture of subscriber apparatus, is that of having very little need to "buy in" components. Plessey can source most items in-house, at reduced cost, and can simultaneously facilitate design protection.

Like GEC, Plessey is quite strong in the defence market, and has also been a major participant in the non-BT telecommunications market . Throughout the 1970's Plessey was the leader in the private sales market[1], through Plessey Office Systems and Plessey Communications Sales Ltd, dealing with large business products and smaller consumer items respectively.

Having specialised in electro-mechanical production, Plessey was severely hit by the Post Office's cutback in orders of exchange equipment, in 1976. This event cost the company £7,720,000 net,[2] ie including redundancy payments, surplus stock provisions, disruption costs and property dilapidation. Plessey later rationalised, by disposing of loss-making subsidiaries and rapidly introducing new products, and subsequently increased profits by 140% in 1979/80. In 1984 Plessey's Telecommunications Division employed almost 3500 people and achieved a turnover of almost £150 million.

Standard Telephone and Cable (STC) originally belonged to Western Electric but was bought by ITT in 1924/25. STC grew into a "purer" telecommunications company than either GEC or Plessey, with

approximately 60% of its total sales being telecom related, but was traditionally treated as their junior partner. However, STC's involvement in the development, and subsequent manufacture, of "electronic" exchange equipment partially shielded it from the effects of the Post Office's cutback in electromechanical technology in the mid-1970s, and indirectly transformed STC into an equal partner.

STC consists of 8 divisions, with interlocking interests, the largest of which is STC Telecommunications. This division produces more than 40% of total output and covers switching, transmission, terminal apparatus and defence sales. Subscriber equipment, including telex in which the company is particularly strong, is the responsibility of STC Technology, STC Business Systems and STC Components. STC has never been heavily involved in the non-BT market for subscriber apparatus; the company initially focused on the supply of large PABX, and only became involved in the lower end of the market when contracted to manufacture three styles of decorative handset for the Post Office's "Special Range" in the late 1970's.

During its term of office in the 1970's the Callaghan Labour Government tried, unsuccessfully, to merge STC with Plessey. There had been some suspicion of STC, and its US ownership, but the company overcame the threats and remained relatively independent, although subjected to the rigid financial and planning procedures which ITT imposed on all its subsidiaries. In 1979, ITT decided to sell 15% of STC shares to UK investors and followed this, in the spring and autumn of 1982, with sales of a further 10% and 40% respectively. STC is now relatively free of ITT control and, in 1983/4, it employed 1750 people and achieved a turnover of £100 million.

The Telephone Manufacturing Company (TMC) was incorporated in 1919 but traded only in the private telecommunications market in its first 40 years of operation. In 1960, TMC was bought by Pye of Cambridge and subsequently began a period of rapid expansion, in terms of both its product range and its manufacturing base. However, it was not until 1966 that TMC won its battle to supply the Post Office, and became a member of the Bulk Supply Agreement for subscriber apparatus. Although

it was much smaller than GEC, Plessey or STC, TMC was guaranteed almost an equal share of Post Office orders but, having had little experience in development or innovation, did not participate on an equal basis in R&D. In 1967, Pye was bought by Philips of Holland. This transferred TMC to foreign ownership but also gave the company the opportunity to source the wealth of knowledge gathered, by its new parent, in wordwide telecommunications activities.

After the Bulk Supply Agreements terminated, TMC decided to focus on the market for subscriber apparatus, and to develop a considerable design capacity in which all new product developments would be based on electronic technology. The success of this strategy enabled TMC to increase its share of both the handset and small business system markets, even though it was effectively driven out of the market for exchange equipment by GEC and Plessey. Of the four incumbent firms only TMC merits description as an "undiluted" telecommunications firm and, in 1983/4, this company employed 1500 people and achieved a turnover of £70 million.

Small Exclusive Suppliers to British Telecom

The firms contained within this grouping are of a smaller size than those above and were contracted to the Post Office, after the demise of the Bulk Supply Agreements, to initially manufacture non-CPE items of equipment. These firms were subsequently encouraged to become involved in the manufacture of CPE products when the Post Office/BT decided to increase the number of its suppliers.

Each firm was initially chosen on the basis of its experience in some related area of manufacture, and their present production of subscriber apparatus is expected to stimulate, rather than cause the demise of, such production and its related development. In the case of subscriber apparatus these firms rely on BT for product design and development, the payment of testing and approval fees and the supply of many inputs :

Austin Taylor Electrical Ltd is a family business which was established in 1947, and which entered the telecommunications industry in 1950. This company initially manufactured and supplied line jack units and distribution equipment, and its production of subscriber apparatus did not commence until 1979. In 1984 Austin Taylor employed 360 people and achieved a turnover of almost £8 million.

AP Besson Ltd was established in 1957 and became a subsidiary of Chrystalate Holdings in 1971. This particular firm manufactures telephone inserts, linesman test phones and sound systems, but has recently commenced manufacture of telephone handsets, under licence from British Telecom. In 1983/4 this firm employed 925 people and achieved a turnover of £17 million.

Denis Ferranti Meters Ltd is a family business which was established in 1951 to manufacture electrical meters, but which is now involved in more diverse activities, including defense related work. This firm has been involved in telecommunications since 1969, and the demise of the Telephone "Ring", and presently manufactures handsets designed by British Telecom. In 1983/4 this firm employed 643 people, of which approximately 470 worked in telecommunications, and achieved a turnover of £14 million.

UK Agent Firms

The following two firms do not manufacture telecommunications equipment but act as "agents" for foreign firms who prefer to enter the UK market through import, rather than by establishing production facilities :

Ansafone Ltd was established in 1960, and subsequently became one of the Post Office's four approved distributors of telephone answering machines on a rental basis. However, after liberalisation opened this particular market to competition from cheaper imports, it became apparent that the new products were relatively more attractive to the

consumer than the high quality, high priced products of domestic manufacturers, and the latter companies were forced to diversify. Ansafone presently distributes key-telephone systems which are manufactured by the NEC Corporation of Japan. In 1983/4 Ansafone employed 270 people and achieved a turnover of £60 million.

Shipton Communications Ltd was established in 1930 and became one of the four approved suppliers of telephone answering machines. Like Ansafone, this company suffered as a consequence of liberalisation in its previously protected market, and was forced to rationalise by closing subsidiaries. Shipton decided to concentrate on the supply of other telecommunication products, and to provide technical support, and presently acts as an agent for the German firm "De Te We", which had been seeking an export opportunity at the very time the UK market was liberalised. In 1983/4 Shipton employed approximately 200 people and achieved a turnover of £8 million.

Joint Venture Companies

The following group of three UK owned firms are participating in joint ventures with foreign counterparts. Under such arrangements, a UK subsidiary is formed to deal with all aspects of the development and distribution of products. These products have been designed by the foreign parent in the partnership :

Thorn-Ericsson Telecommunications Ltd was established, in 1973, as a joint venture between the British firm, Thorn EMI, and a Swedish telecommunications multinational, ie Ericsson, with 51% and 49% stakes respectively. Thorn EMI had been involved in the UK telecommunications market since the late 1960's, but this agreement gave it immediate access to a much wider variety of product. This joint venture has established production plants in the UK, but the majority of products produced are of Swedish design and require only assembly type work, as opposed to true manufacture, in the UK. In 1984 Thorn-Ericsson employed 750 people and achieved a turnover of £45 million.

Ferrant-GTE was established, in 1981, as a joint venture between Ferranti plc and the GTE Corporation, ie between a domestic micro-electronics firm and a US owned telecommunications firm of considerable eminence in the world markets. Ferranti own 51% of this venture, which was established to exploit the technical opportunities made available as a direct consequence of liberalisation. The joint venture is run on a strictly 50-50 basis with regard to research and development, manufacturing, sales, maintenance and installation. Sourcing products direct from GTE ensures Ferranti-GTE of an instant, and varied, product range, although the joint venture has the resources necessary for independent product development. In 1983/4 Ferranti-GTE employed 120 people and achieved a turnover of £8 million.

Vanderhoff-AOIP is a joint venture established between Vanderhoff Communications Ltd and the French company, AOIP. Under the terms of this agreement the manufacture of a French designed PABX will be undertaken, in the UK, by Vanderhoff. This firm represents just part of a much larger group which manufactures line test equipment, small exchanges, interface products and multi-channel recording equipment. In 1984 Vanderhoff achieved a turnover of £5.25 million and the joint venture was expected to create 20-30 jobs.

Multinational Companies of Foreign Ownership

The following group of firms includes five multinational companies. Each of these firms has recently chosen to locate in the UK, but not necessarily as a consequence of liberalisation itself :

Comdial Communications Ltd is a subsidiary of the American Comdial Corporation which was established in 1981 to manufacture semi-conductors and telecommunications equipment. The liberalisation of the UK market was only one of several reasons behind this firm's decision to locate a subsidiary in Wales. In 1983/4 this subsidiary employed 98 people and achieved a turnover of £356 thousand.

Harris Communications Ltd is a subsidiary of the Harris Corporation, ie a US multinational involved in many areas of telecommunications and information technology. This company's decision, to locate a subsidiary in the UK, was a direct consequence of liberalisation, and was implemented in 1981. The UK subsidiary is obliged to follow formal planning procedures designed, by the parent company, to give each subsidiary a sense of direction. In 1983/4 Harris employed only 25 people but achieved a turnover of £5 million.

IBM (UK) Ltd is a subsidiary of the IBM Corporation which represents a significant force in both computing and telecommunications. IBM's decision to locate a subsidiary in the UK was made prior to liberalisation and was, in fact, a direct consequence of the breakdown of the Bulk Supply Agreements and the Post Office's subsequent decision to source technically advanced products from foreign firms. One unusual aspect of IBM's business strategy is that it has chosen not to distribute telecommunications products in its home market. IBM's products are manufactured in France and distributed only throughout the European markets, where they are regarded as technically sophisticated. In its domestic market IBM is content to be involved only in transmission. In 1984 IBM employed 70 people in its Telecommunications Division in the UK.

Mitel Communications Ltd[3] is a subsidiary of a Canadian multinational which was founded 14 years ago by two British emigrants. Before liberalisation Mitel decided to establish a subsidiary in the UK, through which it could market products in Europe. The company was suitably encouraged by the Post Office, who viewed Mitel's entry as an opportunity to encourage its traditional suppliers to "shape up". At the time of interview, Mitel's UK subsidiary enjoyed reasonable independence from its parent company, and had been granted total autonomy over all decisions regarding its operations in European markets. In 1983/4 this subsidiary employed 750 people and achieved a turnover of £48 million.

TIE Communications UK Ltd is a subsidiary of a US company, TIE Communications Incorporated, which manufactures and supplies the world's largest selling key-telephone system, and is in the enviable position of controlling almost 50% of the US key telephone market. TIE's decision to locate a subsidiary in the UK was made, in 1981, in response to liberalisation. Although the short term objective is to supply key-telephone systems, PABX type products may be introduced in the longer term. In 1983/4 TIE's UK subsidiary employed 24 people and had achieved a turnover of £5 million.

Small Domestic Companies

The final group of participants in this study includes small domestic firms who were not, generally, involved in telecommunications prior to liberalisation, but who have since been sufficiently attracted by the available opportunities. These firms undertake independent product design and manufacture and distribute products through BT or private retail outlets. They consequently differ, quite considerably, from the "suppliers" who rely exclusively on BT for product design and distribution :

Answercall Ltd is a privately owned firm which was established, in 1979, to supply telephone answering equipment. This firm was suitably encouraged by liberalisation to diversify into the markets for telephone handsets and value added network services. Since 1979 Answercall's turnover has doubled each year, reaching £11m in 1984, and employment has grown at an annual rate of 70% over the same period.

Dellfield Digital was established, in 1982, to manufacture and supply digital PABX. Dellfield does not intend to be restricted to the opportunities available in its domestic market, and is consequently seeking to establish itself on a world-wide scale through success in export markets. Finance for this operation has been sourced from two rounds of equity financing. A significant proportion of Dellfield's

manufacturing is subcontracted, and in 1983/4 Dellfield employed 51 people and achieved a turnover of £1.5 million.

Dialatron Ltd is a privately owned firm, created by a team of people who previously marketed business systems and word processors, for almost 16 years. A related company had attained such a large amount of success in supplying telephone handsets in the liberalised US market, that Dialatron campaigned for liberalisation in the UK and entered the market immediately the policy was introduced. This company has chosen to subcontract its product manufacture to the Far East and, consequently, employed only 15 people in 1984 but achieved a turnover of almost £2.5 million.

Intercom (Nottingham) Ltd is a privately owned firm which was established, in 1966, to manufacture internal telephones and intercom equipment. This firm conntinued in that line of business until 1983, when it became only the second company to be granted approval to supply a key-telephone system. The introduction of key telephone systems has, somewhat ironically, been responsible for the demise of the internal communications market. Key-telephones consequently account for almost 100% of Intercom's present output. In 1984 Intercom employed 86 people and produced a turnover of £3 million.

Sitronix Ltd is a privately owned firm which was established in 1981 to manufacture handsets. Sitronix's decision to enter the market was the result of an apparent need for its intended product, ie a technically good business telephone. This firm's entry into the market was not a direct consequence of liberalisation, but would have been impossible in the absence of such policy. Sitronix's product is geared towards business users, and is sold in minimum order sizes of 100 units. Although manufacture is initially subcontracted within the UK, this company plans to establish manufacturing facilities in France. Approval for Sitronix's product was not granted until April 1984, in which year Sitronix achieved a turnover of only £2000 and employed 20 people. A turnover of £2m was expected in 1985.

Fidelity Radio plc is a consumer electronics firm which was established in 1946. Fidelity moved into the telecommunications market, in 1983, to exploit the opportunities presented by both liberalisation and its own technological expertise. Fidelity not only designed and manufactured the UK's first cordless telephone, but also supplies one-piece handsets and clock-radio telephones. In November 1984 Fidelity was taken over by Caparo Industries which is involved in the supply of metal, steel and machine parts and is, therefore, keen that Fidelity remain relatively autonomous. Fidelity presently manufactures a wide range of consumer electronic goods, including TV, radio and hi-fi equipment, but achieved a telecommunications related turnover of more than £1 million in 1983/4. In that year the company employed 500 people.

Astral Telecom was established, in 1980, with the specific aim of entering the telecommunications industry. Astral was originally a subsidiary of Octavious Hunt, which was subsequently taken over by Charles Hill of Bristol, but in July 1983 its managing director bought the company outright. The managing director has since retained the majority shareholding. Astral is only active in the market for telephone handsets and, although it does not "manufacture" these products, all product assembly work is carried out in the UK. In 1983 Astral employed 10 people and achieved a turnover of £500,000.

Conversation Pieces (UK) Ltd is a privately owned company which was established, in 1974, to sell non-approved, antique style telephones. Although liberalisation has not significantly increased the company's product range, it has altered the firm's customer base. Before liberalisation, the retail of non-BT approved products was legal, but their connection to the public telecommunications network was illegal. Both the sale and attachment of these products are now legal, and the company's customer base has, consequently, increased in size and changed in character.

Conversation Pieces is a parent company with subsidiaries involved in the manufacture, sale and supply of business systems, and in 1983 this company employed 20 people and achieved a turnover of £1 million.

The Excelsior Telephone Company (ETC) is a privately owned firm which was established in its present form in 1983, although it had previously been involved, for 2-3 years, in the import and development of decorative handsets. Liberalisation has opened up new markets to ETC and, although its products were not granted approval until August 1984, ETC achieved a turnover of £500,000 in that year, employing only 5 people.

In the above sample, firms have been classified according to their ownership or to some particular feature of their commercial background. Another method of classification is equally relevant, however, ie that based on the type of product supplied, ie telephone handsets, small business systems, large PABX or some combination of these. Using this classification system the 26 sample members can be grouped as illustrated in the following table :

TABLE 5.1 PRODUCT MARKETS AND PARTICIPATING FIRMS

(I) HANDSETS	(II) SMALL BUSINESS SYSTEMS	(III) LARGE PABX
GEC	GEC	GEC
PLESSEY	PLESSEY	PLESSEY
STC	STC	STC
TMC	TMC	-
AUSTIN TAYLOR	-	-
AP BESSON	-	-
D FERRANTI	-	-
-	ANSAFONE	-
-	SHIPTON	-
FERRANTI-GTE	FERRANTI-GTE	FERRANTI-GTE
THORN-ERICSSON	THORN-ERICSSON	THORN-ERICSSON
-	VANDERHOFF-AOIP	-
COMDIAL	-	-
-	-	HARRIS
-	-	IBM
-	MITEL	MITEL
-	TIE	-
ANSWERCALL	-	-
-	DELLFIELD	-
DIALATRON	-	-
-	INTERCOM	-
SITRONIX	-	-
FIDELITY	-	-
ASTRAL	-	-
CONVERSATION PIECES	-	-
ETC	-	-

Column (I) lists the sample members who have chosen to participate in the handset market and includes all four incumbent firms, all three suppliers, two joint ventures, one multinational and seven small domestic firms. Neither of the agent firms have been attracted to this market, and the one participating multinational was still awaiting product approval, at the time of interview; and intended to move, eventually, into the market for larger sized products.

Column (II) lists the sample members participating in the market for small business equipment and includes all four incumbent firms, both agent firms, all three joint ventures, two multinationals and two small domestic companies. The suppliers and the majority of small domestic firms have chosen to remain outside this market.

Column (III) lists the participants in the market for large PABX and includes three of the four incumbents, two joint ventures and three multinationals. The suppliers, agents and domestic firms generally consider this market to be unattractive.

One interesting feature of Table 5.1 is that it illustrates the extent to which firms from the various ownership groupings have been attracted to the same product markets. These findings suggest a link between firm type and market location which becomes more apparent in the following table. Each firm has seven possible locational options :

A : to participate in all three product markets

B : to participate in the large and small PABX/key-telephone markets

C : to participate in the small PABX/key-telephone and handset markets

D : to participate in the large PABX/key-telephone and handset markets

E : to participate only in the large PABX market

F : to participate only in the small PABX market

G : to participate only in the handset market

Category	A	B	C	D	E	F	G	Total
Incumbents	3	1	0	0	0	0	0	4
Suppliers	0	0	0	0	0	0	3	3
Agents	0	0	0	0	0	2	0	2
Joint Ventures	2	0	0	0	0	1	0	3
Multinationals	0	1	0	0	3	0	1	5
Small Domestic Firms	0	0	0	0	0	2	7	9
Total	5	2	0	0	3	5	11	26

Two columns, C and D, record only zeros, which verifies that participants in the handset market have either elected to locate in that market alone, or else in all three product markets. The large number of categories in the above table, ie 42, and the relatively small sample size of only 26, renders conventional statistical tests invalid, but the presentation of data in the above form is sufficient to highlight the strong relationship between firm type and market presence, namely :

a) the three UK owned incumbents, ie GEC, Plessey and STC, participate in all three product markets[4];
b) all three "suppliers" participate only in the market for telephone handsets;
c) both agent firms are participating only in the market for small business equipment;
d) all three joint ventures are present in the small systems market, and two of these also offer both telephone handsets and large PABX;
e) four out of five multinationals have located in the market for business products, while the fifth intends to become active in this sector in the near future;
f) seven of the nine small domestic firms are participating only in the handset market, and the remaining two firms are competing in the market for small business products; no small domestic company has chosen to participate in the market for large PABX.

Having established the identity of the firms attracted to each of the three product markets, which will be analysed in the following case study material, some preliminary comments can be made regarding the expected implications of the above results ie :

a) the market for telephone handsets appears to be the most competitive with regard to the number of firms participating. Not only are the incumbents remaining active in this market, but the majority of small domestic firms are also apparently attracted by the large volume size of the market, the low development costs involved and the existence of several market niches which offer significant opportunities to a small firm. Foreign competition is

minimal in this market;

b) the market for small business equipment has not attracted as many firms as the handset market, being smaller in volume terms, but in value terms this is likely to be the most profitable sector and is, consequently, attracting many foreign entrants. Competition is expected to be tough in this market, given that it effectively represents one more location in which these international competitors can fight for dominance;

c) all competitors in the large PABX market are multinationals of UK or North American ownership, and competition is likely to be extremely fierce even with few competitors. The small customer base, and high sales value, should ensure that each participant is keen to secure each potential customer.

The following section of this chapter employs a case study approach to examine the economic effects of liberalisation in the market for large PABX products, and will be followed, in Chapters 6 and 7, by similar case studies on the markets for small business systems and telephone handsets. In each chapter an attempt is made to establish the distinguishing characteristics of the market before and after liberalisation, and the true nature of competition with regard to :

a) the conditions of production - including new technology, R&D and investment;

b) the effect of the present product testing and approval procedure, and

c) methods of product distribution and the apparent effectiveness of both price and non-price competition.

This information is presented with a view to testing the three major hypotheses of this thesis, outlined in Chapter 4 above, with regard, initially, to each of these three product sectors in isolation. Ultimately, in Chapter 8, the results will be summarised and the impact of liberalisation will be discussed for the more general case of the telecommunications equipment market as a whole.

PART (B) : THE MARKET FOR LARGE PABX

(I) PREFACE

A Private Automatic Branch Exchange (PABX) is an exchange, situated on the user's own premises, which facilitates the connection of each telephone extension to both external subscribers, through the public network, and other internal extensions. A PABX is central to any development of the "integrated office" and has been significantly affected by the technological convergence of computing, telecommunications and office automation. Since the mid-1970s electro-mechanical PABX have been gradually replaced by electronic products, which incorporate stored programme control, and there has been an increasing prevalence of digital technology. In 1980, 85% of the installed base of large PABX employed electro-mechanical technology, 12% employed electronic and 3% employed digital[5].

Before liberalisation BT had not exercised its monopoly power in the large PABX market, but had licenced seven manufacturers to supply products direct to the consumer. This situation cannot be described as truly competitive, in that BT restricted the number of licences issued and retained the sole right to maintain these products, but it was undeniably more competitive than the markets monopolised by BT, ie those for small business systems and telephone handsets.

The size and capability of a large PABX product, incorporating more than 120 lines, is only relevant to a limited number of business users, and the number of potential consumers is, consequently, limited. Competition for each available contract, often worth several million pounds, has been further heightened by BT's decision to enter the market as a competitor. However, one far-reaching effect of liberalisation has been BT's loss of monopoly over the installation and maintenance of any digital PABX equipment installed after the policy became fully effective. Although BT has retained its monopoly over the maintenance of all installed PABXs, and any subsequent analogue equipment to be installed, its loss of control over new

digital products presents manufacturers and independent contractors with an opportunity to offer local, regional and even nationwide installation and maintenance services. All products introduced into the large PABX market must be guaranteed for one year, but subsequent maintenance can be provided from any site registered by an approved maintainer.

Prior to liberalisation the large PABX market, with an installed base of more than 5000 systems and an annual volume of approximately 202,000 extension lines, was worth almost £50 million in manufacturers prices.[6] More than 88,000 extension lines were shipped in the sector supplying products of more than 500 lines. With market prices of £500-550 per extension, this particular sector was the most profitable, but the sector dealing with 200-300 extension line products, in which a much higher volume of sales is achieved, provided a higher level of revenue.

(II) IDENTIFICATION OF THE COMPETITORS

British Telecom

Before liberalisation BT had investigated the needs of each customer and relayed this information to its licenced suppliers, but its subsequent decision to compete in the liberalised market, and its goal of securing a 70% market share, suggested significant changes in competitive conditions. Although BT's goal of a 70% market share may not be achievable in its initial years of participation in this market, it is not unrealistic in the long run considering that :

a) BT has a history as a monopoly supplier of equipment and consequently controls a large market base for smaller sized products, ie those incorporating less than 120 lines, which has given it relevant market experience;
b) BT commenced the liberalised era as the sole maintainer of all PABX, except digitial exchanges installed after 1983, and is, consequently, capable of offering a complete package to consumers;
c) BT operates the primary national network and can, therefore, offer consumers an integrated nationwide service which is unlikely to be challenged by other competitors, and
d) consumers are aware of the extent of BT's monopoly power and may fear the consequences of rejecting its contract tenders.

The incumbent equipment suppliers in this market have viewed BT's entry with considerable trepidation, even though BT has appeared keen to distribute selected products manufactured by some of its effective competitors.

Other Competitors

The firms presently competing through, and with, BT in the large PABX market can be identified through the groupings established in Part A, section (II) above as (i) incumbents, (ii) joint ventures and

(iii) multinationals:

(i) The three participating incumbent firms were given two years in which to adjust to liberalisation and BT's subsequent entry into this particular market, but view the sale of products through BT as attractive, in so far as BT undertakes the cost of selling and relieves the manufacturer of considerable expenditure. However, the emergence of BT as a simultaneous competitor and customer has entailed several significant costs, as far as the incumbents are concerned, not least being the threat of bankruptcy if they should fall out of favour with BT.

The opportunities facing the incumbent firms, as a result of liberalisation, will be limited until some degree of reciprocity is introduced in world markets as a whole, but particularly in Europe. The goals presently pursued by the incumbent firms are those of growth with an acceptable level of profitability, and a real rate of return on capital expenditure of 6-7% in the case of new investment; this return is deemed necessary, by the incumbents, simply for survival.

ii) The two joint venture firms in this market were established to exploit the opportunities presented by both liberalisation and the advance of micro-electronic technology. As far as the joint venture companies are concerned, liberalisation offers considerable opportunities in that it not only permits entry into a previously blockaded market, but has subsequently increased demand at a faster rate than would be expected purely on the basis of new technology. The main impedence facing the joint venture companies is one of adapting foreign designed products to British technical standards, and subsequently obtaining product approval. The primary goals of these firms have been to penetrate the UK market, to control 15% of that market, to secure an acceptable level of profits and to achieve at least a 25% gross rate of return on capital expenditure.

(iii) Several multinational companies have welcomed the major opportunity offered by liberalisation, ie a substantial increase in their customer base. These firms have generally decided to locate in

the UK regardless of government incentives, but the availability of such grants, and R&D subsidies etc, has significantly influenced their choice of location within the UK itself.

The goals of multinational companies are commonly constructed on a global basis, but specific medium term targets have been introduced for the UK market, eg to become a "significant" participant and to secure 30-40% of the market. One long term goal of the multinationals locating in the UK concerns the establishment of close ties with suppliers of office automation equipment. These particular multinational companies intend to participate not only in the UK telecommunications market, but also in the much wider market for information technology.

Having established the identity of the firms participating in the market for large PABX, and the opportunities which apparently face these firms, consideration will be given, in section (III) below, to several aspects of market behaviour, and the particular strategies adopted by these firms with regard to :

a) Conditions of Production, Investment, R&D etc;
b) Product testing and Approval, and
c) Retail Distribution, Price and Non-Price Competition.

The behaviour of BT will be discussed only in general terms and not under these specific headings because BT's role, in each of the three markets studied, is that of a distributor of a variety of products. The aim of this thesis is to analyse the impact of liberalisation on the manufacture of CPE products and BT is, consequently, of relevance only in so far as it provides a route by which the products of the other participants can reach the market. One of the major implications of liberalisation is that manufacturers can now supply products in competition with BT, and the nature of this competition will be analysed in both the discussion of market conduct, in section (III), and the statistical evaluation presented in section (IV).

(III) THE MARKET STRATEGIES OF COMPETING GROUPS

(a) Conditions of Production, Investment, R&D etc.

Incumbent Firms

Prior to liberalisation the incumbent manufacturers had found the UK market too small to justify the high level of expenditure necessary for independent product development. These firms had consequently worked jointly with each other, and with the Post Office, who had generally acted as chief co-ordinator. Liberalisation has not alleviated the problem of small market size but it has effectively destroyed the possibility of further joint development work because firms are now competing with their previous partners, for sales to BT and sales direct to end-users. The incumbents have consequently found the cost of product development so prohibitive that they have decided to take out licences on products designed abroad, and now spend an average of £2m on anglicisation, compared to the £20m regarded as necessary for independent development. Even with this strategy, however, the incumbents have still had to increase their R&D expenditure, on PABX, by almost 50% since liberalisation.

The incumbents believe that an average product lifespan of 17 years is adequate for large PABX, but face some conflict between the pressure for greater product reliability, in the face of high repair and maintenance costs, and the equally strong pressure for shorter life cycles and the demand for "fashionable" products. These firms estimate that a 4-5 year perspective is required for a manufacturer to simply regain the engineering costs involved in product development, and that the sales volume achieved over that period must reach approximately 100,000 lines in total. With this in mind, the incumbents have adopted a strategy of altering the technology behind products after approximately 15 years, but several cosmetic changes will be made, and new product features introduced, during that period.

The timing of new technology is of considerable importance, and the incumbents admit that, for example, the digital products they have introduced already, will not offer significant benefits until digital links are provided throughout the national telecommunications network.

The incumbents exhibit a significant degree of integration into other areas of telecommunications and related aspects of electronics and engineering; this integration facilitates the inhouse supply of semi-conductors, printed circuit boards and transducers which are employed in the manufacture of large PABX. However, these firms have found that the bought-in proportion of their inputs has increased as a consequence of digital technology, and the corresponding disappearance of their own inhouse electro-mechanical capability. The incumbents have also found it invariably cheaper to source inputs required for the manufacture of mature products externally, and to place orders designed to achieve some of the potential economies of bulk-buying. In 1984/5 an average 15% of the value of the incumbents' large PABX products was bought from external suppliers, and a further 15% from subsidiaries. In most cases a second source of supply is required and this is generally chosen purely on the basis of the lowest price.

Liberalisation appears to have encouraged dramatic cost reductions within the incumbent firms, and these are expected to continue for some time, even though the cost of software is unlikely to fall; the development of software is labour intensive and wages are expected to rise. The incumbents consequently believe that the West can only compete with the Far East by increasing automation, and have invested heavily in test equipment, software and robotic lines, flow solder equipment and computer aided design and manufacture. In 1984 one incumbent firm invested over £3.5m on test and automatic insertion equipment, including £400,000 on an LSI semi-conductor tester, £300,000 on a printed circuit board tester, £300,000 on a Sentry II LSI tester, £300,000 on an in-circuit component tester and £2.5m on a mainframe and computer aided design system. The incumbents anticipate further investment in plant to achieve the minimum possible labour content.

Investment undertaken by the incumbents is generally directed towards the multiple goals of improving product quality, increasing

productivity and achieving lower unit costs. As productivity increases and employment levels fall, the incumbents are becoming more development and software intensive, and are aiming to achieve both a significant degree of standardisation in production and further computerisation of product manufacture. Introducing the new technology involved has, however, been subject to delays caused by a nationwide shortage of suitably qualified engineers and skilled labour.

The incumbents generate most of their investment finance internally, although some support is offered by the Department of Trade & Industry who, for example, granted one incumbent firm almost £3m in 1984. This support helps to alleviate some of the problems of establishing project priority, but the incumbents believe the Government should do more by introducing a "strategy for high technology" and offering more support to domestic firms. The expected payback period on funds invested by the incumbents generally depends on the level of investment undertaken, but investment relating to PABX in particular is usually returned within 2.5 years.

Joint Ventures

The two joint ventures in the large PABX market had no need to develop products for the UK, because these could be sourced from their foreign parent companies. The joint venture is only required to undertake some software development and enhancement work. However, at least 6% of the turnover achieved by the joint ventures in the UK market is spent on R&D, and more than 70% of this expenditure is directed towards ensuring that products comply with UK regulations and standards. Some R&D work is subcontracted within the UK.

The joint ventures recognise infrequent product renewal as one of the major characteristics of the large PABX market, but face conflict between achieving the long product life demanded by consumers, or designing products for short term replacement, given the present state of product innovation. Product life has already been reduced from 20 to 7 years and is expected to eventually drop to 5 years.

The joint ventures exhibit a considerable degree of integration in

the supply of integrated circuits and software, electronics, information technology and cable production. However, integrated circuits produced inhouse tend to be sourced from the domestic parent and are, consequently, less strongly orientated towards the needs of the telecommunications market than those produced by the incumbent firms. Given that the foreign parent companies generally co-ordinate other component supplies on an international basis, there is a strong possibility that inadequate consideration will be given to the specific needs of the UK ventures, even though the parent companies have been sufficiently encouraged to increase their internal component production.

The joint ventures believe that they have benefitted from some "learning" effects over their relatively short period of operation in the UK market, but are still a long way from achieving independent production. At least 50% of the output of the joint ventures was sourced from their foreign parents in 1984, and some work was also subcontracted to local firms, even though this appears relatively expensive if the contracts involved are small. One condition which the joint ventures place upon chosen subcontractors is that their specific needs be given priority but, although this may ensure a fast and reliable service, low prices are unlikely to follow. The joint ventures are, therefore, considering bulk supply arrangements for all suitable inputs such as microprocessors and memories.

The joint ventures had to invest heavily to enter the liberalised PABX market; one such firm invested over £2.5m in a suitable factory and more than £700,000 on automatic test gear, automatic insertion equipment, printed circuit board design, flow soldering and software. These firms expect equally heavy investment in such equipment to be required every 2-3 years, in this particular market, and are considering the additional purchase of relatively expensive test equipment, in an attempt to join the Manufacturers' Dedicated Test Laboratory scheme (MDT) which enables firms to test products independently, although the results must be approved by BABT. These firms generally operate a formal process of capital appraisal, and employ a 25% target rate of return on capital expenditure. This implies a payback period of four years, although the nature of test

equipment etc prevents it from being appraised independently.

Although the pressures of competition, and the desire to reduce costs, have obliged the incumbent firms to reduce employment levels since liberalisation, as far as the joint ventures are concerned, liberalisation has created jobs, both directly within their own factories and indirectly through work subcontracted to local firms. Like the incumbents, however, the joint ventures have experienced a shortage of engineers suitably trained in both telephony and the use of contemporary software. Some problems of insufficent manpower have also been experienced in sales and marketing, and these have led to higher costs, even though employees with such skills appear relatively mobile between markets.

Multinationals

The high cost of developing a new PABX, estimated by the multinationals to be around $120m, has encouraged these firms to enter the UK market with products developed and patented elsewhere. The multinationals have, consequently, incurred only limited R&D expenditure in the UK. In 1984 such expenditure amounted to £4m in the case of one firm, and was directed almost exclusively towards ensuring its products reached the established UK standards. Even in future product design, the requirements of the UK consumer will be considered only in so far as the UK subsidiaries can justify these and make adequate representation to their respective parent companies.

The future orientation of products offered by the multinationals will be towards the integration of computing and telecommunications, with possible expansion into office automation and the development of the interface between PABX products and telecommunications networks. One concern voiced by the multinationals, however, is that gross profits of 60-70% are necessary if product development costs are to be successfully financed and there is doubt as to whether firms can finance such high levels of investment from the relatively low level of profits being achieved at present.

A second problem facing multinationals concerns the life cycle of

large PABX products, which is expected to fall to 5 years later in the 1980s. The recent fall in the average life cycle, to the present level of 7.5 years, suggests market saturation within 8 years and it is, therefore, extremely important that firms continually enhance products by introducing new software etc. Given that it is simultaneously desirable to design products with almost infinite lifespans to satisfy consumer requirements, the multinationals have compromised by designing products to operate for at least 20 years between total system failure, and hope to achieve an attractive level of profits from maintenance contracts.

The multinational firms manufacture standard components within their own organisations but generally use Intel as a second source. These companies believe that they are about 60% of the way along the learning curve, having gained knowledge of the UK market and how to survive within it. This has resulted in some cost reduction, which has been further augmented by a significant decrease in the price of integrated circuits. These cost reductions are of considerable importance, because hardware accounts for 30-40% of the total product price and software accounts for 60-70%. One multinational estimates that materials account for almost 70% of its total manufacturing cost, that 30% of its product's selling price is accounted for by the purchase of raw materials, and that 30% of these raw materials are semi-conductor chips which are produced inhouse.

The multinationals make some regional purchases of components and other raw materials in an attempt to be "good citizens", or if required to do so by offical bodies such as BT, who frequently demands this from its suppliers. Having attempted to source some inputs locally, the multinationals are extremely critical of the "substructure" of the UK telecommunications industry and estimate that the electronics industry may face a £2,000m drag in its balance of trade as a consequence of an inadequate supply of components. One multinational, in particular, argues that the CPE products available in the liberalised market represent only the 10% tip of an iceberg, of which the remaining 90%, ie the manufacture and supply of inputs, has been given very little attention even though it is of equal, if not greater significance.

The multinationals necessarily undertook considerable investment, on entering the UK market, to achieve :

a) a suitable level of capacity;
b) an acceptable level of productivity;
c) the capture of a significant share of the market, and
d) the manufacture of products which are either suitably attractive to BT as a buyer, or can otherwise compete successfully with BT's own range in the liberalised market.

Investment in a suitable factory cost one multinational £20m and was financed by its parent company, the EEC and a local development agency. This same company estimates that it had to invest a further £2.5m in automatic insertion equipment, flow wave solder, automatic printed circuit board production and testing systems before it could enter the PABX market, and investment into computer aided design and manufacture is also anticipated. The multinationals adopt a fixed term evaluation of investment capital and expect relatively short payback periods, of only one year, in the case of their UK subsidiaries.

Although the multinationals are aiming to minimise costs, they do admit that this goal could be thwarted by a lack of suitably skilled marketing and engineering staff. Staff must have some degree of telephony experience and the multinationals consequently accept that they must formally train both engineers and marketing staff, possibly sending employees to parent companies for specific courses or work experience. Most of the multinationals have retained the option of manufacturing abroad if staff problems become particularly acute in the UK.

(b) **Product Testing and Approval**

Incumbent Firms

One of the incumbent firms estimates that, in 1984, it spent more than £1m preparing a large PABX for the liberalised market; one quarter of this expenditure went to BABT while three quarters financed the development of product prototypes etc. The incumbents believe that the testing and approval procedure is operating as well as people involved in the industry had expected, but are aware of the general concern over time delays. The incumbents benefit from present conditions, in which product approval can take up to 2.5 years, because this delays competition in the market. However, these firms also recognise the need for faster approval of their own products, and consequently participate in the MDT scheme.

The incumbents have had to invest several million pounds installing the test equipment necessary for participation in the MDT scheme and, in 1984, one of these firms spent more than £0.5m testing a selection of products which included just one large PABX. Although such costs appear to be large, they are similar to those recorded by BABT; when products were submitted to BABT, the incumbents had to pay an average £50,000 deposit, an average basic approval cost of £100-140,000, and approximately £7,000 per month for subsequent product enhancements.

The incumbents believe the greatest advantage of the MDT scheme is one of speed. Participation in this scheme bestows a significant competitive advantage in so far as it enables firms to retail products, and commence the payback of development and overhead costs, prior to competitors entering the market.

Joint Ventures

The joint ventures were represented on the committees formed to establish suitable product standards for the liberalised market, but still find these to be too rigid. These firms consider that BT's

requirements, as a buyer, have been built into product specifications, and that too much importance is consequently placed upon product performance. The joint ventures believe it is only product safety which should be tested.

Extremely detailed product specifications have led to approval costs which the joint ventures consider to be too high, and to testing procedures which take an unacceptable length of time. Before liberalisation, BT charged one such firm £3,000 for the approval of a PABX which took one day to test, but BABT recently charged the same firm £200,000, and took 6 months, to provide a similar service.

The joint ventures resent the necessary cost of providing continual back-up engineering during the product testing period, and the fact that each firm must pay the estimated approval cost prior to testing, to indicate commitment to the product. The joint ventures find these requirements difficult to meet and, consequently, consider it almost impossible for small firms to enter the market without the benefit of steady revenue from the sale of other products. The joint ventures are interested in joining the MDT scheme, but must first weigh up the cost of buying, installing, gaining approval for, and operating, the necessary test equipment, against BABT's charges of almost £600 per day for laboratory testing and the effective cost of the time lags involved in this latter option.

Multinationals

The multinationals object strongly to the stringent product standards which prevail in the UK and which do not, in their view, guarantee good products. In conjunction with high approval costs, these standards are judged to simply create a sizeable entry barrier. The multinationals believe product specifications are far too tight, because product functionality is tested rather than product response to the network. These firms would prefer the market to decide all product features except safety. A case can admittedly be made for examining the potential use and benefits of imported products, but the multinationals believe that the present system simply stultifies

innovation, because products cannot be tested until adequate specifications have been written.

One multinational recently paid BABT a £50,000 deposit, prior to the testing of its large PABX, followed by £250,000 for the approval itself and a further £80,000 for the approval of enhancements. Product peripherals cost £2-3,000 per approval and must be tested for use with each model of PABX in turn. This cost is judged to be at least five times greater than that previously charged by BT, in real terms, and the multinationals consider the time taken to be too long; especially since the final testing and approval charge depends on the length of time each product spends with BABT, and not on the tasks completed. Only the very large competitors in this market can afford to pay the necessary costs and to wait the necessary length of time for product approval, and the multinationals consequently argue for a programme of self-certification similar to that adopted in the US.

(c) Retail Distribution, Price and Non-Price Competition

Incumbent Firms

The incumbent firms find that distributing large PABXs requires considerable planning. BT presently provides the primary and most attractive outlet to the market, but its approach to product selection has altered unfavourably since liberalisation. Whereas BT used to specify products and guarantee selected manufacturers a specific market share, its present approach is one of "cherry picking" from the many products developed, independently, by both domestic and foreign firms. The incumbents must now tender product prices to BT, in the hope of negotiating PABX contracts for several thousand lines, and face the dilemma of either reducing price, to win a significant share of BT's attractive business or refusing to discriminate against their own alternative sources of distribution, ie retail outlets and salesmen.

Apart from sales made privately, or through BT, the incumbent firms export some large PABX, although both the volume and value of such sales have decreased in recent years. This is judged, by the incumbents, to be a consequence of inappropriate product decisions made, in the past, by the incumbents themselves or by BT, who was frequently responsible for product specification. The incumbents do not believe that liberalisation has encouraged exports, as yet, but expect the situation to improve if the increased level of competition encourages an increase in productivity, the achievement of lower costs and the development of more attractive products.

The product price displayed in the market is rarely determined by the incumbent firms themselves; distributors raise prices to include a suitable mark-up, and suppliers to BT have virtually no influence over the final product price. The incumbents admit, however, that their product prices are related to what the market will bear, rather than production costs, although any cost falls achieved will be taken into consideration. These firms argue that if the market trend is one of falling prices, as in the case of the large PABX market, then any one

firm lowering its product price, for cost reasons, is unlikely to achieve a significant increase in its sales volume.

Competition in the large PABX market has eroded the market price, and the incumbents believe that manufacturers must rely on new technology to give them a compensatory margin. Consumers are either obtaining the same products as before, at reduced prices, or are paying similar prices for products which now incorporate an increased number of features. The incumbents estimate that prices in this market are presently falling at the rate of 10% p/a, but that the employment of features is simultaneously increasing by 20%.

The incumbent firms accept that the lowest price in the market will generally be that of the newest entrant, and that established firms must, therefore, ensure that their product prices do not fall too far out of line. These firms would never set product prices at deliberately low levels, and refuse to follow price movements slavishly, although they must be followed to some extent. If products are of sufficiently high quality, the incumbents believe that prices can remain 20-25% out of line with the market average, without the firm suffering a significant loss in market share.

The incumbents view particular aspects of non-price competition as important in the large PABX market, and believe that firms compete almost entirely on non-price factors if their product price lies within an acceptable range of the market average. The design of a large PABX is not considered important, but considerable emphasis is placed on the facilities and services which such products offer. The importance of product differentiation has increased as manufacturers strive to make their particular product unique. In an analogous situation to introducing add-on products/features in the motor industry, increasing the number of facilities offered by a PABX can keep prices high. Products offered by the incumbent firms presently offer an average of 80 features, even though these firms admit that consumers only make intensive use of the five or six offered by the majority of products in the market.

Liberalisation has forcibly removed the incumbents from the situation in which they simply responded to BT's needs, and made them relatively more aware of the consumer. Market research is now

considered to be necessary, and the incumbents have established "consumer groups" to relay user requirements to the manufacturers. One general requirement of consumers is the provision of suitable maintenance and after sales services and, with respect to this, the incumbents appear to have a distinct advantage through the distribution, maintenance and service networks which they operated prior to liberalisation. The incumbents believe that consumers judge a good service to be more important than price, and consequently provide "remote diagnostics" facilities[7], benefitting from the fact that trade union resistance prevented BT from offering an equivalent service. All PABX supplied by the incumbents have a guaranteed maintenance facility for up to ten years after product availability has ceased.

Advertising is an important feature of any competitive market, but the incumbents' promotional expenditure has not increased, significantly, since liberalisation. A large share of promotion by these firms is undertaken at the corporate level, to secure a high profile for the company's trade name, and specific product promotion is undertaken primarily by the subsidiaries who distribute products.

The incumbents have found it necessary to increase their sales and marketing forces almost 5-fold since liberalisation, and promotional expenditure accounts for an average 5% of the product selling price, although advertising expenditure is considerably lower. The incumbents deliberately refrain from "Daz-type" advertising, and prefer promotion through trade exhibitions, trade journals, direct mail and specific showroom promotions. For simple cost reasons, the incumbents have rejected the use of media advertising, ie charges of approximately £0.25m for a television campaign, are deemed prohibitive.

Joint Ventures

The joint ventures sell products through direct sales forces rather than established retail outlets. Sales forces must quickly accept change and be ever capable of understanding, and explaining, what products can offer consumers; for this reason, the joint ventures employ a high proportion of graduates.

The joint ventures do not distribute large PABX through BT, and believe there are advantages to be gained from independent distribution ie :

a) consumers can deal directly with the manufacturers and need not go through intermediaries;
b) BT's procurement organisation has the ability to demand products at unacceptably low prices;
c) independent distribution enables firms to switch quickly to the supply of new products, and
d) some disatisfied customers of BT may be attracted to independent suppliers. This, however, requires that firms offer complete product packages, including installation and maintenance services which are similar to those offered by BT.

In addition to rejecting product supply through BT, the joint ventures differ from the incumbent firms by not choosing to export. The function of the joint ventures is to promote foreign products in the UK market, and export strategies are consequently redundant; product sales abroad are made by foreign parent companies, subsidiaries or other joint ventures.

The joint ventures believe that prices were unnecessarily high prior to liberalisation, but that consumers are now aware of prices prevailing elsewhere, and are unwilling to pay relatively more. These firms judge that prices in the UK market as a whole have fallen 35% in nominal terms, ie 50% in real terms, since liberalisation although those of large PABX have been relatively more stable. For this reason, the large PABX market has remained attractive to new entrants such as the joint ventures, even though gross profit margins of 30-35% must be achieved for survival.

Prior to liberalisation the joint ventures priced large PABX at approximately £500 per line, but this has subsequently fallen to £325 per line, and products offer an increased number of functions. The joint ventures sell products direct to consumers at negotiated prices ranging from £50,000-£2m and established generally on the basis of what the market will bear. The products offered by the joint venture companies are not the cheapest in the market, and emphasis is placed

on quality rather than price.

The joint ventures do not operate as loss-leaders, have never been prepared to "buy" their way into the market, and would not be prepared to accept smaller profit margins than are presently achieved. If products are selling badly the joint ventures prefer to stimulate demand through non-price competitive strategies, including new selling approaches, rather than by lowering price. The latter option would only be acceptable as a last resort.

These companies do not view some aspects of product differentiation, such as style, as relatively important, and would rather be recognised by the quality, feel and robustness of their products than by the specific features they display. Features are not judged to provide a good basis for the sale of large PABX, because most products offer similar features. The joint ventures consequently believe that a conscious effort should be made to emphasise the management and operation of systems being promoted. Total selling costs presently account for an average 12% of the turnover of these firms, and are expected to remain at this level for some time.

The joint ventures recognise the importance of non-price competition in a market where the consumer is concerned with quality, and the provision of maintenance facilities, in addition to price. However, restrictions imposed upon the private installation and maintenance of analogue PABXs have limited the ability of the joint ventures to offer consumers suitable packages for large PABX, even though they offer maintenance services on other products such as key-telephone systems. After such restrictions have been abolished, the joint ventures intend to fully utilise their established national maintenance networks, and expect to subsequently achieve a favoured position in the market.

These companies believe that each firm, competing in the large PABX market, is striving to build long term relationships with consumers who are segregated into various user categories such as hospitals, factories and hotels etc. Each manufacturer must show some market awareness and, although their initial entry into one particular market segment may have been accidental, valuable experience can be amassed if the firm then attempts to understand the consumer and to react to

his needs. Sales departments are designed to monitor the requirements of selected user groups, and growing demand for particular features or services will be satisfied as soon as possible.

The joint ventures view advertising and product promotion as features of the "free" market and, consequently, believe they are almost obliged to advertise. The basic image which these firms hope to promote is one of product quality and consistency, although specific product features may be promoted in particular cases. One of the joint venture companies formulates a detailed promotional plan and assigns a specific proportion of sales revenue to advertising, presently 2%. This firm has spent more than ₤1/2m since liberalisation. Adverts are most frequently placed in trade journals, magazines and in newspapers, although the method of promotion generally depends upon the product in question.

One specific problem facing the joint ventures is that although the name of their domestic parents may be known to consumers, the name of their foreign parents are generally unknown. As a result, these firms must undertake a significant level of corporate advertising. Given that large PABX require relatively little promotion in comparison with other products, generally being sold to well-informed telecommunications managers, the aim of product promotion undertaken by the joint ventures is to outline the technical advantages of particular products. On average, these firms spent just over ₤0.5m, on such advertising, during the first twelve months after liberalisation.

Multinationals

Unlike the joint ventures, the multinationals have no objection to distributing products through BT, and are especially keen to do so. BT buys a significant share of one multinational's output and is offered discounts on purchases over ₤25m. However, although distributing products through BT is the preferred option of the multinationals, they recognise two major disadvantages ie :

a) one marketing lever has been effectively lost to a third party, and
b) products will be recognised by consumers as belonging to "BT's"

range and will rarely be credited to the manufacturer himself.

In addition to product distribution through BT, the multinationals have established sales forces to sell direct to consumers but have generally rejected the idea of establishing independent retail outlets. Contrary to the decisions of the joint ventures, the multinationals intend to export products, and to employ UK subsidiaries as suitable bases from which to reach markets in Europe, the Middle East and Africa; there may even be opportunities to export back to the parents companies' domestic markets.

Before liberalisation, the multinationals sold large PABX at 3-4 times the average market price, but have since seen prices fall from £50,000 plus £250 per extension, to £40,000 plus £230 per extension. A significant proportion of this decrease is attributed, not to competition, but to falling component prices and the ability to "write off" a significant proportion of initial R&D costs. One multinational believes that price competition prevails in the UK market, to such an extent that manufacturers selling products at prices which are 5% above their lowest competitor must have a good explanation, in terms of the features incorporated etc, and considers it almost impossible to sell products at prices which are 10% above the market minimum. Consumers in the large PABX market are presently demanding products which exhibit all possible features, but which are supplied at relatively low prices.

The multinationals believe that product quality is undeniably important, but that it is price which actually sells a PABX. However, these firms refuse to sell products at a loss and will only lower prices once other products in the market are significantly cheaper, and then only if the present price can no longer be justified and the planned price still ensures an adequate return.

The significant price fall witnessed in the large PABX market is attributed, by the multinationals, to BT's entry strategy. BT appears to have been so keen to secure a significant market share that it has supplied products below cost and, consequently, obliged other distributors to reconsider their traditional 100% mark-up. The multinationals object to this strategy, and estimate that BT could increase its profit level ten-fold by supplying only a quarter of its

current volume of large PABX, at higher prices which the market would still bear. Such action would not only increase BT's profitability, but would also provide considerable opportunities for competitors; the large PABX market would be more attractive to entrants offering new and innovative products.

The multinationals believe that product differentiation is increasing in importance in the large product market. A low product price has made quality relatively unimportant, although a certain level must still be achieved. The multinationals prefer to compete on the basis of non-price, as opposed to price, competition and would invariably make non-price moves to increase demand for failing products. In the large PABX market non-price competition takes place through the introduction of product features, and the multinationals are consequently attempting to introduce those features which consumers are actually demanding, rather than simply copying those offered by other firms. Once a consumer has bought a particular PABX, it is possible to upgrade the installed product by adding features and software, but the multinationals accept that there is only a very thin line between "locking the consumer in" and "catering to his changing requirements".

Like the joint ventures, the multinationals have been restricted by BT's monopolisation of the installation and maintenance of analogue products, and have been obliged to subcontract such work to approved maintainers. Once these restrictions are removed, the multinationals intend to offer extensive maintenance services, and regret their present loss of profitable maintenance contracts.

With regard to advertising and marketing, the multinationals estimate that they spend significantly less than their competitors, although they view such expenditure as particularly important for new entrants in this market. Only one of the multinationals establishes, and monitors, a quarterly advertising budget. This particular budget amounted to less than 1% of turnover in 1984, ie approximately £50,000, and was employed to finance advertisements in trade journals and purchasing guides. This company believes it is selling "solutions to customer problems" and hopes to secure the image of a high quality supplier of reliable, but simple, products. The multinationals, as a

group, believe that good quality advertisements should have relatively more impact than poor quality promotion and regret that, in the present climate, firms appear to be judged almost solely on the quantity of adverts placed, rather than quality.

(IV) ANALYSIS OF QUESTIONNAIRE DATA AND HYPOTHESES TESTING

In the previous section the opportunities and consequences of liberalisation were discussed by firm type, ie as seen through the eyes, in this particular market sector, of the incumbent firms, joint ventures and multinationals. However, to test the hypotheses designed to highlight the effects of liberalisation on market structure, the conduct of firms and the competitiveness of domestic firms, a more objective and analytical approach is required. The information employed is again drawn from the interviews completed with market participants and, although subjectivity cannot be removed completely, statistical tests will be conducted to determine the significance of results and to facilitate testing the hypotheses in as objective a manner as possible.

Some comment must be made regarding the emphasis which can be placed on the statistical tests completed below, and in Chapters 6 and 7. In an effort to present as much data as is considered relevant to this study, the following tables are constructed on a two-tier basis, where the upper tier contains data categorised on the basis of firm type, and the lower tier contains data categorised on the basis of market presence or exclusion. The sample, however, although closely approximating the population of relevant firms, contains only 26 members. This restricts the use of those statistical tests generally assocated with contingency tables similar to those presented below, especially when firms are divided into several possible categories on the basis of their behaviour or views etc. To reduce the statistical problem would require combining classes, ie table columns, but this would reduce the amount of information presented and would detract from the intended economic analysis. For this reason the data is simply presented on the basis of firm type, but is not tested for statistical significance - any relationship which does exist between the rows and columns of the upper tiers of the tables presented is usually quite obvious.

Care must also be taken in interpreting the results of the tests of statistical significance which are undertaken in the case of participants and non-participants, ie in the lower tier of each table.

χ^2 tests of significance are employed, using the method detailed below, but the small sample size again, arguably, introduces some element of doubt as to the validy of these results. If the row and column totals are low in value, then a significant test statistic, using the χ^2 distribution, cannot be treated as undisputable "proof" of any hypothesised relationship. This problem is not considerable in the tests completed regarding participants and non-participants, but should not be completely ignored. For this reason the hypotheses tested in this chapter, and in Chapters 6 and 7 below, are not tested only on the basis of the statistical data presented. All hypothesis tests relevant to this study are completed on the basis of both the subjective type analysis presented above, and the more objective analysis presented below.

Market Structure

Prior to liberalisation, BT did not participate in the large PABX market, but licenced 6-7 firms, ie incumbents, joint ventures and multinationals, to supply products direct to consumers. At the time of interview there were eight identifiable competitors, which suggests the entry of only one additional competitor although the level of participation of some of the other companies may have increased. BT had also entered the market, but only in a distributive capacity, and had secured 13% of the market by 1985, and more that 41% of the sector for products incorporating more than 500 lines. By 1984/5 the large PABX market was valued at £76m in current manufacturers' prices and £129 in terms of prices to end users.[8]

The relationship between firm type and participation in this sector has already been discussed in Part (A) above, where it was established, using Table 5.1, that only large firms, ie incumbents, joint ventures and multinationals, are attracted to this market. Smaller firms, such as suppliers, agents and small domestic companies, do not participate in this sector. This suggests a potential relationship between firm size, as measured by telecoms related turnover, and participation. If economies of scale are important, as

they are judged to be in this sector, we can expect a positive relationship between size and participation.

The following table contains four categories of firm size (x) and distinguishes between participating and non-participating firms[9] as :

Turnover (£m)	$0<x\leq5$	$5<x\leq20$	$20<x\leq50$	$x>50$	Total
Participants	0	3	2	3	8
Non-participants	9	7	0	2	18
Total	9	10	2	5	26

These figures represent the observed (O) relationship between firm size and market presence and suggest that there is a relationship between large firm size and participation in the large PABX market. To test the significance of this result we construct a table of expected values (E) which are obtained by dividing the product of each relevant row and column total by the total number of sample members, ie 26.

Turnover (£m)	$0<x\leq5$	$5<x\leq20$	$20<x\leq50$	$x>50$	Total
Participants	2.77	3.08	0.62	1.54	8.01
Non-participants	6.23	6.92	1.38	3.46	17.99
Total	9.00	10.00	2.00	5.00	26.00

To calculate the χ^2 statistic, as a test of significance, the series of values $(O-E)^2/E$ is summed. In this particular case χ^2 = 10.45, with 3 degrees of freedom, and is significant at the 2% level, ie there is a statistically significant relationship between size and participation.[10]

Given that this market is characterised by a small number of large

scale participants, and that entry has apparently been limited, we can further investigate the structure of this liberalised market by examining the concepts of vertical integration, diversification and entry barriers. Taking vertical integration first, firms can be classified according to their integration pattern as :

Category	A	B	C	D	Total
Incumbents	2	0	1	0	3
Joint Ventures	0	0	2	0	2
Multinationals	0	0	3	0	3
Participants	2	0	6	0	8
Non-Participants	0	1	1	16	18
Total	2	1	7	16	26

where A : firm displays both forwards and backwards integration
B : firm displays only forward integration
C : firm displays only backward integration
D : firm displays no vertical integration

These results suggest a relationship between integration and participation; only two firms in the sample exhibited both forward and backward telecom related integration, and both participate in this sector, as do 6 of the 7 firms displaying backward integration only. Testing the significance of these results on the basis of the χ^2 distribution, with 3 degree of freedom, gives a value for χ^2 of 21.95 which is significant at the 0.01% level.

The above results indicate that the option of backward integration has been selected by all participants, regardless of firm type - there is no apparent relationship between firm type and integration although there is a relationship between integration and market participation. Although each participant displays some degree of backward integration the incumbents, however, appear to have a relative advantage. The

joint ventures and multinationals display suitable levels of integration in to the supply of "standard" components but face problems associated with the particular inputs required only for the anglicised version of products. These problems do not apply, to the same extent, in the case of the incumbent firms, even though they generally wish to improve the relationship between their production of semi-conductors and telecommunications equipment.

Another structural variable of some importance is that of diversification, either within the general telecommunications market or external to it. To test the significance of diversification in this market firms are classified, in the following table, into four groups as :

A : diversified within telecoms and externally

B : diversified within telecoms only

C : external diversification only

D : no diversification

Category	A	B	C	D	**Total**
Incumbents	2	1	0	0	3
Joint Ventures	0	2	0	0	2
Multinationals	1	2	0	0	3
Participants	3	5	0	0	8
Non-Participants	0	11	1	6	18
Total	3	16	1	6	26

These figures confirm that all 3 sample members who displayed both internal and external diversification participate in the large PABX market, and also confirm that every participant displays some measure of diversification within telecommunications. To test whether the relationship between participation and diversification is significant the test statistic of 9.90 is compared with the χ^2 distribution with 3

degrees of freedom and is found to be significant at the 2% level.

The question of the entry barriers surrounding an industry or sector is quite difficult to analyse statistically and only two potential barriers are examined in isolation, ie patents and product differentiation. To test the relationship between market participation and the control of patents firms are again categorised into four groups as :

A : firm/parent controls patents and registers product designs

B : firm/parent controls patents only

C : firm/parent registers product designs only

D : firm/parent neither controls patents nor registers product designs

Category	A	B	C	D	**Total**
Participants	4	3	1	0	8
Non-Participants	1	3	2	12	18
Total	5	6	3	12	26

Of the eight firms competing in this market, seven control relevant patents, and five register product designs. Using the χ^2 distribution with 3 degrees of freedom the test statistic of 12.05 is significant at the 1% level, confirming a positive relationship between participation in the large PABX market and the control of telecoms related patents. This result suggests that patents do represent a barrier to entry in this particular sector.

Patents may constitute a well-defined and easily recognisable barrier to entry, but other barriers are not so easily defined or analysed. Product differentiation may represent an entry barrier if it increases brand loyalty, but may also facilitate entry by firms who can develop products designed to fill some unexploited niche in the characteristics space. The presence of excessive product differentiation can be socially inefficient if it encourages more entry than is justified on the basis of social welfare maximisation.

To give some indication of the extent of product differentiation in the large PABX market each participant has been classified on the basis of the number of product models offered as :

No. of Models	1	2-5	5-10	>10	Total
Incumbents	3	0	0	0	3
Joint Ventures	2	0	0	0	2
Multinationals	2	1	0	0	3
Total	7	1	0	0	8

These results highlight the limited extent of differentiation in this particular market, with only one firm, a multinational, offering more than one model. There is no apparent relationship between firm type and number of products offered. Consumers face a limited range of products, which reinforces the argument that economies of scale is the most important issue in this particular sector. Product differentiation does not represent an important characteristic of the structure of this sector and its impact as either a barrier to entry or an encouragement to entry is minimal.

In an effort to establish other relevant barriers to this market, firm were asked to classify the sources of any significant barriers as

A : both price and non-price sources and securing BABT approval

B : price sources and BABT approval

C : non-price sources and BABT approvals

D : price sources only

E : non-price sources only

F : BABT approvals only

G : a mixture of price and non-price sources

H : no significant barriers

Non-price sources include high levels of advertising and R&D expenditure etc which will be analysed in isolation, later, with regard to the conduct of participating firms.

Category	A	B	C	D	E	F	G	H	Total
Incumbents	0	1	0	0	0	1	0	1	3
Joint Ventures	0	0	0	0	0	2	0	0	2
Multinationals	0	0	0	0	0	2	0	1	3
Participants	0	1	0	0	0	5	0	2	8
Non-Participants	0	1	1	2	3	5	0	6	18
Total	0	2	1	2	3	10	0	8	26

Six participants argue that the approvals process represents a significant barrier to entry, and one of these firms also points to limit pricing, made possible by cost advantages achieved through significant economies of scale. Two participants refuse to recognise the existence of any significant barriers. Whereas both the joint venture firms and two of the multinationals cited BABT and the approvals process as the only significant barrier to entry, the incumbent firms do not consider this to be such a problem. These firms undoubtedly benefit from their extensive knowledge of the operation of the approvals procedure, their participation in the writing of suitable product specifications and membership of the MDT Scheme. Whereas the joint ventures and multinationals judge the specifications to be too tight and the costs of approval to be too high, and argue for some form of self-certification, the incumbents generally expressed satisfaction with present arrangements which will restrict the number of new products launched onto the market.

To test whether views concerning entry barriers are influenced by the particular sectors of the market in which sample members have located a χ^2 distribution with 5 degrees of freedom is employed. The test statistic of 4.87 is not significant, suggesting that the above views are representative of the entire sample and are not peculiar to those firms participating in this particular sector of the market.

Similar views are also held by the entire sample regarding the threat of future competition from new entrants - in the large PABX

market five firms claimed to be threatened by entry from foreign competition, while the remaining three did not regard any potential entrant as "threatening" to their position in the market. No firm regarded domestic entrants as providing a serious threat, on the basis that no domestic firm could enter the market at the scale required to represent even a minor threat to participants, and the presence of large economies of scale successfully deters small scale entry.

The final aspect of market structure examined in this study concerns the sources of financial support which is made available to participants. Firms operating in the liberalised market have received a combination of support from two major sources - the development agencies, in the case of capital support, and government support schemes designed to help firms introduce new technology. The aid received to date by each sample member is classified as :

A : support from the government and development agencies

B : government technical support only

C : development agency support only

D : no support received to date

Category	A	B	C	D	Total
Incumbents	0	3	0	0	3
Joint Ventures	0	0	1	1	2
Multinationals	1	1	1	0	3
Participants	1	4	2	1	8
Non-Participants	2	4	4	8	18
Total	3	8	6	9	26

Using the above information we can test for a significant relationship between presence in the market and sources of aid made available, but the relevant χ^2 statistic with 3 degrees of freedom, ie 4.02, is not significant. The above results suggest that not only is

there no statistically significant relationship between participation in the large PABX market and aid made available, but that there is no relationship between firm type and aid received.

TABLE 5.2 SUMMARY OF STRUCTURAL RESULTS

VARIABLE	HYPOTHESISED DIFFERENCE BETWEEN PARTICIPANTS & NON-PARTICIPANTS
(1) SIZE	SIGNIFICANT
(2) VERTICAL INTEGRATION	SIGNIFICANT
(3) DIVERSIFICATION	SIGNIFICANT
(4) PATENTS	SIGNIFICANT
(5) ENTRY BARRIERS	NOT SIGNIFICANT
(6) THREAT OF ENTRY	NOT SIGNIFICANT
(7) SOURCES OF AID	NOT SIGNIFICANT

The above results highlight some interesting features regarding the structure of the large PABX market. Only large firms are attracted to the sector, economies of scale being of considerable importance and being fully exploited only at considerable levels of volume output. Entry into this market has been limited since liberalisation, with the most significant entrant undoubtedly being BT in its role as a distributor and non-manufacturer. The barriers surrounding this sector do not appear to differ significantly, in terms of source, from those surrounding the other sectors examined in Chapters 6 and 7 below, but they may be of a greater height. The fact that potential entrants hold relevant patents, and exhibit a suitable level of backward integration, is considered to be an effective deterrent to domestic firms, and leaves only foreign firms providing even a "potential" threat. Most foreign firms who would be suitable entrants are already participating in the market, and it is doubtful whether the number of participants will increase significantly. Firms do not appear to place much emphasis on product differentiation which cannot be said to be

either encouraging excess entry or creating an effective barrier. Product differentiation appears to have been generally rejected by participants in the pursuit of scale economies.

Given the above results and those presented in the case study analysis, which suggest limited entry but a significant amount of rivalry between firms, Hypothesis 1 is accepted, ie the government's liberalisation policy appears to have successfully introduced a socially efficient level of competition into this particular market sector.

Conduct of Market Participants

Given that the structure of the large PABX market appears to approximate that of an oligopoly situation, we can expect to witness some degree of interdependence in the competitive strategies of market participants. On the basis of the theory discussed in Chapter 4, these interdependent strategies are hypothesised to produce a prevalence of non-price competition. With a view to testing whether this hypothesis holds in the large PABX market sector we will examine pricing policies, R&D, advertising, investment and the question of whether firms themselves judge competition to be based on price or non-price factors.

The question of investment in plant and equipment must be treated carefully in this type of analysis given that several firms have only recently taken the decision to locate in the UK, even though they may have participated in the market prior to liberalisation. Such a decision entails abnormally high levels of investment expenditure, taken as a percentage of turnover, and will not be representative of strategy in later years. However the following information is still of considerable interest in as much as it details the situation in 1984/5 and gives some indication of the the identity of the firms choosing to expand UK operations after liberalisation. In this table capital investment expenditure (x) is expressed as a percentage of turnover and split into four categories.

Investment (%)	$0<x\leq 0.5\%$	$0.5<x\leq 5\%$	$5<x\leq 10\%$	$x>10\%$	Total
Incumbents	0	2	1	0	3
Joint Ventures	0	0	1	1	2
Multinationals	1	0	0	2	3
Participants	1	2	2	3	8
Non-Participants	4	4	0	10	18
Total	5	6	2	13	26

Employing a χ^2 distribution with 3 degrees of freedom the test statistic of 5.10 is not significant. The investment levels of market participants are high, with three firms investing more that 10% of turnover in 1984/5, but are not statistically different to the investment levels recorded by non-participants in the sample. Given that there is no apparent relationship between the rows and columns in the upper tier of the table, we can also confirm the absence of any significant relationship between firm type and investment.

In addition to investment in plant, market participants must also invest in the development or introduction of new products and production processes. To establish whether a significant relationship exists between market presence and such investment strategies, the following table has been constructed on the basis of five strategic categories according to whether expenditure is directed towards :

A : the development of new products

B : the move into other telecom markets

C : thedevelopment/introduction of process technology and/or test equipment

D : the integration of computing and telecommunications

E : the establishment of better channels of distribution

Category	A	B	C	D	E	Total
Incumbents	0	0	3	0	0	3
Joint Ventures	0	0	2	0	0	2
Multinationals	0	1	1	1	0	3
Participants	0	1	6	1	0	8
Non-Participants	5	4	3	2	4	18
Total	5	5	9	3	4	26

In the test of significance between participation and strategy the test statistic of 9.73, with 4 degree of freedom, is significant at the 5% level. The participants in the large PABX market place relatively more importance on the introduction of process and test equipment, with only 2 firms stating that this was not their major priority. Relatively little importance is placed on either the development of new products or the establishment of new or improved channels of product distribution. The emphasis apparently placed on low cost production and the exploitation of economies of scale is reinforced by these results. Given that category C was relevant to all three incumbent firms, both joint ventures and one multinational, there are no grounds for accepting the presence of a significant relationship between firm type and investment strategy.

One of the categories of investment discussed above was that of product development, which is also relevant to the question of R&D expenditure and direction. Taking R&D expenditure[11] as a percentage of turnover (x) the relative importance of this variable to sample members can be classified as :

R&D Expenditure	$0<x\leq0.5\%$	$0.5<x\leq5\%$	$5<x\leq10\%$	$x>10\%$	Total
Incumbents	0	0	3	0	3
Joint Ventures	0	0	0	2	2
Multinational	2	0	1	0	3
Participants	2	0	4	2	8
Non-Participants	8	6	1	3	18
Total	10	6	5	5	26

On inspection the participants in the large PABX market appear to favour relatively high levels of R&D expenditure, although two firms recorded minimal levels. To test whether there is a relationship between market presence and R&D expenditure a χ^2 distribution with 3 degrees of freedom is employed, and the relevant test statistic of 9.10 is significant at the 5% level.

All three incumbent firms spent 5-10% of turnover on R&D in 1984/5, as did one multinational. Both joint ventures spent relatively large amounts on R&D, the majority of which was directed towards gearing products of foreign design to the requirements and established product specifications of the UK market. Two multinationals recorded minimal expenditure in the UK, having the distinct advantage of being able to source the results of R&D work completed abroad by their parents or related subsidiaries. Not only is there a significant relationship between R&D expenditure and market participation, but the spread of firms within the upper tier of the above table also suggests an equally important relationship between firm type and expenditure. The multinationals are spending least (as a proportion of turnover) and the joint ventures are spending most.

Further information regarding R&D expenditure and the competing groups is provided in the following table which identifies the possible directions of such expenditure as :

A : basic research

B : product development/enhancement

C : product design

D : process work

E : software

Category	A	B	C	D	E
Incumbents	2	3	3	0	3
Joint Ventures	0	2	1	0	0
Multinationals	0	2	1	0	0

These results confirm that all three incumbent firms carry out product development and enhancement, as do the joint ventures and multinationals, although the expenditure of the latter group is minimal. However, whereas all three incumbents also undertake product design, this is only attempted by one multinational and one joint venture. The incumbents also appear to be directing some of their expenditure towards software development and basic research in telecommunications, but neither of these are undertaken by the other market participants. The multinationals and joint ventures leave such work to their parent companies or other subsidiaries and focus, in the UK, almost exclusively on product development and enhancement.

The methods through which firms communicate are especially important in the early days of competition in a market which has been recently liberalised. Not only must firms listen to consumers to ensure that they are making the correct product developments etc, but they must also decide how they can best inform consumers of the products and services provided. In an attempt to gauge the extent to which firms appear willing to listen to consumers and their expression of preferences, the significance of the following results can be tested :

Category	A	B	C	D	Total
Incumbents	1	0	1	1	3
Joint Ventures	0	2	0	0	2
Multinationals	2	1	0	0	3
Participants	3	3	1	1	8
Non-Participants	2	11	1	4	18
Total	5	14	2	5	26

where categories A-D represent different methods of monitoring consumer preferences as :

A : no identifiable method is employed

B : sales figures are used

C : market consultants are employed

D : consumer panels are used

Three out of the eight market participants admit to having no identifiable method of monitoring consumer preferences and, consequently, rely heavily on guesswork. A further three firms rely on sales figures which are of limited use given that they only inform firms of consumers' preferences regarding products already on the market and give little information regarding potential developments. To test whether these choices are significantly different to those made by participants in other areas of the market a χ^2 distribution is imposed, with 3 degrees of freedom. The caclulated χ^2 statistic of 3.18 is not significant and suggests that similar choices are being made by firms who do not participate in this particular sector.

Consideration of the actions of the competing groups within the large PABX sector suggests that these firms are not acting in a unified or consistent manner. Each of the three incumbent firms is employing a different strategy, the two joint ventures are acting consistently in their preference for sales data, which is also favoured by one multinational. Two multinationals have made no attempt

to gauge the preferences of UK consumers, although such preferences are considered important in the markets where these firms' products were originally developed.

Of equal importance in a competitive market is the effectiveness with which firms inform consumers of the products and services offered. Given that "advertising" apparently constitutes the preferred method of imparting such information, it is of interest to establish whether there is a relationship between advertising expenditure as a percentage of turnover (x) and participation in the large PABX market and/or between such expenditure and firm type.

Advertising (%)	**$0<x\leq0.5$**	**$0.5<x\leq5$**	**$5<x\leq10$**	**$x>10$**	**Total**
Incumbents	0	2	1	0	3
Joint Ventures	0	2	0	0	2
Multinational	0	3	0	0	3
Participants	0	7	1	0	8
Non-Participants	8	7	2	1	18
Total	8	14	3	1	26

Seven of the eight participants in the large PABX market spend less than 5% of turnover on promotion and only one firm spends 5-10%. The expenditure pattern of participants appears to be much less diverse than that recorded by non-participants. To test the significance of this finding we again employ the χ^2 distribution with 3 degrees of freedom and a test statistic of 6.44 which is significant at the 10% level. This result confirms a relationship between participation and the level of advertising expenditure but, given that the expenditure of seven participants falls within category B, there is no apparent relationship between firm type and advertising strategy. The incumbent firms, however, hold the advantage of trading under established company names, implying little need for advertising at the corporate

level and enabling them to focus on product promotion. In contrast the multinationals and joint ventures who had only a limited presence in the pre-liberalised market are pressurised to undertake a combination of both corporate and product promotion. This apparent advantage has not restricted the expenditure of the incumbent firms whose average advertising/sales ratio was 2.51% in 1984/5, compared to equivalent ratios of 1.56% and 1.08% for the joint ventures and multinationals respectively. In absolute terms the incumbents are also spending relatively more with an average expenditure of ฿1.25m compared to ฿330,000 on the part of the joint ventures and ฿203,000 by the multinationals.

This discussion of market conduct has focused on aspects of non-price competition to date. Prices in a market such as that for large PABX are difficult to compare given that products are extremely flexible with regard to both size and the range of features offered. However, on the basis of "price per line", the products offered by the three competing groups of firms can be classified as "high", "medium" or "low" if they fall within the ranges ⩽฿300, ฿301-400 or ⩾฿401 respectively.

Price	High	Medium	Low	Total
Incumbents	0	3	0	3
Joint Ventures	0	2	0	2
Multinationals	1	1	1	3
Total	1	6	1	8

The incumbent firms have effectively surrendered control of product prices in the case of sales made through BT, but have otherwise chosen to price at a level which "the market will bear" rather than on the basis of cost. The joint ventures make the majority of their sales through direct contact with business users and also set prices at a level the market will bear. The multinationals appear to be more diverse in their approach to pricing - one firm cites its intention as

being to secure survival, a second wishes to secure a suitable share of the market and the third selects a high price in the pursuit of profit.

Given that the products offered by six of the competing firms can be classified as "medium" priced, there is no apparent relationship between firm type and product price. However, the fact that the majority of participants offer products of a fairly similar price does not necessarily imply that price competition is an insignificant characteristic of this market. Most firms participating in this sector would prefer to compete on factors other than price but find themselves unable to do so - especially when in competition with BT who has selected to price the products it distributes at or even below cost, in an effort to secure the leading market share. The pursuit of economies of scale and other sources of cost reduction discussed above suggests that price competition remains of some importance and, to test whether this is so, firms were asked to state whether they intentionally competed on the basis of price competition, non-price competition or a mixture of the two strategies. Using the adopted method of analysis firms can be categorised into four groups on the basis of their competitive strategy as :

A : using a combination of price and non-price competition

B : using price competition only

C : using non-price competition only

D : too early to say

Category	A	B	C	D	**Total**
Incumbents	1	0	1	1	3
Joint Ventures	0	1	1	0	2
Multinationals	1	2	0	0	3
Participants	2	3	2	1	8
Non-Participants	7	4	7	0	18
Total	9	7	9	1	26

Five participants identified price competition as being important in the large PABX market, and one firm remained undecided; only two firms suggested that non-price competition was relatively more important. Using the χ^2 distribution with 3 degrees of freedom gives a test statistic of 3.34 which is not significant, ie although price competition is undoubtedly a major factor in the large PABX market, there is no apparent reason for concluding that this is not also the case in the markets for small business products and telephone handsets. Neither is there any apparent relationship between firm type and competitive strategy.

TABLE 5.3 SUMMARY OF CONDUCT RESULTS

VARIABLE	HYPOTHESISED DIFFERENCE BETWEEN PARTICIPANTS & NON-PARTICIPANTS
(1) CAPITAL INVESTMENT	NOT SIGNIFICANT
(2) OTHER INVESTMENT	SIGNIFICANT
(3) R&D EXPENDITURE	SIGNIFICANT
(4) CONSUMER MONITORING	NOT SIGNIFICANT
(5) ADVERTISING/SALES	SIGNIFICANT
(6) COMPETITIVE STRATEGY	NOT SIGNIFICANT

Table 5.3 summarises the results of the tests regarding the competitive strategies of firms participating in the large PABX market. Given the oligopolistic structure of this sector these strategies display some interdependence. In testing Hypothesis 2, however, we are primarily interested in whether such actions have led to a prevalence of non-price over price competition, as was hypothesised on the basis of the theoretical discussion of liberalisation in Chapter 4.

The major differences found between participants and non-participants in this market concern investment, advertising and R&D expenditure - where the latter two variables are expressed as a

percentage of turnover. In the case of advertising expenditure participants appear to be medium-range spenders, although in absolute terms such levels of expenditure are high. In the case of R&D expenditure relatively high levels of expenditure are favoured in both percentage and, therefore, absolute terms. With regard to R&D expenditure there appears to be a significant relationship between firm type and strategy, although this is undoubtedly a consequence of the fact that the multinationals have little need for expenditure in the UK market.

Firms in this market focus their non-plant investment on securing product test equipment and improved process technology, which suggests a general pursuit of cost reduction. Low costs imply high profits if competition is weak, but the rivalry established between these firms suggests that some price cuts will be passed on to consumers and that some level of price competition will prevail. Five participants identified price competition as taking place, and only two believed non-price strategies to be more important. Taking into consideration the low level of product differentiation in this market, the low level of monitoring of consumer preferences and the lack of significant levels of advertising expenditure, Hypothesis 2 must be rejected. Although non-price competition is present in the large PABX sector, it is price competition which is relatively more important.

Performance of Market Participants

Performance is a difficult concept to measure but can be gauged on the basis of profitability, efficiency, growth and technical progress. Some firms also judge their performance against targets regarding market shares or sales figures, while smaller, relatively new participants may be pursuing just one goal, ie survival.

To test whether the goals pursued by firms participating in the large PABX market differ significantly from those pursued elsewhere we can employ the data presented in the following table in which firms are classified on the basis of their primary goal :

Goal	Growth	Mkt Share	Profits	Survival	Sales	Total
Incumbents	2	0	0	0	1	3
Joint Ventures	0	1	1	0	0	2
Multinationals	0	1	1	1	0	3
Participants	2	2	2	1	1	8
Non-Participants	3	6	5	1	3	18
Total	5	8	7	2	4	26

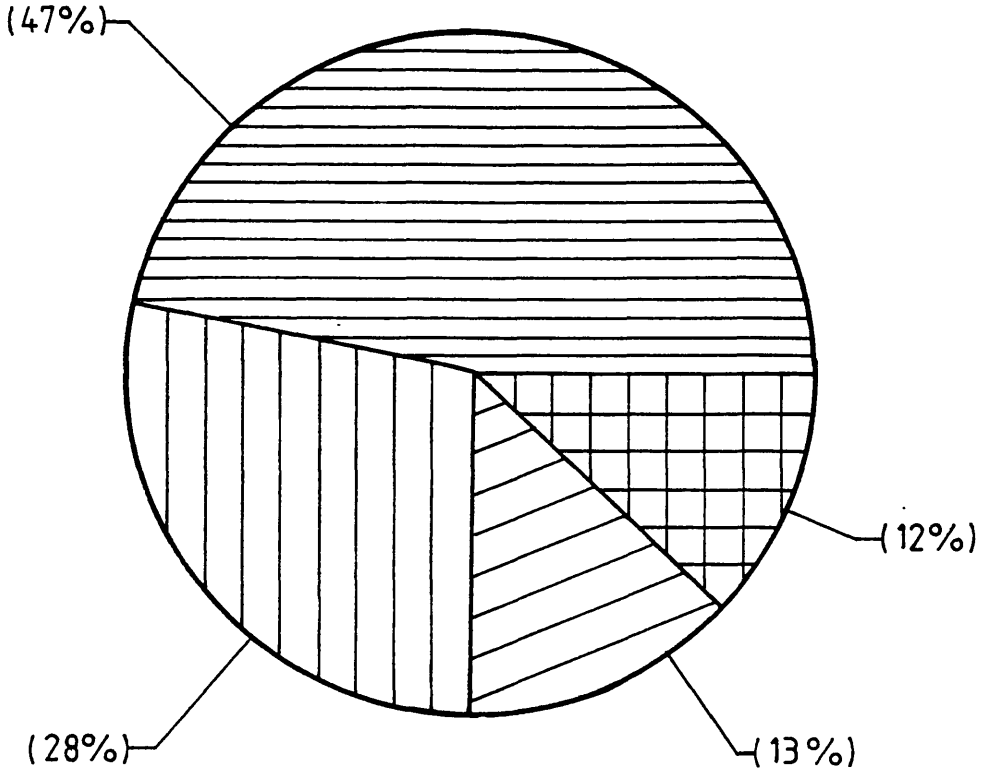
Only one participant states "survival" to be its primary goal, and five appear to judge their performance on the basis of some measure of size eg growth, market share and/or sales. Using a χ^2 distribution with 4 degrees of freedom confirms that the goals pursued by firms participating in the large PABX sector are not significantly different from those pursued by firms located in other sectors of the market. Neither is there any apparent relationship between firm type and goals pursued.

Growth figures do not provide an adequate basis for comparisons beetween firms, given that firms growing from a small size will record high levels of growth which cannot be matched by their large sized competitors. However, sales and/or market shares do provide some means of comparison and are illustrated, in Diagram 5.1, on the basis of firm type and market value in 1984/5. BT had successfully secured 13% of the market by 1984/5, but this represents sales of products manufactured by other firm types - primarily by the incumbents. This group of firms had consistently controlled 70% of the market prior to liberalisation, but controlled only 47% in 1984, by which time the multinationals and joint ventures had secured 28% and 12% respectively. Given that total market size is limited by the number of suitably large-sized business customers, the incumbents appear to have faced a decrease in volume sales and a significant loss of market share.

Diagram 5.1 illustrates the position in the domestic market only,

DIAGRAM 5.1 LARGE PABX MARKET

(% market share by value)



TOTAL MARKET VALUE = £129 m

BRITISH TELECOM

INCUMBENTS

MULTINATIONALS

JOINT VENTURES

but firms also have the opportunity to make export sales. If competition in their domestic market is encouraging the international competitiveness of the incumbent firms then an improvement in export sales would be expected. In the following table export sales (x) are expressed as a proportion of turnover and firms can be categorised as:

Exports (%)	$0<x\leq1.0\%$	$1<x\leq5\%$	$5<x\leq10\%$	$x>10\%$	Total
Incumbents	0	0	1	2	3
Joint Ventures	2	0	0	0	2
Multinationals	2	0	0	1	3
Participants	4	0	1	3	8
Non-Participants	10	1	1	6	18
Total	14	1	2	9	26

These figures confirm that almost no export sales were made, from the UK, by the joint ventures or multinationals in 1984/5. However the export pattern of the participants is not statistically different to that returned by the non-participants, ie the test statistic of 0.84, with 3 degrees of freedom, is not significant. What is significant, however, is the difference in export performance between domestic and foreign owned companies, but this result is attributable to company philosophies rather than performance.

Technical progress and efficiency are achieved through a combination of investment and R&D expenditure, the effect of which depends not only on the amount of expenditure but also on its direction. It has been confirmed that all participants in this market are pursuing cost reduction through investment in process technology and product test equipment, but firms could give no specific details of how effective such expenditure had been to date. One major concern for the incumbents, however, was that their loss of market share, to foreign competitors, implied a decrease in output which could prevent

the exploitation of the economies of scale required to remain cost competitive. Their present loss of market share has not implied a significant drop in output because the market has grown since liberalisation. However the danger for the incumbents lies in the fact that this growth is not "real" in nature but reflects the replacement of old-fashioned products with modern technology. In volume terms the installed base of the large PABX market increased from 1.33m lines in 1982 to 1.77m lines in 1985, but this growth rate of 28% was achieved only in conjunction with a replacement rate of 36%.[12] Once the replacement phase is completed the loss of market share experienced by the incumbents will entail more serious consequences. If output decreases and unit costs increase the incumbents face the danger of not only being uncompetitive on the world market, but of losing even more market share in the UK. To keep prices in line with competitors the incumbents would face a sharp drop in profitability.

With regard to profitability, we are again interested in two possible relationships ie that between market participation and profit levels, and that between profitability and firm type. In the following table the telecom related profits (x) of each firm are expressed as net return on telecom sales (ie post tax) :

Profits (%)	**$0<x\leq5\%$**	**$5<x\leq10\%$**	**$10<x\leq20\%$**	**$x>20\%$**	**Total**
Incumbents	0	0	3	0	3
Joint Ventures	1	0	1	0	2
Multinationals	0	1	2	0	3
Participants	1	1	6	0	8
Non-Participants	6	7	3	2	18
Total	7	8	9	2	26

These figures highlight the similarity in the level of profits achieved by participants within the market, ie six of the eight competitors achieved net returns of 10-20% in 1984/5 while the low

returns recorded by one multinational and one joint venture were the consequence of the high level of costs deemed necessary for establishment within the liberalised market.

To test whether there is a significant relationship between profitability and market presence the test statistic of 8.84 is compared with the critical values of the χ^2 distribution with 3 degrees of freedom. The result is statistically significant, ie the majority of sample members achieving a return of 10-20% participate in this relatively lucrative market. There is no apparent relationship between firm type and profitability, given that six of the eight participants fall into category C.

TABLE 5.4 SUMMARY OF PERFORMANCE RESULTS

VARIABLE	HYPOTHESISED DIFFERENCE BETWEEN PARTICIPANTS & NON-PARTICIPANTS
(1) GOALS	NOT SIGNIFICANT
(2) EXPORTS	NOT SIGNIFICANT
(3) PROFITABILITY	SIGNIFICANT

Hypothesis 3 states that liberalisation is not expected to encourage an increase in the international competitiveness of domestic firms. To test whether this hypothesis holds, consideration must be given to the data and tests presented immediately above, and summarised in Table 5.4, and to the previous discussions of market structure and the conduct of competitors. On the basis of this information Hypothesis 3 should be accepted, entailing the conclusion that the liberalisation of the large PABX market has not increased the international competitiveness of the incumbent firms - in fact, there is a danger that their competitiveness will be reduced. The main threat to the incumbents is one of a loss of market share and sales volume; this could remove some of the benefits of economies of scale and increase unit costs. Given that price competition is considered

important in this market, an increase in costs cannot be met by a proportional increase in prices and profitability will, consequently, be reduced. Lower profits imply lower levels of investment funds which may leave domestic firms lagging even further behind in the future. It is, therefore, a possibility that liberalisation has not only failed to improve the performance of domestic firms but will actually decrease their international competitiveness.

NOTES

1. The private sales market concerns all sales except those made to British Telecom, ie to non-BT domestic consumers and foreign consumers. This market existed before liberalisation but, in the case of domestic sales, the majority of consumers were large business users who had installed private networks or large PABX.

2. Figures sourced from the Plessey Report & Accounts (1983).

3. Mitel was taken over by British Telecom in 1986. However, at the time of interview Mitel was recognised as an independent multinational company, and the subsequent takeover has little bearing on the results presented.

4. TMC is also categorised as an incumbent firm, but this firm is no longer of UK ownership and had not selected, at the time of interview, to participate in the market for large PABX products.

5. Figures have been calculated on the basis of data sourced from BT.

6. These figures are estimates based on data obtained from British Telecom, Oftel, the Monopolies Commission (1986a) and from participating firms.

7. Remote diagnostic facilities are designed to discover faults before these affect the consumer and should, consequently, minimise the time engineers must spend on the repair of products.

8. Figures estimated on the basis of data provided by British Telecom, Oftel, the Monopolies Commission (1986a) and participating firms.

9. Participants are those firms in the sample who compete in the large PABX market and non-participants are sample members who do not offer large PABX. Some firms participate in more than one sector of the market but, whenever possible, these firms have answered questions for each market sector independently.

10. In cases where one of the row or column totals is "zero" in value χ^2 is calculated by omitting that row or column ie effectively combining the category in question with one of the other categories. This prevents χ^2 from taking infinately high values and allows the construction of a more appropriate test statistic. The degrees of freedom are reduced accordingly.

11. Firms operating in more than one of the CPE markets analysed in this thesis have attempted to estimate their R&D expenditure, on this particular product, as a proportion of total sales of this product; at best, these figures are only approximations. This point also applies in the case of figures returned for advertising/sales and exports/sales etc, and in all three product markets analysed in Chapters 5-7.

12. Figures estimated on the basis of data sourced from British Telecom.

APPENDIX 5.1 : QUESTIONNAIRE

COMPANY HISTORY AND STRUCTURE

1) When was the company set up, and when did it enter the telecommunications industry?

2) What form of ownership does the firm have eg shareholders, manager owned?

3) Is the firm a parent company?
How many subsidiaries does it have and which industries are they involved in?
Is the firm a subsidiary?
Is the parent firm UK or foreign owned?
Is the parent company involved in the telecommunications industry?
How much independence does the firm have ie to what extent does the parent company exert a strong influence over its subsidiaries?

4) Does the firm own/control its own component supplies?
What proportion of components are bought in from outside sources, and what proportion are sourced in-house?

5) How diversified is the firm? What are its major product areas?

6) What was the firm's previous relationship with the PTT?

PRODUCT INFORMATION

7) What products are produced for the telecommunications equipment market under the headings : a) telephone handsets;
b) keytelephone systems;
c) PABX.

8) What are the prices of the above products to the end user?

9) Are products manufactured using standard components?
Are products customised in any way?

10) Are products geared towards individual consumers or business users or are they aimed towards both sectors of the market?

11) Are products manufactured on a replacement basis, or do they have long life expectancies? What is the present life expectancy of a product?

12) Apart from terminal equipment, does the firm offer any other telecommunications products or services?

13) Are any products exported?

LIBERALISATION

14) What specific opportunities have been offered to the firm by the liberalisation of the telecommunications market?

15) Has liberalisation caused the firm to be saddled with any major and identifiable costs?

16) Has the firm expanded substantially since liberalisation?

17) Has product variety increased significantly since liberalisation?
What have been the most notable additions to the product range?
Has liberalisation encouraged new models in existing product ranges, or new product ranges?

18) What has been the effect of liberalisation, if any, on :
(a) output;
(b) employment;

(c) investment;

(d) R&D expenditure;

(e) advertising;

(f) prices?

19) Are there any further liberalisation measures that the firm would like to see, or any changes made to existing measures?

20) What have been the advantages/disadvantages of the present approvals process?

21) What changes could be made to the present approvals system?

TECHNOLOGY

22) What have been the main technical developments which have occurred over the last few years?

23) Has the introduction of digital technology offered any outstanding opportunities?

24) How important is computing and software to the firm's products?

25) What is most likely to be the technical orientation of the firm in the near future?

26) Is there an effective transfer of technology inside the organisation?

PRODUCTION AND COSTS

27) Have there been any major process innovations in recent years?

28) Have there been any major problems/delays in the introduction of

new technology?

29) Have there been any serious skill shortages?

30) Are any components bought from abroad?

31) Have costs fallen significantly as volume output has been increased?

32) How important, relative to total costs, are/were the promotional costs incurred after liberalisation?

COMPANY STRATEGIES

33) What type of goal is the firm/telecommunications division aiming for - profit margin, sales targets, growth rate, market share, product quality achievement etc?

34) What areas appear to be most encouraging/attrative for future investment?

35) Does the firm engage in an active patent policy?
Has this enabled the firm to attain a valuable lead in the market?

36) How important is the control of patents for firms in this industry?

37) Does the firm regard it as more important that it follows the movements of other firms with regard to a) prices or b) non-price competitive moves?
Who are the price leaders in the market?

KNOWLEDGE OF THE MARKET

38) Has liberalisation caused the market for the firm's product to grow?

39) Are foreign firms providing a serious threat?

40) For each specific product area in which the firm is involved, is competition in the market believed to be in terms of price factors, or non-price factors?

PRICES

41) If the product was not selling well, would the firm choose to :
    a) lower the price, or
    b) use non-price competitive moves to stimulate demand?

42) Would the firm ever be encouraged to lower prices?
    What would be the necessary circumstances?

43) Is pricing seen as a possible way in which to deter entry, or are other factors believed to be more important?

44) In pricing, is any distinction made between the individual consumer and the business user?
    How are product prices arrived at?

MARKETING

45) How important has marketing become in the industry as a whole, and to the firm in particular?

46) What method, if any, does the firm employ to monitor consumer preferences? Have any changes been introduced recently?

47) How is the firm trying to promote its products - is it emphasising design, technology, after sales servicing etc?
At what point would the decision be taken to drop an unsuccessful product from the firm's product range?

48) What type of retail outlet does the firm use?
Is British Telecom a customer?
How important is it to have British Telecom as a customer?
What are the disadvantages to facing such a large degree of countervailing power in the market?

PRODUCT DIFFERENTIATION AND NON-PRICE COMPETITION

49) What are the main characteristics of the products, offered by the firm, which set them apart from others in the market?

50) How important is product differentiation in this market?
Are product design and appearance more important than the facilities and technology incorporated?

51) How important is quality as opposed to a lower price for the products offered by the firm?

52) What is the firm's advertising policy?
What type of advertising does the firm engage in eg newspapers, television, radio, bill posters etc?

53) How important is the company's trade name?

54) Does the firm have a particular image which it is trying to put across to the public? What is this?

RESEARCH AND DEVELOPMENT

55) Is there a formal R&D facility in the firm?
What is mostly carried out there a) basic research,
b) design of products,
c) product development?

56) If the firm is part of a larger organisation, does it have the use of joint/central R&D facilities?
Is any R&D carried out abroad?

57) Does the firm have research or development work carried out by
a) central group laboratories,
b) subcontactors,
c) the user/buyer eg British Telecom,
d) universities?

58) Does the firm belong to any industrial research associations?

59) Has R&D expenditure increased as a result of liberalisation?

60) Are there any serious constraints which may hinder the development of new products or production processes?

61) Has any use been made of the Department of Trade & Industry's Innovative Support Scheme?
Is use made of any other schemes or forms of industrial support?

62) What have been the main product innovations introduced by the firm?
Where have the ideas for these products mainly stemmed from?

63) How important is the immediate introduction of a product innovation?

CHAPTER SIX : THE MARKET FOR SMALL BUSINESS PRODUCTS

(I) PREFACE

Before liberalisation the market for small business products, ie those incorporating fewer than 120 lines, was monopolised by BT who sourced products from five selected manufacturers. These manufacturers made some private sales of the same products, but only to business users operating private networks. The market for small busiess systems was relatively large, in volume terms, but had not been sufficiently exploited. BT's monopoly, and its particular purchasing policy, resulted in products which were out-dated in terms of both technology and the facilities offered. In contrast to the market for large PABX, new technology had not been introduced smoothly into the small product market and, by 1980, there was an obvious need to replace a significant proportion of the installed product base. Key-telephone systems and fully automatic exchanges were developed to replace the installed base of manually operated products, such as PMBX and key and lamp units, and digital technology was also introduced. The value of replacing the installed base with modern equipment was estimated to be at least £800 million[1].

In 1980/81 BT achieved rental sales value of almost £149 but private sales, ie those made by the manufacturers direct to consumers, were limited in both size and number and amounted to less than £100,000 in the case of products offering fewer than 16 lines. BT achieved a rental sales value of £40 million in the same sector. In volume terms, BT supplied 1,014,000 lines in 1980/81, of which 727,000 lines were sold via products serving less than 16 lines, but private sales of the same size of products only achieved 5000 extensions in the same year[2].

It is almost impossible to draw a suitably clear distinction between a key-telephone and a PABX but, in general, a PABX has a least size configuration of 5 exchange lines and 20 extensions, whereas key-telephones offer from 1-10 exchange lines and 3-50

extensions. Key-telephones are unlikely to be cost effective below 8 or 9 extensions. A key-telephone system provides a connection between several telephones and one group of circuits, ie an incoming call can be answered by one of several individuals who can subsequently hold the call himself, or transfer it to another extension. Key-telephone systems differ from manual branch exchanges (PMBX) in that they do not require central operators, and differ from automatic branch exchanges (PABX) in that calls do not necessarily go direct to the intended recipient. Electronic and digital key-telephones enable the smallest of business users to access facilities previously available only to large scale customers.

Liberalisation of the small business product market was initially designed to be phased in over a three year period. Full liberalisation of the key telephone market was originally planned for October 1982, but was eventually delayed until July 1983 in the case of electronic products. By this time only "interim" arrangements had been introduced in the case of digital products. The first "tranche" of six products was selected by the Dept of Trade & industry towards the end of 1983, but had to be tested chiefly by BT, as the only suitably qualified body. By the spring of 1985 twenty-six products had been approved through two interim testing schemes, but many more products had been released onto the market through a procedure known as "grandfathering"[3]. The significant delay, in establishing liberalisation in this market, was designed to enable incumbents to design and develop products which could successfully compete with the expected flood of foreign goods. This particular market was expected to be the most attractive to foreign competitors.

(II) IDENTIFICATION OF THE COMPETITORS

British Telecom

Prior to liberalisation, BT exerted monopolistic control over the supply of small business products. BT's considerable power as a buyer had enabled it to source products at low prices, but the high volumes, and hence the high contract value involved, had also made these arrangements acceptable to manufacturers, who were attempting to operate in an industry characterised by a high level of fixed costs.

Prior to liberalisation, a widespread view in the market was that BT had been too complacent in its attitude and had consistently failed to address the needs of the consumer. Following liberalisation however, BT faced the possibilty of losing market share to new entrants and decided :

a) to introduce new and varied products, and
b) to behave more aggressively within the market itself.

As part of its aggressive strategy, BT encouraged consumers to purchase the products they previously rented, thus removing these consumers from the market until the next round of purchasing. In applying this strategy BT has had the advantage of holding information regarding both consumer identity and the expected date of equipment replacement. BT need only compete on equal terms with regard to sales to consumers entering the market for the first time. But, even in these cases BT may win an informational advantage via the consumer's initial application for connection to the network.

BT's strategy appears to have been successful in so far as 95% of products in this market were rented in 1981, but 98% were purchased or rented from BT or other distributors in 1983[4]. Liberalisation has transformed BT from a "purchaser" into a "distributor", but its sizeable product requirements still ensure some influence over manufacturers. BT is especially keen to exercise its considerable purchasing power by demanding that firms reduce costs and hence prices, while its ability to "cherry pick" among products developed by domestic and foreign firms, has increased its ability to satisfy

consumer requirements.

Other Competitors

The firms who have selected to compete with BT in the small business system market can be identified, through the groupings established in Chapter 6, as incumbents, agent firms, joint ventures, multinationals and small domestic manufacturers :

(i) In contrast with the effects of liberalisation in the market for large PABX, in the smaller product market it was BT who lost control of the market, and the incumbent firms who have been permitted to compete directly. The four incumbent firms in this particular market were given two years in which to adjust to the new competitive conditions, and the implications of competing directly with BT. BT will always be important as the largest buyer in this market, and the incumbents are, therefore, aware that aggressive marketing, in competition with BT, may affect subsequent orders.

The incumbent firms do not believe that liberalisation has encouraged the market to grow, in real terms, although an increased rate of replacement has temporarily increased volume output. This replacement is partly a consequence of technological innovation, which was one of the driving forces behind liberalisation itself. The incumbents view technology as more important than liberalisation and give no support to the view that causality runs from liberalisation to technological change.

The over-riding goal of the incumbent firms is that of growth with adequate profits. Liberalisation has caused gross profits to fall to 25-28%, but the incumbents believe that a 10% net return on sales is necessary for survival. The dual target of growth and an adequate rate of return has led, automatically, to several other targets covering manufacturing investment, R&D expenditure and manpower levels etc.

The incumbents do not believe that the liberalisation of the small business system market offers them any opportunities which were not previously available through their close association with BT. These

firms have lost their secure BT market and are now under pressure to supply a relatively larger variety of product, but in relatively smaller volumes. This implies a need for high levels of R&D expenditure, significant investment in production equipment and considerable expenditure on distribution and marketing. Each incumbent considers it necessary to secure sales of at least 2,000 units p/a simply to survive in the key-telephone market, but believes this will be extremely difficult to achieve, especially in the face of the high levels of foreign competition which are now present.

(ii) In sharp contrast to the incumbent firms, the two agent firms welcomed liberalisation, which gave them a "theoretical" opportunity to move into new product areas and markets. However, these firms have faced two significant problems ie :

a) the cost of product testing and approval, and the time lags involved, and
b) competing with BT, whose marketing and advertising expenditure is unlikely to be matched by any other firm.

The agent firms believe that liberalisation has caused some market growth and has attracted the interest of the end user. The associated uncertainty, however, has encouraged these firms to reject the adoption of one major goal, and to introduce a multiplicative type goal which covers profits, sales, growth and market shares. At a simplistic level, the agents are aiming to maximise "profitable growth" within the limitations imposed by market conditions, and the definition of "profitable" is necessarily lower than it would be under less uncertain conditions.

The agent firms do not believe the UK market will be truly liberalised until the government retreats completely from product testing and approval. The agents also believe that many new entrants must overcome a considerable amount of prejudice because BT, and many other large consumers, are still attracted primarily to domestic products. However, the established names of the agent firms have helped to eliminate some of the prejudice against the foreign products they supply. These firms are cautious about the expected benefits of

liberalisation, having lost their favoured positions in the market for telephone answering machines as a result of this, and view any high rates of return, which can be earned in this particular market, simply as compensation for opportunities conceded elsewhere.

(iii) The three joint ventures believe that the major benefit of liberalisation, as a whole, has been the opportunity to enter the small business system market. This has provided foreign parent companies with another outlet for their products, and the establishment of subsidiaries in the UK is of strategic importance for subsequent attacks on similar markets in Europe and the Middle East. The UK market is especially attractive to these companies because it displays a high level of demand and provides a suitable outlet for products straddling the "Information Technology" market, ie offering both voice and data transmission.

The joint ventures believe liberalisation has "stimulated" the market but question whether there has been any real growth. Liberalisation is judged to have speeded up the rate of product replacement and caused almost insatiable, but temporary, consumer demand, whereas real growth requires the introduction of suitable new technology and even more competitive conditions. The major cost of liberalisation for the joint venture companies has been that of meeting the established product specifications and obtaining approval. The financial cost of entering the liberalised market has been almost prohibitive, but this is attributed not to liberalisation itself, but to the way in which the policy was implemented.

The major goal of the joint ventures is to become established as recognised suppliers of small business products. One of these companies hopes to secure 8% of the 20-30% of the total market which it estimates is not supplied by BT. On average, the joint ventures operate a 25% gross profit target and a 25% target for return on capital investment.

(iv) The multinationals view the timing of liberalisation as ideal because it provided an additional outlet for products which must be produced in large volumes if costs are to be recovered. These firms

were especially attracted to the UK because it facilitates access to Europe, but some expected the liberalised market to be larger than it actually is. The multinationals are aware that the presently high levels of demand reflect product replacement rather than growth, and expect future market sizes to be smaller in volume terms.

These firms argue that a pseudo-monopoly still exists in this particular market because competition was not implemented quickly enough, ie the government was reluctant to completely liberalise the market prior to the privatisation of BT. BT was given a head start which it exploited by encouraging consumers to replace products while its market was still protected. Products were supplied so quickly in some sectors of the market, such as that covering 50-120 lines, that the multinationals expect an imminent slump. This will be followed, after about one year, by a similar slump in the 20-50 line market, where product lives are shorter but the replacement rate of products has not been so rushed. These expectations limit the opportunities available for the multinationals and have encouraged some of these firms to seek collaboration with suppliers of office automation equipment, in an attempt to move into "related" areas.

The general market strategy of the multinationals is one of growth, and annual sales targets are established for individual product sectors. One of the multinationals has a targeted output level of 2000 units p/a, in the case of 2-line products, and believes that such a volume is necessary simply to avoid loss-making.

(v) Only two small domestic firms have chosen to locate within the small business system market, and both of these admit this to be a consequence of liberalisation destroying the sectors of the market in which they would have rather participated.

The small domestic companies appreciate that the small business system market has grown, not through liberalisation, but through high levels of product replacement and are concerned that the next round of replacement, expected in 1987/8, will be characterised by a return to either BT or the incumbent suppliers. This expectation has influenced the market strategy of these small companies and encouraged them to focus on the short run, and to attempt to secure a small share of the

total market by attracting consumers who are willing to pay relatively high prices for good quality products. One firm estimates that, to cover costs, it must produce and sell at least 1000 systems p/a. This is only half of the equivalent volume estimated by the multinationals.

Having established the identity of competitors in this market, the conduct and market strategies of these firms will be analysed, in section (III), using a similarly structured approach to that employed in Chapter 5 above. The conduct of the incumbents, joint ventures and multinationals has been discussed already, in the case of the large PABX market, and in many respects their behaviour in this particular market will be similar. Some repetition is, therefore, unavoidable, but it is hoped that this can be limited by focusing mostly on those aspects of conduct, with respect to this market, which differ from those discussed in the case of the large PABX market. BT is again discussed in general terms only, for similar reasons to those given in Chapter 5 above.

(III) THE MARKET STRATEGIES OF COMPETING GROUPS

(a) Conditions of Production, Investment, R&D etc.

Incumbent Firms

The incumbents argue that their traditional association with BT, in technical and commercial terms, places them at a present disadvantage by constraining potential relationships with other domestic firms and foreign entrants into this market. When BT monopolised the market it designed products which were further developed by the incumbents, but each firm must now develop and finance products independently. The incumbents have consequently chosen to take out licences on products from Europe or North America, and to develop these to suit the UK market. These firms justify this behaviour on the basis of a shortage in development capacity, rather than a lack of engineering capability, and view it as uneconomic to develop small business systems for the free market when development costs for PABXs and key-telephone systems are £20m and £14m respectively. In 1984/5, one of the incumbents produced 40,000 key-telephone systems for BT.

The incumbents have found their R&D expenditure to be relatively static, in real terms, at approximately 10% of sales in the case of formal R&D, with an additional 5% necessary to finance test equipment. For one incumbent this amounted to £8.7m, in 1984/5, of which £1.4m was spent on product development and the majority was spent on the salaries of skilled engineers. Any patents granted to the incumbents are guarded jealously and, given that royalties from BT alone account for 1-2% of turnover on average, intellectual property rights are treated as major competitive weapons.

The incumbents have invariably found it beneficial to design semiconductor chips inhouse, even if they must subsequently arrange external manufacture. Customised chips are sourced inhouse when possible, but this requires a minimum volume of around 200,000 p/a to cover costs, and in many cases the incumbents' needs simply fail to

justify in-house production. Standard chips are frequently sourced through preference deals established with external suppliers and an average contract value of £9m p/a gives the incumbents some degree of bargaining power. One firm presently sources 20% of its raw materials and semi-finished materials inhouse, plus 50% of its component requirements and 50% of its printed circuit board requirements.

The incumbents' present approach to manufacture is one of mass production, limited only by BT's demand for "unique" products. One incumbent has achieved 90% commonality between its PABX ranges, 35% commonality between the chips and sounders employed in its key-telephone systems, and 80% commonality between product ranges. Key-telephones and PABX differ chiefly with respect to the keypads, mouldings and printed circuit boards which are sourced externally.

The incumbents have increased investment since liberalisation, although this has remained relatively static as a proportion of turnover. The purchase of test equipment has accounted for the largest share of this investment and, in 1983/4, one such firm invested a total of £5.4m of which £1.5m financed factory equipment and a further £2m was spent on test equipment for chips and printed circuit boards. Some of this expenditure has been partially financed by grants from the Dept.of Trade & Industry and the development agencies, but the remainder must be financed from internal profits.

The capital equipment required for manufacture in the small PABX market is similar to that required in the larger market. Computer aided design and manufacturing equipment facilitates the rapid and economic design of complex integrated circuits and other customised work, but priority must also be given to flow soldering equipment, testgear, auto-insertion for printed circuit boards and rapid production equipment. The incumbents purchase most of their capital equipment "off the shelf", although test rigs and modules are customised to suit the exact requirements of the manufacturer. Capital expenditure in this market has a target payback period of aproximately two years, and the incumbents believe that a 6-7% real rate of return is necessary for survival.

The investment undertaken by one incumbent firm has reduced factory costs by 45% over 5 years, although some of this cost fall is

attributed to cheaper input materials and the benefits of "learning". Productivity within this particular firm has increased as employment has fallen by more than 5000 in 3 years. At present, 73% of the workforce are employed in manufacturing, 16% in R%D, 8% in administration and management and 3% in marketing. Of the employees in manufacturing, 1% are engineers and 8% are technicians and, of the employees working in development, 57% are qualified R&D staff and 22% are technicians.

Agent Firms

Some foreign manufacturers have already spent £20m developing small PABX and require high sales volumes to recover these costs within a reasonable time period. These firms have, therefore, been attracted to the liberalised UK market but have decided to distribute products through agent firms. Agents are responsibile for the progress of products through the testing and approval procedure, and contribute more in the way of "know-how" than in financial expense. Redesigning products for the UK market has not been too problematical and the agents' R&D expenditure has subsequently fallen, in real terms, since liberalisation forced them to move from other sectors of the market. The agents hold no patents because the foreign manufacturers apply for these abroad and remain responsible for their application world-wide.

The products offered by the agents are manufactured for replacement and have life expectancies of approximately 10 years, during which time products will be fully supported. Each agent must make a serious, and long-term, commitment to support any product it agrees to market. Products are sourced abroad in almost completed form, and the agent firms have little need for backward integration. These firms have no plans to produce input requirements inhouse, but chip requirements for anglicised products have given them some experience in the semi-conductor market. Their experience suggests that, above a certain level of demand relating to a manufactured output of £100m p/a, the price of semi-conductors becomes independent of volume, ie further increasing volume requirements will not reduce unit costs.

The agent firms are in the enviable position of having required only minimal investment prior to market entry, and this was primarily directed towards securing a faster path through the testing and approvals procedure. Subsequent to their establishment within this market the agents have invested only in modern methods of stock control.

On average, the agent firms employ 50% of their workforces in engineering, 20% in administration and management, and 30% in sales and marketing. Within the engineering sector, roughly 40% of staff provide technical support, 20% are employed in maintenance and 10% provide installation services. Both agent firms were obliged to shed a significant proportion of their labour forces after the demise of their traditional markets, but employment is now relatively stable and the number of qualified technical staff has increased.

Joint Ventures

The three joint ventures believe that products in the small business system market should have long life expectancies, but, due to the present state of product innovation, they are now manufactured for replacement. Key-telephone systems, in particular, are regarded almost as fashion items and, although they have manufactured lives of 5-10 years, product renewal is expected within three years.

The investment requirements of the joint ventures were discussed in Chapter 5 above but, on average, these firms estimate that entry into the small business sector cost an additional £350,000. One company spent £51,000, in 1984, establishing suitable R&D facilities but, given that products are sourced from parent companies, the only development work required in the UK concerns the modification of products to meet UK standards and the particular needs of the UK market. No process development is undertaken by these firms and, on average, less than 1% of employees work in R&D, although some work may be subcontracted.

The joint ventures generally undertake "kit-type assembly" of products, but hope to become self-sufficient in the near future,

although, to avoid loss, this would require an estimated minimum output of, for example, 500 key-telephones p/a. Components are generally sourced from the foreign partner of the joint venture and supplied through an arm's length commercial relationship. The intention of each joint venture is to increase the proportion of domestic components supplied, but as yet more than 50% of the total input requirements for small PABX must be sourced abroad. Suitable components are not available in the UK as yet, but present arrangements have still enabled at least one firm to halve its input costs over four years.

Employment costs are presently high for the joint ventures. One of these firms has created 140 jobs, in total, since liberalisation. It is impossible to distinguish the employees working only in the small business market but, overall, 11% of this firm's employees work in sales and marketing, 36% in assembly type work, 7% in engineering, product support and development, 10% in installation, 0.1% in training and the remaining 46.9% in administration, stores and distribution. None of the joint ventures have experienced any serious skill shortages, but this is partly attributed to a conscious decision to locate in areas of the country where firms employing suitably skilled labour were shedding some of their workforces.

Multinationals

The multinationals offer products which have been developed through the progressive updating of features and software employed in previous models, and which would not have been offered to domestic consumers in the absence of liberalisation. Quality is considered to be especially important, because telephones usually provide the first line of contact to many small businesses, and key-telephone systems etc are consequently designed with service expectancies of ten years, although market expectancy is lower at only seven years.

The multinationals believe their strength in this market stems from the transfer of technology from their parent companies, who are responsible for product design and development. No R&D work is

subcontracted within the UK but most companies have established formal R&D facilities which employ an average of 100 people, of which approximately 80% are graduate engineers. Although the bulk of work is accounted for by the customisation of foreign products to meet UK regulations, a limited amount of new product development is also undertaken, but only 2% of engineers, on average, are employed in such design projects. One multinational estimates that it spent 21% of its turnover on engineering, in 1984, of which 15% was R&D type work. Some financial assistance was received, for this, from the Dept.of Trade & Industry who granted this particular company almost £1m.

In the manufacture of key-telephone systems the multinationals generally subcontract their assembly-type work on the basis that BT's dominance over the market has made it uneconomic to undertake manufacture which is volume dependent, and which would subsequently require that a considerable proportion of stock be sold, through BT, at unsuitably low prices. Very little assembly work is subcontracted in the case of PABX however, and any which is will usually be subcontracted to the parent companies. In the manufacture of small PABX, the multinationals aim for 100% commonality in software and approximately 60% in hardware, ie the major difference between products is simply one of "packaging". Each firm ensures that particular items, such as printed circuit boards, are common between ranges.

The investment requirements of at least some of the multinationals have been discussed in Chapter 5 above. However, one company estimates that it had to spend an additional £1m before entering the key-telephone market and that total investment, in this particular market, stood at £3m in 1984. Investment in this market is ongoing in nature but, whereas previous expenditure focused on securing suitable capacity and productivity, present and future investment is directed towards building a strong engineering base in the UK, from which to attack other markets.

One of these companies estimates that it is 25% of the way along its learning curve in this particular market and can, therefore, expect to benefit from cost reduction as it moves further along. A significant proportion of total costs is, however, accounted for by

high returns to suitably skilled labour. On average, the multinationals operating in this market employ 8% of staff in marketing, 11% in R&D and 3% in engineering. Between 60-70% of the engineers employed by any of these companies are graduates and approximately 30% hold HNC qualifications.

Small Domestic Companies

The small domestic manufacturers view themselves as involved in the "complex application of complex chips" rather than product manufacture. Each competitor is attempting, through the use of software, to make basically similar semi-conductor chips perform in a different manner to that employed in competing products. These firms believe that liberalisation has encouraged a high level of product replacement and this has, in turn, encouraged head-to-head competition within the market. It is crucial to stay ahead in such a market, and R&D expenditure has consequently increased, in nominal terms, since entry, although increasing sales have caused such expenditure to fall as a proportion of turnover.

R&D undertaken by the small domestic manufacturers is obviously limited in comparison with that undertaken by the incumbents and multinationals etc, but these firms still view themselves as R&D intensive. These firms have established "development" departments for product design work but are not interested in undertaking basic research; all development work must have "deliverable" conclusions. The life expectancy of small business systems is, ideally, whatever the user decides is appropriate and, although products are designed to last 5-10 years, fashion and changing technology have made five year lives most appropriate. Because it is almost impossible to patent a combination of hardware and software, the small domestic firms have chosen to protect their products through secrecy.

Being small and relatively new, the small domestic firms do not control their own component supplies and are seeking low cost suppliers. Each firm hopes to secure an attachment to one particular supplier, preferably of US or Japanese ownership, to cut out domestic

distributors and consequently reduce costs. These firms are small by world standards, however, and they frequently face component shortages whenever foreign suppliers revert input supplies back to own their domestic markets to meet higher levels of demand.

One small domestic firm estimates that it invested £2.7m to enter this market, although this expenditure would have been significantly lower, at approximately £0.33m, if it had chosen to import rather than design its own product. The level of investment undertaken by small domestic manufacturers has increased steadily, not because of liberalisation, but because an effort is now being made to become established on an international scale. Investment expenditure is financed through a mixture of equity financing and support from the Dept.of Trade & Industry.

Present investment by the small domestic manufacturers includes expenditure on computer aided design and manufacturing equipment (CAD/CAM). Some process innovation will be introduced into the manufacturing processes of these firms, but as yet this has only concerned the computerised testing of components and products. To ensure that PABX and key-telephone systems remain simple and reasonably inexpensive to manufacture, the small domestic firms believe it is vital that production technology runs alongside product development, and considerable investment will be channelled into cost reduction. Costs are falling at present, and this is expected to continue as firms increase volume output and exploit considerable economies of scale. Labour costs are, however, expected to remain high; on average these firms employ 47% of employees in manufacturing and 53% in administration, sales, installation and R&D.

b) **Product Testing and Approval**

Incumbent Firms

The incumbent firms invested heavily to reach BT's stringent technical standards before liberalisation, and are keen that tight specifications be retained in the liberalised market. However, although they are generally happy with the present testing and approvals procedure, the incumbents have expressed concern over the suitability of BT as judge and jury. Because it had previously been responsible for the approval of all small business systems, BT began the liberalised era as the only organisation with the appropriate technology and personnel. BT consequently undertook product testing on behalf of BABT, but the incumbents would have been happier if BT had been totally removed from the approvals procedure.

The incumbents recognise that the approvals procedure has constituted a barrier to entry in this market, but attribute this to misuse of the procedure rather than an expected and planned consequence. The time delays experienced in testing and approving small PABX are judged to be mostly the fault of the manufacturers themselves, who are submitting products which are not sufficiently prepared to meet the established specifications, and must expect these to be rejected. The introduction of an interim testing scheme has speeded up the approvals process, and there are so many participants now competing in the small business market that the incumbents judge this barrier to have been relatively ineffective. These firms also judge the cost of product approval, in this particular market, to be comparable with their own costs which are incurred under the MDT scheme, ie testing a hybrid PABX/key-telephone and a small PABX costs approximately £20,000 and £25-30,000 respectively.

Agent Firms

The agent firms view queues for product testing as an inevitable

consequence of the equipment and personnel shortages suffered by an underfunded and inexperienced BABT, but argue that consumers will not benefit from a wider choice of product unless the time involved in obtaining product approval is significantly reduced. These firms also complain about the high cost of approvals; one firm was charged almost ฿50,000 for the approval of a small business system, but knows this to be more than double the approval cost estimated by the incumbents. This agent firm has considered introducing a new PABX into this market but is concerned that the approval cost, expected to be almost ฿150,000, would be at least six times the fee payable in the manufacturer's domestic market.

The agents view the approvals procedure as bureaucratic and full of red tape. Insufficent knowledge on the part of BABT employees has prevented them from acting flexibly, and forced them to work to the letter of the law. This problem is further compounded by the fact that product specifications are so complex that the agents believe they are more suited to defence and other military products.

Joint Ventures

The joint ventures believe that product testing was more stringent in this market before liberalisation, but BT's testing fees were considerably lower than those now charged by BABT, and were not requested until testing had been completed.

In the small business system market, approval costs are lower than in the larger market, but a lower product price makes it relatively more difficult to pass these costs onto the consumer. A small product which cost ฿2-300 for approval through BT, in 1984 prices, presently costs ฿35,000 through BABT, taking 18 months to two years, and one joint venture recently paid ฿100,000 for a PABX approval which would have cost ฿7,000 in the USA. However, although such costs appear high, these firms are aware that suitable testing equipment costs at least ฿200,000, and that an annual outlay of ฿100,000 would be required to keep this operational.

The joint ventures believe that time lags and the high costs of

approval effectively remove any advantage of being first in this particular market. Some product specifications are considered almost impossible to meet, with the result that pioneering firms find themselves involved in lengthy queries, during which time approval fees remain with BABT and the manufacturers forego interest payments on these funds. Present arrangements are viewed as especially harmful to small firms, and the joint ventures consequently suggest that private testing laboratories be authorised to test and approve products. These products would then receive automatic approval from BABT.

Multinationals

The multinationals believe the approvals procedure has represented a problem, but is now more suitably organised. Writing the required product specifications was a sizeable task and it is only now that these specifications are being finalised in a suitable form. The approval costs incurred by the multinationals, ie ₤25,000 for a small PABX and ₤30,000 for a key telephone system, are viewed, however, as exceptionally high and constituting obstacles which are especially difficult for smaller firms to overcome. The multinationals also object to the rule that "add-ons", designed for use with PABXs, must be tested and approved with each relevant model of PABX. This is viewed as both costly and unnecessary. Finally, these firms disapprove of the fact that BT acted as both judge and jury for some time in this market, but accept that this was due to insufficient technical knowledge on the part of BABT.

Small Domestic Companies

The small domestic firms in this market view the network itself as a limiting factor which would not be found in other countries, and which is the result of underinvestment by the Post Office and BT. Because such variable technology is found in the network itself,

product standards must be high enough to cope with the poorest technology installed. These standards were not published on schedule, and many firms found themselves in the position of developing products to meet unknown specifications.

The high cost of product approval has encouraged the small firms to apply for one basic approval and to rely on the introduction of enhancements to provide a suitable variety of products. For one firm this basic approval cost was ₤20,000, which is just slightly lower than larger firms have been charged, even though the product in question was of a more basic design. Because BABT has not been obliged to publicise its cost structure, the small firms are concerned that it can adopt a perfectly discriminating pricing policy, ie charging the maximum amount that each manufacturer is willing to pay.

Small firms find the slow pace of attaining product approval to be especially harmful because the expected cost of approval must be paid to BABT in advance and is tied up for some time. To complain about BABT itself, or the specifications which products must meet, only leads to further delays which are difficult for small firms to finance.

(c) Retail Distribution, Price and Non-Price Competition

Incumbent Firms

As far as the incumbents are concerned, BT continues to represent the major route to the market. In 1983/4 BT accounted for 81% of the total deliveries of one incumbent, whereas only 14% of sales were made direct to end users and 5% through independent distributors. Of total deliveries made to BT, 50% were "proprietary", ie the products had been developed by BT and were manufactured, by the incumbent, under licence. This company has remained strongly orientated towards production for BT, who bought 90% of its output of key-telephone systems in 1984. As in the large market however, the incumbents admit to disadvantages associated with supplying products to BT, ie firms lose their ability to determine product prices to end users and are under considerable pressure to price discriminate in BT's favour. The profit levels presently achieved by the incumbents are significantly lower than those achieved under the Bulk Supply Agreements, because the present system employs undisclosed tenders to establish normative product prices.

The incumbent firms made private sales in the large PABX market before liberalisation enabled them to compete directly in this particular market, and have subsequently benefitted from the ability to employ the sales and servicing networks which were already operational. Only minor alterations have been required to adapt this structure to the supply of smaller sized products but, in the case of very small products such as those incorporating fewer than 30 lines, it is not considered economic to distribute and install these directly, and distributors are generally employed.

A third possible distribution channel is exporting which accounts for an average 5% of the incumbents' business and 10% of their total output of subscriber equipment. Key-telephone systems do not have major export potential but the incumbents have found small PABX to be especially successful in South East Asia, and hope to penetrate markets in the US, Europe, Italy, Germany and the Middle East.

As in the market for large PABX, the incumbents set prices at a level the market will bear and work backwards to costs and volume decisions. The final market price is, however, frequently set by distributors. Prices in this market are judged to be falling 15% p/a while the feature content of products is increasing at the rate of 20%, ie a similar rate to that achieved in the larger product market.

Product differentiation is of increasing importance in the small business system market, although it appears to have been irrelevant in the past. Manufacturers can now place their names on products, and characteristics such as design and product appearance have become significant. Most products offered in this market have similar technology and capabilities, and attempts to make products appear unique must consequently focus on factors such as the speed of delivery, supplier reputation, maintenance facilities, the attitude of marketing staff and product presentation. A considerable advantage may also be obtained if products are manufactured domestically. Product quality is important but is taken for granted in the case of products distributed through BT. After sales services have become particularly important in the case of products not supplied through BT, and the incumbents consequently provide both direct product support and indirect services through both dealers and distributors.

Advertising expenditure has not increased significantly since liberalisation, because the incumbents believe they are operating in a low profile industry where consumers care little about manufacturers and where advertising has a limited effect. One of the incumbents sets aside a total promotional budget equal to 5% of total sales, but spends only 1% of this advertising small business products, and a further 0.5% on administrative pull-through. In nominal terms this firm's budget has increased from ₤100,000 in 1979 to more than ₤2m in 1983/4. The increase in "promotional" expenditure since liberalisation has been phenomenal, but increases in advertising expenditure have been less noticeable.

Agent Firms

The agent firms have not secured BT as a buyer but regard it as an extremely attractive distributor, because it controls such a large proportion of the customer base. However, given BT's ability to grind suppliers into the ground over price, and to subsequently mark products up by 100% but remain the market price leader, the agent firms would only be willing to trade with BT through lock-tight contracts.

The agent firms are attempting to attract customers from BT, but are limited by sales forces which are too small to cover the entire market. These firms do not own any retail outlets but make direct sales and sales through distributors. Being one of the first firms to enter this particular market gave one of the agent companies a considerable advantage, in so far as it could secure the services of the more reputable distributors. The use of back-street "risk" ventures is considered to be more harmful than beneficial in the long run, and it is unlikely that such firms would be able to cope with the volume of output which the agents intend to achieve.

Because the products supplied by the agent firms have been developed and manufactured by foreign manufacturers, export sales are improbable. Products are already supplied to profitable export markets by the foreign manufacturers themselves, or through the use of other agent firms as necessary.

Key-telephone prices ranged from £1800-7000 in 1984, and were dependent upon the features offered and the size configuration of each product. The agents consider there to be little scope for price reduction, given that prices are already lower than those in the US market, but do not believe that price competition has been severe enough to deter entry. Prices will always be relevant in this market, but the agent firms believe that these are now becoming a secondary issue and that the most successful firms will not compete on price alone. Given that their function is one of adding technical value to foreign products, these firms believe they can best secure large profit margins by offering consumers suitable distributional and service arrangements, including product installation, after sales

services and maintenance facilities.

The agent firms are aware of the increasing importance of product differentiation which has encouraged firms to aim for exterior product attractiveness in addition to high levels of technical capability. The facilities offered and the ease of product use are considered to be the most important elements of non-price competition, but aesthetics also count to some extent. Trade names are considered important in so far as they facilitate customer referrals and introductions, and it is, therefore, important that consumers recognise the agents' names, even if this is with regard to something other than small business systems.

The agent firms have both promoted their company names but, while one firm increased its expenditure on product promotion, the other cut its expensive national advertising by ₧80,000 in 1983/4. Total marketing expenditure now represents 18% of this company'S turnover but advertising only accounts for 0.25%. Both agents determine their advertising strategies annually and treat advertising as a form of investment. Advertising appears to be most effective when undertaken through newspapers, business magazines and direct mail.

Joint Ventures

The joint ventures believe that the sheer size of BT's procurement operation outweighs both the cost, to the manufacturer, of providing products at low prices, and the possibility that consumers will be unaware of the manufacturer's identity. The joint ventures, however, do not supply small business systems through BT and have only limited direct dealings with consumers; most of their sales are made through dealers and distributors who are also encouraged to offer the necessary after sales services for any products they supply. Exports are not the concern of the joint venture companies themselves, but of their foreign parent companies.

In setting product price the joint ventures believe the customer should get what he pays for, ie products offering few features should be competitively priced but good quality products, backed by major

trade names, can be sold at higher prices, although prices must never get too far out of line with the market average. Good quality products can also result in lucrative maintenance contracts. The joint ventures' own prices are established, in this particular market, on the basis of cost rather than what the market will bear.

The joint ventures closely monitor their competitors with a view to copying any non-price strategies which appear particularly successful. Product differentiation is considered to be important, in this market, and these firms are attempting to differentiate their products with respect to both visible factors, such as style and design, and invisible factors, such as technology and quality. In the case of key-telephone systems attempts are made to package each product uniquely, and sales resistance appears relatively easy to overcome through the addition of new product features. The joint ventures believe it important that their trade names be associated with good quality products, and are attempting to exploit the good reputation of their parent companies.

Selling products through dealers and distributors reduces the "need" for manufacturers to undertake specific product advertising, but one of these companies still estimates that an expenditure equal to 5% of turnover is necessary if it is to secure an acceptable market share. Just over half of this firms's expenditure is spent in a pre-ordained manner, but the remainder is spent in a more ad-hoc manner. In general, the joint ventures favour promotion and advertising through trade shows, mail shots, newspapers, trade journals and magazines and consider the use of radio to be effective, but too expensive as yet.

Multinationals

The multinationals distribute some of their output through BT, and believe this to be necessary for success in a market where BT is still responsible for 70-80% of sales. BT appears to be selling larger volumes of product than before liberalisation, and the multinationals intend to share in this growth. The supply contracts drawn up by BT

are, however, quite vague in nature and contain only a commitment on its part to purchase, for example, "between 5-8000 small PABX" in one year. The multinationals estimate they would require at least 3 months notice before the volume procured could be altered from one limit to the other.

The multinationals employ only limited sales forces in this particular market sector and prefer to make all private sales through distributors, who are generally better equipped to compete with BT. Some export sales are also made, especially to the Middle East, Africa and Northern Europe.

The multinationals estimate that they lost a considerable amount of revenue on entering this particular market, because while market prices remained stable or decreased, the exchange rate was fluctuating, and manufacture was taking place abroad. Production facilities have now been established within the UK however, and such problems have lost significance. Prices are now established on the basis of both cost and what the market will bear, and the introduction of some particular product features may command a 20% premium on the basic product price.

The multinationals do not believe that any firms are making significant profits in this market. Prices have been driven downward since liberalisation and, although they appear to have stabilised in the transfer of products to dealers or distributors, they are still decreasing with regard to the end user. Once suitable levels of installation service, product support, maintenance and company credibility have all been assured, prices provide the dominant means of competition but appear to be remaining relatively higher, on a per-line basis, than those in the market for larger business products.

The multinationals do not consider product differentiation to be of much significance in the market for small business systems although products are differentiated in terms of style and packaging. Competition on the basis of voice features, in particular, is considered to have reached its limit. Trade names are, however, important, because consumers appear eager to buy products from established distributors if not from BT itself. A suitable after sales service must also be offered for any product not supplied through BT,

and the multinationals have recently established repair depots to deal with key-telephone systems, and offer both sales and engineering courses to dealers and distributors.

The multinationals believe that marketing is of significant importance and should be directed at both the end user and potential dealers. No direct market research has been carried out, but consumer preferences are monitored through feedback from agents and distributors. The multinationals have little need to advertise their own products, and leave this to the dealers, but are keen to advertise at the corporate level to familiarise consumers with their company names. Because there is little need to advertise products directly, the advertising budget of the multinationals is relatively low, at ≦0.25-0.6m p/a.

Small Domestic Companies

The small domestic companies do not supply BT with products and consider this to be a significant disadvantage, in so far as the sheer size of BT inspires consumer confidence. However, these firms frequently benefit from consumer disatisfaction with BT. These firms have rejected the idea of establishing large sales forces and have opted for a combination of direct sales and sales through distributors and dealers. No export sales were made in 1984/5, although export mechanisms were in the process of being established. One firm aims to export 70% of its output by 1990 and considers the UK market to be limited in comparison with those available throughout the world.

The pricing strategy of the small domestic firms involves charging a premium over the price of their nearest competitor. This premium is justified in so far as they consider their products to be of a higher quality and level of functionality. Considerable attention is given to price, but this does not provide the basis of competition. Price is most important to the smaller business customers who have little need for networking capability or data transmission, but relatively larger users, who may operate multi-site networks, appreciate that compensation for price premiums will be received

through superior product operation. One small firm refuses to regard product price as a barrier to entry and considers price to be insignificant if it lies within 30% of the market average. This particular firm has increased its product price since liberalisation, even though prices have generally fallen.

The small domestic firms view product differentiation as critical in any market which is not necessarily price driven, and consider themselves to be participating in a "specialised" product market, ie where products exhibit relatively high levels of differentiation, but there is a limited number of ways in which such differentiation can be achieved. The small domestic manufacturers aim to satisfy true user needs by producing products which exhibit enough flexibility, and updating potential, to be almost tailor made for any consumer. In this market, product reliability is accepted as a matter of course and the small manufacturers see no reason why quality cannot be offered at relatively low prices. Trade names are important and small firms, in particular, must strive to be associated with high quality if they are to dissuade consumers from drifting back to the incumbent firms in the long run. However, in response to the requirement that each firm must offer nationwide maintenance services, either independently or through the dealers and distributors appointed to supply its products, the small manufacturers only offer a service of "last resort".

These small firms see no apparent need to advertise their company names, having received adequate publicity on first entering this "competitive" market, and view product advertising almost as the sole responsibility of distributors. However, these firms place considerable emphasis on product marketing, and commission market research reports, employ focus groups and organise meetings with salesmen and dealers in an effort to monitor consumer preferences. Sales data only informs companies of the correct time to withdraw products from the market, and arrives too late to influence product design, so the small firms pay particular attention to "why" specific products are selling well and are not content to simply know that they are successful. The total promotional costs of the small domestic firms are quite low, at an average of 2-3% of turnover, and advertising expenditure accounts for only 0.95% on average.

(IV) ANALYSIS OF QUESTIONNAIRE DATA AND HYPOTHESES TESTING

In the above discussion the views of market participants were presented on the basis of firm type. This discussion was unavoidably subjective in nature but it is the intention of the following section to test the three hypotheses of this thesis in a more objective manner, using the structure and methodology employed in Chapter 5.

Market Structure

Prior to liberalisation, BT exerted a monopoly over the market for small business systems, and supplied products manufactured primarily by the incumbent firms. Liberalisation was designed to enable both manufacturers and other distributors to compete with BT, but a two year adjustment period was stipulated before competitive conditions would prevail. During this period the incumbent firms held the considerable advantage of supplying products to BT who was encouraging product replacement before the market was completely liberalised. BT's policy was successful in so far as more than 40% of the installed base was replaced before the end of 1983 and BT itself achieved an 80-85% share of the replacement market.

In 1983, immediately prior to complete liberalisation being enforced, total sales of small PABX systems were worth £142.5m in market prices and sales of key-telephone systems were valued at an additional £37.5m, giving a total market value of £180. In manufacturers' prices the PABX market was worth £100m and key-telephone systems were valued at £20m. After liberalisation, in 1984/5, the PABX market had increased in value to £151m in manufacturer's prices and £188.27m in current market prices, while the equivalent values for the key-telephone market were £47.9m and £90m respectively. On the basis of these estimates, the total value of the small business system market has increased, in nominal terms, by 66% in manufacturers' prices, but by only 55% in market prices[5]. Most firms expected 1984/5 to be the peak year for sales in this market; as

the rate of product replacement decreases, the value of this market is expected to fall in both real and nominal terms.

The relationship between firm type and participation in this sector of the market was discussed in Chapter 5. All four incumbent firms compete, both agent firms, all three joint ventures and two multinationals. This market holds little attraction for other domestic manufacturers, however, with none of the suppliers participating and only two out of seven small domestic firms. Given that firm type is related to participation, there may also be a relationship between firm size and participation. To test whether this is true both participants and non-participants are classified on the basis of size (£m) as :

Turnover (£m p/a)	$0<x\leq5$	$5<x\leq20$	$20<x\leq50$	$x>50$	Total
Participants	2	4	2	5	13
Non-participants	7	6	0	0	13
Total	9	10	2	5	26

Within the sample of twenty-six firms interviewed in this study, thirteen participate in the market for small business equipment and thirteen do not. Only six out of the nineteen smaller sized firms (ie those with turnovers of less than £20m) compete while all seven of the firms with turnovers of more than £20m participate in this sector. This distribution, with a χ^2 statistic of 10.18 with 3 degrees of freedom, is statistically significant, confirming a relationship between firm size and participation in the small business product market.

As in the case of large PABX, the effects of liberalisation on market structure will be discussed in terms of vertical integration, diversification and the presence of entry barriers. The arguments for integration may be quite strong in this market, especially if economies of scale are important and the volume procurement of inputs

is best obtained through an integrated structure. Forward integration may also be favoured by firms who do not distribute products through BT and require suitable channels of distribution to ensure that their products reach the market.

The following table gives some indication of the extent of integration witnessed among sample members where

A : firm displays both forward and backward integration,

B : firm displays only forward integration,

C : firm displays only backward integration,

D : firm displays no vertical integration,

Category	A	B	C	D	Total
Incumbents	2	0	2	0	4
Agents	0	1	0	1	2
Joint Ventures	0	0	2	1	3
Multinationals	0	0	1	1	2
Small Domestic Firms	0	0	0	2	2
Participants	2	1	5	5	13
Non-Participants	0	0	2	11	13
Total	2	1	7	16	26

These figures confirm that the two firms in the sample who display both forward and backward integration compete in the small PABX sector - these firms also compete in the large PABX sector and, as will be confirmed in Chapter 7, in the market for telephone handsets. The one sample member displaying only forward integration also participates in this market, as do five of the firms displaying backward integration (of which four competed in the large PABX market).

There is a significant relationship between the pattern of integration exhibited by firms and their participation in this particular sector - the χ^2 test statistic of 6.54 is significant at

the 10% level. As in the case of the large PABX market we can, therefore, confirm that integrated firms, especially those integrated in the backward direction, are attracted to this particular sector. However, the spread of figures in the upper tier of the table does not suggest the presence of a significant relationship between firm type and integration.

The results obtained regarding diversification are not similar, and are summarised in the following table where :

A : diversified within telecoms and externally

B : diversified within telecoms only

C : external diversification only

D : no diversification

Category	A	B	C	D	Total
Incumbents	2	2	0	0	4
Agents	0	2	0	0	2
Joint Ventures	0	2	0	1	3
Multinationals	0	2	0	0	2
Small Domestic Firms	0	1	0	1	2
Participants	2	9	0	2	13
Non-Participants	1	7	1	4	13
Total	3	16	1	6	26

These results indicate that, of the thirteen sample members participating in this sector, eleven display some measure of diversification within telecommunications. Two of these firms are also diversified outside telecommunications and a further two participants display no diversification. However, this result is not statistically significant, ie there is no apparent relationship between participation and diversification. Neither is there a relationship between firm type and diversification, given that nine out of

thirteen participants are placed in category B.

Patents are of some importance in the small business sector, as can be confirmed by the following categorisation where :

A : firm/parent controls patents and registers product designs

B : firm/parent controls patents only

C : firm/parent registers product designs only

D : firm/parent neither controls patents nor registers product designs

Category	A	B	C	D	**Total**
Participants	5	2	1	5	13
Non-Participants	0	4	2	7	13
Total	5	6	3	12	26

Of the thirteen firms competing in this market, seven control patents and six register product designs. The relationship between rows and columns is statistically significant at the 10% level, with a χ^2 test statistic, given 3 degrees of freedom, of 6.33. This result suggests that patents, and the registration of product designs, represent a barrier to entry to this particular sector.

In the large PABX market product differentiation was not found to be significant, and all but one of the participants offered only one model. In the smaller product market, however, there is much more product variety not only because of the larger number of participants, but also because the majority of firms offer more than one model of product.

No. of Models	1	2-5	5-10	>10	Total
Incumbents	0	3	1	0	4
Agents	1	1	0	0	2
Joint Ventures	1	2	0	0	3
Multinationals	0	2	0	0	2
Small Domestic Firms	1	1	0	0	2
Total	3	9	1	0	13

The small domestic companies and agent firms appear to offer limited product ranges at this time, but the incumbents, joint ventures and multinationals favour relatively larger product ranges. The effect of this has been a considerable increase in the number of product available to consumers - with the majority of these new products being offered in an attempt to exploit niches in characteristics space and not being differentiated on the basis of price. However, it is doubtful whether there is a significant relationship between firm type and product variety.

Different categories of firm have different opinions regarding the volumes required to minimise production costs. In the case of key-telephone systems, for example, the joint ventures estimate that an output of 500 units p/a will just cover costs, whereas the small domestic firms estimate the same figure to be 1000 units p/a and both the multinationals and incumbents believe an output of 2000 units p/a is required. The variance in these estimates reflects several factors, including the use of different production processes, different cost structures, and the level at which the product can be priced. Both the multinationals and incumbents make significant sales through BT, who sources products at low cost, and both categories of firm estimate a relatively high level of output to be necessary before costs are recovered. Such views are likely to restrict the number of product models offered by such firms who will place considerable emphasis on economies of scale.

To establish the general identity of other significant barriers to

this market, ie in addition to economies of scale, each sample member classified the sources of significant barriers as :

A : both price and non-price sources and securing BABT approval

B : price sources and BABT approval

C : non-price sources and BABT approvals

D : price sources only

E : non-price sources only

F : BABT approvals only

G : a mixture of price and non-price sources

H : no significant barriers

where non-price sources include product quality, advertising and R&D expediture etc.

Category	A	B	C	D	E	F	G	H	Total
Incumbents	0	1	0	0	0	2	0	1	4
Agents	0	0	0	0	1	0	0	1	2
Joint Ventures	0	0	0	0	0	2	0	1	3
Multinationals	0	1	0	0	0	1	0	0	2
Small Domestic Firms	0	0	0	1	0	1	0	0	2
Participants	0	2	0	1	1	6	0	3	13
Non-Participants	0	0	1	1	2	4	0	5	13
Total	0	2	1	2	3	10	0	8	26

Eight participants view the approvals process as a significant barrier to entry, however two of these firms view limit pricing on the part of participants as of equal importance and three participants refuse to recognise the existence of any significant barriers. Neither of the relationships between firm type and views on entry barriers, or between entry barriers and market presence are significant.

As in the case of the large PABX market, firms in this market hold similar views regarding the threat of entry. Nine firms feel

"threatened" by potential foreign entry, one firm by both foreign and domestic entry, and only four of the thirteen participants are confident that no potential entry could be threatening to their position in the market. The failure of domestic firms to provide a serious threat is again attributable to economies of scale - even though these do not appear to be as significant in this sector, as in the larger product market, they are still of sufficient size to deter domestic firms who would be entering the market with little or no experience. Foreign firms provide the only credible threat and, in contrast to the larger market, further entry is expected in this market in the near future.

The final aspect of market structure to be examined in detail is that of financial support. As before, firms can be classified on the basis of financial support received from the development agencies and other government schemes, where the latter generally offer technical, as opposed to capital, support. Firms are classified into groups as :

A : support from the government and development agencies

B : government technical support only

C : development agency support only

D : no support received to date

Category	A	B	C	D	Total
Incumbents	1	3	0	0	4
Agents	0	0	0	2	2
Joint Ventures	1	0	1	1	3
Multinationals	1	0	1	0	2
Small Domestic Firms	0	1	0	1	2
Participants	3	4	2	4	13
Non-Participants	0	4	4	5	13
Total	3	8	6	9	26

Three participants receive support from both government schemes and development agencies, but four firms appear to receive no support at all. Of the thirteen participants, a total of five receive development agency support and seven receive support from technical schemes run by the government. All four of the incumbents qualify for some form of support, as do both of the multinationals, but one joint venture, one small domestic firm and the two agent firms are given no financial help. Using a χ^2 test confirms the absence of a statistically significant relationship between market presence and financial support received.

TABLE 6.1 SUMMARY OF STRUCTURAL RESULTS

VARIABLE	HYPOTHESISED DIFFERENCE BETWEEN PARTICIPANTS & NON-PARTICIPANTS
(1) SIZE	SIGNIFICANT
(2) VERTICAL INTEGRATION	SIGNIFICANT
(3) DIVERSIFICATION	NOT SIGNIFICANT
(4) PATENTS	SIGNIFICANT
(5) ENTRY BARRIERS	NOT SIGNIFICANT
(6) THREAT OF ENTRY	NOT SIGNIFICANT
(7) SOURCES OF AID	NOT SIGNIFICANT

The above results highlight some of the most interesting features of the large PABX market. There is a relationship between size and participation in so far as every sample member with a turnover exceeding £20m competes in this sector although, unlike the larger PABX market, there are also opportunities for smaller scale competitors. Although economies of scale are important in this market, these are not as important as in the larger product market and opportunities for niche-filling by smaller firms remain. These opportunities are aided by the presence of some degree of product differentiation.

In this particular market product differentiation does not appear, as yet, to constitute a barrier through brand loyalty, but has the effect of facilitating entry. This gives rise to the important question of whether excess entry is being encouraged by such conditions but, at the time this study was completed, this did not appear to be the case. The number of participants, at thirteen, was not considerable, and most firms have limited their product ranges to 2-3 models. Firms are still pursuing economies of scale in this market which, in conjunction with the other barriers discussed, suggests that entry has occurred but has not been excessive. On the basis of the above results, and the case study material presented beforehand, Hypothesis 1 must be accepted - ie the government's liberalisation policy appears to have successfully introduced a socially efficient level of competition into this particular market sector. In fact, this appears to be the most competitive of the three sectors examined in this study.

Conduct of Market Participants

The structure of the small business equipment market approximates a very weak oligopoly situation in which strong interdependence is displayed between some competitors, or in some areas of the market, and relatively weak levels of interdependence in other. On the basis of the theory discussed in Chapter 4 such a structure is hypothesised to lead to a prevalence of non-price competition, a hypothesis which was rejected in the large product sector discussed in Chapter 5. With a view to testing whether the same hypothesis holds in the small business equipment sector an objective analysis of pricing policies, R&D, advertising, investment etc will be completed below and judged in conjunction with the more subjective analysis presented in the case study reports above.

The question of investment in plant again requires careful treatment in so far as firms which have recently entered the industry may display unusually high levels of investment expenditure. The following data must, therefore, be accepted only as an illustration of

investment patterns in 1984/5. Investment expenditure (x) is expressed as a proportion of turnover and split into 4 categories as :

Investment (%)	$0<x\leq0.5\%$	$0.5<x\leq5\%$	$5<x\leq10\%$	$x>10\%$	Total
Incumbents	0	3	1	0	4
Agents	0	1	0	1	2
Joint Ventures	0	1	1	1	3
Multinationals	0	0	0	2	2
Small Domestic Firms	0	0	0	2	2
Participants	0	5	2	6	13
Non-Participants	5	1	0	7	13
Total	5	6	2	13	26

This information confirms that no participant in the small business system market invested less than 0.5% of its turnover in 1984/5. Six firms, all new entrants establishing production facilities in the UK, invested more than 10% while the incumbents in the market invested between 1-10%. Statistically, there is a significant relationship between market participation and levels of investment expenditure - the relevant test statistic takes the value 9.74, with 3 degrees of freedom. However, there is no apparent relationship between firm type and investment expenditure.

The strategies of firms with regard to product and process development/ investment have also been analysed in this study. Each firm has been classified on the basis of the primary direction of its expenditure as :

A : the development of new products

B : the move into other telecom markets

C : thedevelopment/introduction of process technology and/or test equipment

D : the integration of computing and telecommunications

E : the establishment of better channels of distribution

Category	A	B	C	D	E	Total
Incumbents	0	0	4	0	0	4
Agents	0	2	0	0	0	2
Joint Ventures	0	0	3	0	0	3
Multinationals	1	0	1	0	0	2
Small Domestic Firms	1	0	0	0	1	2
Participants	2	2	8	0	1	13
Non-Participants	3	3	1	3	3	13
Total	5	5	9	3	4	26

Again emphasis is placed on the development/introduction of process technology and/or test equipment, although six of the eight firms classified in group C also participate in the large PABX market where such expenditure is of greater significance. Of the firms participating in the small, but not the large, PABX market two have selected the introduction of process technology, two concentrate on developing new product models, two are investing in diversification into other areas of telecommunications and one firm is concentrating on establishing better channels of product distribution.

The relationship between market presence and investment strategy is significant at the 5% level, and there also appears to be a significant relationship between firm type and strategy. Not only are participants displaying a different patten of investment to non-participants but, within the market, the various competing groups are selecting the strategy which best suits their goals and position in the market.

As in the large product market, firms can be classified on the basis of their R&D expenditure (x) expressed as a proportion of turnover as :

R&D Expenditure	$0<x\leq 0.5\%$	$0.5<x\leq 5\%$	$5<x\leq 10\%$	$x>10\%$	Total
Incumbents	0	0	3	1	4
Agents	1	1	0	0	2
Joint Ventures	0	1	0	2	3
Multinationals	1	0	1	0	2
Small Domestic Firms	0	1	1	0	2
Participants	2	3	5	3	13
Non-Participants	8	3	0	2	13
Total	10	6	5	5	26

These figures indicate that all five firms who spent 5-10% of turnover on R&D in 1984/5 participate in the small PABX market; four of these firms also participate in the large PABX market but the fifth is a small domestic firm which participates only in this sector. The expenditure of the latter firm is geared exclusively towards the production and development of small business products, and is not shared with other product types. Three firms recorded expenditure of more than 10%, generally attributing such expenditure to developing suitable products for entry and/or ensuring products meet the established standards.

To test for a statistically significant relationship between market presence and R&D expenditure a χ^2 distribution with 3 degrees of freedom is employed. The resulting test statistic of 8.80 is significant at the 5% level, confirming the significance of this relationship. There does not appear to be, however, any significant relationship between firm type and R&D expenditure.

Further information regarding R&D expenditure and the competing groups in this market is provided in the following table which identifies five possible directions of such expenditure as :

A : basic research

B : product development/enhancement

C : product design

D : process work

E : software

where each firm can be assigned to more than one category.

Category	A	B	C	D	E
Incumbents	2	4	4	0	4
Agents	0	1	0	0	0
Joint Ventures	0	3	1	0	0
Multinationals	0	1	1	0	1
Small Domestic Firms	1	2	2	0	0

Two incumbent firms carry out basic research in telecommunications and this is also attempted, to a limited extent, by one of the small domestic firms. Most firms undertake product development and enhancement - the only exceptions are provided by one multinational who has such work done abroad by its parent organisation, and one of the agent firms who sources completed products from a foreign manufacturer. In the latter case even the work required to ensure products comply with UK standards is completed abroad and is not financed by the agent firm.

With regard to product development the incumbents have had to face considerable problems related to the termination of their close links with BT, their subsequent control of insufficient development capacity, and the reluctance of successful foreign firms to enter into technological partnerships. In this particular market it is the multinationals and joint ventures who have the greatest advantage with regard to product development because these firms can source products which their foreign parents have already found to be successful, and need only undertake R&D expenditure to adapt these products to the requirements of the UK market.

In the previous chapter methods through which firms communicate with consumers were analysed through investigations of how firms

monitor consumer preferences and advertising expenditure. These two investigations are also relevant to the small business system market, especially in the early days of competition. As before, firms are categorised into four groups on the basis of preference monitoring as

A : no identifiable method is employed

B : sales figures are used

C : market consultants are employed

D : consumer panels are used

Category	A	B	C	D	Total
Incumbents	1	0	2	1	4
Agents	1	1	0	0	2
Joint Ventures	0	3	0	0	3
Multinationals	1	1	0	0	2
Small Domestic Firms	0	1	0	1	2
Participants	3	6	2	2	13
Non-Participants	2	8	0	3	13
Total	5	14	2	5	26

Three of the eight market participants have no identifiable method of monitoring preferences and admit to relying, quite heavily, on guesswork. A further six firms rely on sales figures which are of limited use, and only four firms employ market consultancies or consumer panels. However, the distribution of results concerning participants and non-participants is random, ie there is no apparent relationship between market presence and preference monitoring, and the χ^2 test statistic, of 2.61, with 3 degrees of freedom, is insignificant. Given the spread of firms within the market there are no grounds for proposing a relationship between firm type and strategy in this particular case.

Of equal importance, in a competitive market, is the effectiveness

with which firms inform consumers of the products available in this particular sector, and advertising expenditure gives some indication of how this is being achieved. To establish whether there is a relationship between either market presence and advertising expenditure or advertising and firm type, firms can be classified on the basis of their expenditure (x) expressed as a precentage of turnover as :

Advertising (%)	$0<x\leq0.5$	$0.5<x\leq5$	$5<x\leq10$	$x>10$	Total
Incumbents	0	3	1	0	4
Agents	0	1	0	1	2
Joint Ventures	0	2	1	0	3
Multinational	1	1	0	0	2
Small Domestic Firms	1	1	0	0	2
Participants	2	8	2	1	13
Non-Participants	6	6	1	0	13
Total	8	14	3	1	26

Ten of the thirteen participants spend less than 5% of turnover on promotion but one firm spends less than 10%. This apparently high level of expenditure is attributed to the relatively low turnover of the firm concerned, and its need to promote both company name and the products it has introduced. This company expects its expenditure to fall in both absolute and percentage terms in the near future.

Using a χ^2 distribution with 3 degrees of freedom, which produces a test statistic of 3.62, we must conclude that there is no significant relationship between participation and promotional expenditure. This result differs from the large PABX market where the relationship between participation and expenditure was found to be significant. The spread of figures in the upper tier of the table also refutes any hypothesis of a relationship between firm type and

promotional expenditure.

As in the large PABX market, it is easier to quantify non-price competition than to analyse prices. At best, the "price per line" of the primary product of each firm can be classified as high, medium or low according to whether it falls within the range below £300, £301-400 or above £401. These classifications are, however, based only on estimates provided by firms and, in particular, the manufacturers of key-telephone systems found it difficult to quantify price per line.

Price	High	Medium	Low	Total
Incumbents	0	4	0	4
Agents	2	0	0	2
Joint Ventures	0	2	1	3
Multinationals	1	1	0	2
Small Domestic Firms	1	1	0	2
Total	4	8	1	13

The incumbent firms have little control over product prices to end users when sales are made through BT, but prices facing consumers via alternative channels are generally classified as "medium" range. To some extent this reflects the incumbents' strategy of pricing at a level the market will bear and not on the basis of cost. The agent firms both claim to offer good quality products and services and feel justified in charging relatively high prices. One joint venture, who does not compete in any other market sector, believes that low prices and simple products are relatively more attractive to consumers but the small domestic firms, who are also recent, small scale, entrants into the market, believe their products to be of a high enough quality to justify higher prices. These firms deliberately charge a premium above the product prices of their closest competitors, considered to be the multinationals, on the basis that their products are of superior quality and reflect a higher level of functionality. However,

given that eight firms in the market offer "medium" priced products there is little evidence that firm type determines pricing strategy.

The final classification of firms by conduct is completed on the basis of their general competitive strategy in this market sector as :

A : using a combination of price and non-price competition

B : using price competition only

C : using non-price competition only

D : too early to say

Category	A	B	C	D	Total
Incumbents	1	1	1	1	4
Agents	1	1	0	0	2
Joint Ventures	1	1	1	0	3
Multinationals	1	1	0	0	2
Small Domestic Firms	0	0	2	0	2
Participants	4	4	4	1	13
Non-Participants	5	3	5	0	13
Total	9	7	9	1	26

Eight participants view price competition as important, but eight also credit non-price competition as being significant. Only one firm is undecided, this firm also being undecided as to the basis of competition in the larger product market. The remaining twelve firms are equally divided into those categorising their stategies as non-price dependent, or based on a combination of both price and non-price competition. The spread of views between participants and non-participants, concerning the basis of competition, is not statistically significant, however, nor is there any apparent relationship between firm type and competitive strategy.

TABLE 6.2 SUMMARY OF CONDUCT RESULTS

VARIABLE	HYPOTHESISED DIFFERENCE BETWEEN PARTICIPANTS & NON-PARTICIPANTS
(I) CAPITAL INVESTMENT	SIGNIFICANT
(2) OTHER INVESTMENT	SIGNIFICANT
(3) R&D EXPENDITURE	SIGNIFICANT
(4) CONSUMER MONITORING	NOT SIGNIFICANT
(5) ADVERTISING/SALES	NOT SIGNIFICANT
(6) COMPETITIVE STRATEGY	NOT SIGNIFICANT

Table 6.2 summarises the results of tests regarding the competitive strategies of firms competing in the small business system market. The major differences established between participants and non-participants concern investment and R&D expenditure. In the case of both investment and R&D expenditure firms participating in this market are relatively high spenders, but there is no apparent relationship between firm type and expenditure. Only with regard to the direction of product related investment are significant differences apparent between participants and non-participants and between firm types. For the majority of firms, market presence appears to entail emphasis on process technology and/or test equipment, but this is undoubtedly a consequence of several firms participating in other sectors of the market, and the large PABX market in particular.

To test Hypothesis 2 on the basis of the above objective tests is unsatisfactory, and the subjective evidence presented earlier in the chapter must also be evaluated. However, even with the considerable volume of evidence provided by both objective and subjective analyses, it remains unclear as to whether price or non-price competition prevails. The firms participating in this market are equally split in their views of whether price, non-price or a combination of strategies are the most important, and the evidence presented in this chapter does not appear sufficient to accept the dominance of either strategy. For this reason the hypothesis is rejected, ie the conduct of market

participants does not appear to have produced a prevalence of non-price competition - but neither has it produced a prevalence of price competition. Both strategies appear to be of almost equal importance in this market; economies of scale are sufficient to encourage large scale manufacture which frequently entails price competition, but there are also some opportunities for product differentiation and these remove the need for cost minimisation and encourage non-price competitive moves.

This market differs from the large PABX sector. In the latter market BT was the new entrant attempting to win sales from the manufacturers but, in the small PABX market sector, BT held the pre-liberalisation monopoly and it is the role of other categories of firm to win market share from BT. Manufacturers are aware of the difficulty of competing with BT on the basis of price and are, consequently, attempting to win market share through the employment of non-price competitive strategies. For this reason the market is characterised by significant levels of both price and non-price competition, where the former is the preferred strategy of BT and is, consequently, imposed on other participants, but the latter strategy is preferred by the manufacturers themselves.

Performance of Market Participants

As in the case of the large PABX market, the performance of participants, and their international competitiveness, will be gauged partly on the basis of sales and domestic market share, exports and profitability. However, some consideration must also be given to the goals of participants, with a view to establishing whether these differ between firm types and/or between participants and non-participants.

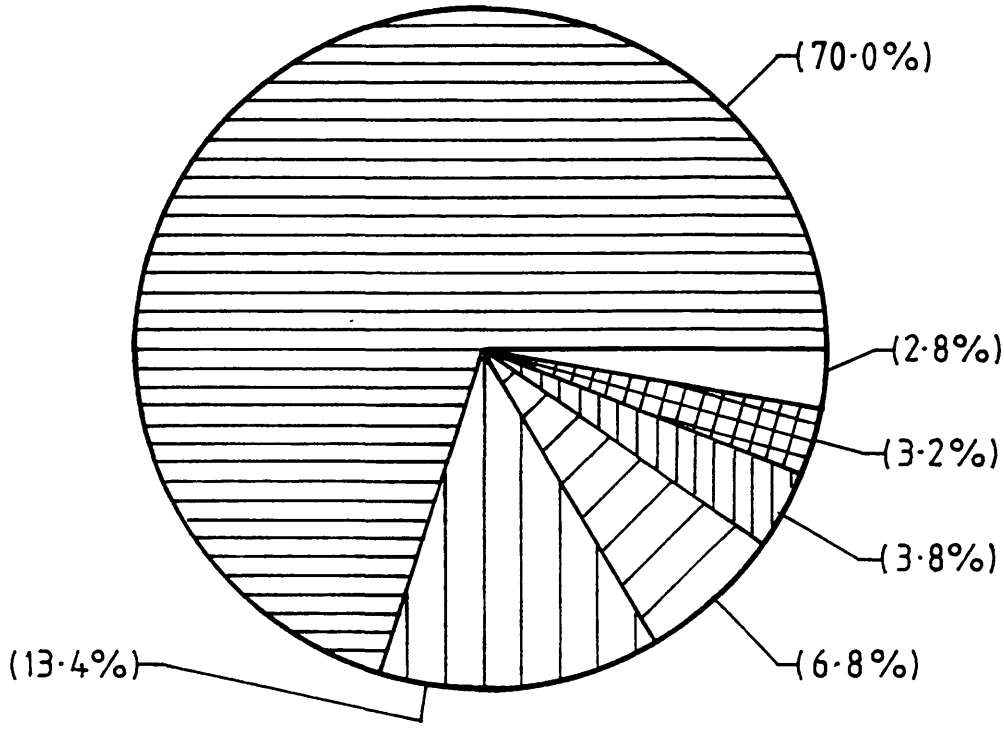
Goal	Growth	Mkt Share	Profits	Survival	Sales	Total
Incumbents	2	0	1	0	1	4
Agents	0	0	2	0	0	2
Joint Ventures	1	1	1	0	0	3
Multinationals	0	1	0	1	0	2
Small Domestic Firms	0	0	1	0	1	2
Participants	3	2	5	1	2	13
Non-Participants	2	6	2	1	2	13
Total	5	8	7	2	4	26

One multinational states survival to be its primary goal, and believes its problems to be similar in the larger product market. Other competitors, however, are primarily chasing profits in this market followed, in terms of popularity, by growth, market share and sales. Using a χ^2 distribution with 4 degrees of freedom confirms the absence of any relationship between market presence and goal pursed - neither is there any apparent relationship between firm type and goal. Only the agent firms are pursuing the same goal, ie profits, whereas members of the other competing groups are pursuing different objectives.

Diagram 6.1 illustrates the breakdown of the market in 1984/5 on the basis of firm type and market value. In 1983, prior to liberalisation, BT controlled 95% of annual sales volume, and 96% of value. By 1985, however, ie 2 years after liberalisation, BT's share had fallen to 70%, in value terms, and is expected to remain at this level for some time. This leaves the incumbents, agents, joint ventures, multinationals and small domestic firms competing directly for the remaining 30%, although this is in addition to contracts distributed by BT itself. Estimates formed on the basis of data sourced from participating firms suggest that, in 1984/5, the incumbents controlled 13.4% of the market through direct sales and those made through distributors. This compares favourably with market

DIAGRAM 6.1 SMALL PABX / KEY-TELEPHONES

(% market share by value)



TOTAL MARKET VALUE = £278 m

BRITISH TELECOM

INCUMBENTS

MULTINATIONALS

AGENTS

JOINT VENTURES

SMALL DOMESTIC MANUFACTURERS

shares of 6.8% in the case of multinationals, 3.8% for the agent firms, 3.2% for the joint ventures and 2.8% for the small domestic manufacturers. Sales through BT significantly increase the relevant market shares of the incumbents and multinationals, but have little effect on the total sales of the agents, joint ventures or small domestic firms. BT's loss of 30% of the market has, however, reduced the incumbents' own market share.

Although failure to supply BT represents a considerable obstacle to the short term success of any competitor in this market, the incumbents and multinationals must trade off the benefits of high volume distribution through BT against the associated cost of low product price. The joint ventures, small domstic firms and agents still stand to benefit from the opportunities offered by liberalisation, but have found the cost of entry to be relatively higher than either the incumbents or multinationals, and the opportunities facing these firms are restricted.

Diagram 6.1 illustrates the relative success of firms in the domestic market, but takes no account of export sales. Firms are categorised on the basis of such sales in the following table where exports (x) are expressed as a percentage of turnover :

Exports (%)	$0<x\leq1.0\%$	$1<x\leq5\%$	$5<x\leq10\%$	$x>10\%$	Total
Incumbents	2	0	2	2	4
Agents	2	0	0	0	2
Joint Ventures	2	0	0	1	3
Multinationals	1	0	0	1	2
Small Domestic Firms	2	0	0	0	2
Participants	7	0	2	4	13
Non-Participants	7	1	0	5	13
Total	14	1	2	9	26

Four participants in the market are exporting more than a tenth of their total output - however such figures require qualification. The high figure returned by two of the incumbent firms represents total product exports and may not be truly representative of exports of small business systems, given that large PABX and handsets are also included and cannot be differentiated to the extent required if figures were to be presented on a sectoral basis. The same argument applies in the case of one multinational firm which also participates in the large product market. The only joint venture recording export sales was producing a volume output which was in excess of its domestic market requirements at this time and was, consequently, distributing a significant proportion of this output to other subsidiaries in foreign markets.

The χ^2 statistical test refutes the hypothesis that there is a significant relationship between market presence and export sales. The majority of participants record very low levels of export sales, regardless of the nature of the firms themselves. In the case of the joint ventures, agents and, to some extent, the multinationals, this is the result of company philosophy rather than poor performance - a fact substantiated by the exporting joint venture's intention to reduce such sales whenever domestic demand for its product reaches sufficiently high levels.

With regard to profitability, the intention of this study is to establish whether there is a relationship between market presence and/or firm type and profits (x) expressed as net post tax return on telecom sales :

Profits (%)	$0<x\leq5\%$	$5<x\leq10\%$	$10<x\leq20\%$	$x>20\%$	Total
Incumbents	0	1	3	0	4
Agents	1	0	0	1	2
Joint Ventures	2	0	1	0	3
Multinationals	0	1	1	0	2
Small Domestic Firms	1	1	0	0	2
Participants	4	3	5	1	13
Non-Participants	3	5	4	1	13
Total	7	8	9	2	26

In the large PABX market profit levels were closely grouped with six out of eight competitors earning between 10-20%. However, in the small business equipment market the relationship between participation and profitability is not so clear. In this market four firms are earning relatively low levels of profit, ie less than 5%, which is viewed as the consequence of the high costs required for establishment within the market. Only one firm is earning what can be termed "high" levels of profit, ie one of the agent firms. This firm has had to bear few costs to enter the market, distributes a product developed and modified by a foreign manufacturer and contributes "know-how" of the UK market rather than financial expense. This firm has also benefitted from the employment of adequate channels of product distribution which were already established. The relatively high quality of this firm's foreign product entitles it to charge high prices at present and this has contributed to the achievement of a profit rate in excess of 20%.

The hypothesis that there is a significant relationship between market presence and profitability is rejected on the basis of a χ^2 test statistic of 0.76 which is insignificant, given a distribution with 3 degrees of freedom. There does not appear to be any form of significant relationship between firm type and profitability.

TABLE 6.3 SUMMARY OF PERFORMANCE RESULTS

VARIABLE	HYPOTHESISED DIFFERENCE BETWEEN PARTICIPANTS & NON-PARTICIPANTS
(1) GOALS	NOT SIGNIFICANT
(2) EXPORTS	NOT SIGNIFICANT
(3) PROFITABILITY	NOT SIGNIFICANT

To test the validity of Hypothesis 3, that liberalisation will not encourage the international competitiveness of domestic firms, consideration must be given not only to the above results, but also to the previous discussions regarding market structure and the conduct of participants. As in the case of the larger product markets, the hypothesis should be accepted.

The incumbent firms have already lost significant market share to new entrants, including many foreign firms or firms distributing foreign products, and again face the possibility of significantly decreased levels of output, although this is unlikely to occur before the present product replacement phase has been completed. If output levels are decreased sufficiently, these firms will lose the benefits of economies of scale and may suffer significant increases in unit costs. This will make it increasingly difficult for the incumbents to compete on the basis of price, which is of significance in this market, and will oblige them to put more emphasis on non-price strategies. However, the success of such a move is doubtful and it is unlikely that competitiveness will be increased. The incumbent firms appear to have "lost out" to foreign competitors in both the BT and non-BT sectors of the market, and are unlikely to win compensatory market shares abroad. The advantages held by the incumbents at the commencement of the competitive era were smaller than those held in the large PABX market, but these firms have again failed to capitalise on these. This market appears to have become the most competitive of the three sectors considered in this study.

The agent firms participating in this market are distributing

products sourced abroad and are, consequently, unlikely to compete in the international market. Liberalisation, as far as these firms are concerned, has opened up the domestic market to them while the international markets remain closed. A similar argument applies in the case of joint venture firms who are, as yet, supplying foreign designed products and are geared to participation in the domestic market only.

The small domestic firms participating in this sector are both relatively new and small in size. These firms have had no experience of international competition in the telecommunications market, although they appear relatively successful at meeting such competition in their domestic market. It is doubtful, however, whether such firms will ever compete successfully on an international scale, unless they can first secure the scale economies already exploited by the major participants. These firms can be relatively successful in the domestic market where the presence of at least some degree of product differentiation enables them to create and fill adequate "niches" but similar conditions cannot be expected in the world market as a whole. In the domestic market these firms exploit the fact that their products are both designed and manufactured in the UK, but such qualities are not so attractive abroad.

It is the US owned multinational firms who have benefitted most from liberalisation of the small business system market. These firms do not rely on UK sales for survival but can potentially achieve further scale economies through their increased volume output. These firms have already secured just under 25% of total non-BT sales made in this market, in addition to a significant proportion of sales made through BT. As far as these firms are concerned the UK represents an especially attractive location, not only because of the opportunities made available through liberalisation, but because the UK provides a suitable base from which to attack the, as yet, unexploited markets in both Europe and Scandanavia.

NOTES

1. Figures sourced from BT.

2. Figures sourced from the Monopolies Commission (1986a).

3. "Grandfathering" occurs when products which had been both approved and supplied by BT, prior to liberalisation, are released onto the general market. The manufacturers who previously supplied these products to BT are given the ability to supply these direct to consumers, and there is no need for the products concerned to be evaluated and approved by an independent body such as BABT.

4. Figures sourced from BT.

5. These figures are given in current prices and are estimates based on figures sourced from BT, Oftel and the Monopolies Commission (1986a).

CHAPTER SEVEN : THE MARKET FOR TELEPHONE HANDSETS

(I) PREFACE

Given that the handset market is the only one of the CPE markets in which many consumers participate, it is especially important to the government, with a mandate to increase competition, that the liberalisation of this particular sector be viewed as successful.

Some indication of the size of the handset market has been given in Chapter 5 above, where demand was divided into four categories on the basis of primary and extension instruments and business and residential users. By 1980/81, ie immediately prior to the liberalisation of the extension handset market, BT controlled an installed base of 9.076m extensions, ie 6.510m in the business sector and 2.566m in the residential sector. In that particular year BT supplied 2,245m extension instruments, of which 1.022m and 1.223m were supplied to business and residential users respectively. In terms of the installed base, and possible product replacement, the business consumer was the more important, but the residential consumer carried more weight in terms of "new" demand.

In the following discussion of the effects of liberalisation, the handset market is divided into five product categories ie :

a) standard telephones, ie two-piece products which are suitable for both business and residential users. Business users can attach these handsets either to an exchange line or to a PABX, although the latter option is only available if the two products employ compatible technology;

b) one-piece telephones, ie handsets in which the entire electronic componentry is incorporated inside the handset rather than being split, as in the conventional two-piece model, between the handset and its base unit;

c) cordless telephones, ie products which grant users considerable mobility while making telephone calls, by maintaining continuous radio contact between the handset and telephone base. The introduction of cordless telephones is expected to stimulate demand

in the handset market, but these products also reduce the need for multiple residential extensions, leaving the overall effect indeterminate;

d) feature telephones, ie products which offer features which are additional to the provision of access to telecommunications services. Examples of such products include clock radio telephones and telephone alarm systems in the residential sector, and multi-feature telephone units in the business sector;

e) decorative handsets, ie those in which style and appearance are the primary consideration. These products are of most relevance to residential users, although there may also be a limited amount of demand from business customers.

Liberalisation in the handset market was initially restricted to the market for extension products, and was delayed because the necessary specifications, and the certification process for approved products, were not completed on schedule; liberalisation had been initially planned for 1st October 1981 but the required specifications were not completed until December 1982. Partial liberalisation was, however, introduced in the intervening period through the following measures :

a) in November 1981 BT grandfathered a limited number of handsets,

b) in November 1981 the Dept. of Trade & Industry introduced an interim approval scheme for extension telephones; in response to this scheme 23 applicants proposed 112 items. Seven firms were chosen to submit 10 products for testing[1] and the first approvals were granted in July 1982;

c) in June 1982 BT grandfathered a further 20 handsets, ie part of its "Special Range" of telephones, but the decision as to whether these would be supplied directly rested with the relevant manufacturers, and

d) in September 1982 the Dept. of Trade & Industry introduced an interim approval scheme for cordless telephones.

Subsequent to liberalisation being fully implemented, BT retained some control over this market. Products could be supplied and

maintained by manufacturers or distributors, but any wiring required had still to be supplied, installed and maintained by BT itself. BT was required, by law, to install telephone sockets which would enable consumers to attach approved products to the network, but could charge for both the socket and its installation. BT's monopolistic control over both wiring and the provision of sockets has undoubtedly restricted competition to some extent, and it is generally expected that domestic extension wiring will be liberalised in the near future.

In January 1985, BT lost its monopoly over the supply and maintenance of primary instruments, ie the first handsets attached to any exchange line. However, when firms were interviewed for this study this policy had not been implemented, although it was imminent, and the following analysis is, therefore, relevant only to the liberalisation of the market for extension instruments.

(II) IDENTIFICATION OF THE COMPETITORS

British Telecom

Prior to liberalisation, BT controlled the major channels through which manufacturers distributed handsets in a "reactive" rather than a "pro-active" manner, ie BT discouraged unsolicited initiatives by the incumbent firms. Subsequent to liberalisation, BT's position in the handset market has diminished as a consequence of new distributors entering the market, and some manufacturers establishing independent product supply. To counteract the damaging effects of liberalisation, BT has introduced "Phone Shops" into the high streets of most major towns, and sources products from an increased number of suppliers. Each manufacturer must now persuade BT to buy their particular products and must bear all the risks involved in product development.

Traditionally, when BT specified all product components, it aimed for a high degree of standardisation both within and between product ranges. Manufacturers now have considerably more discretion in their choice of inputs, but are required to submit "parts lists" with each tender for the supply of handsets, to enable BT to carry out costing analyses. BT has also adopted a "make and hold" clause which causes considerable problems for the manufacturers. These firms find that "holding" products, until BT is ready to receive them, not only decreases their sales figures, temporarily, but also decreases their cash flow, increases their interest charges and increases their insurance costs.

Other Competitors

The firms who have decided to compete with BT in the handset market can be identified, on the basis of the groupings established in Chapter 5, as incumbents, joint ventures, multinationals and small domestic firms :

(i) Liberalisation of the telephone handset market offers no opportunities as far as the four incumbent firms are concerned. These firms say that liberalisation in this market is only a myth; the concept of a telephone must be sold before the consumer will demand a particular handset, and this invariably benefits BT itself. Consumers also appear reluctant to pay for the installation of the sockets through which non-BT handsets can be attached to the network.

The incumbent firms have decided to concentrate on the volume handset market, in which price is a key element of competition. In this particular sector they expect to compete with foreign firms and joint ventures but to be removed from competition with small domestic manufacturers. The only low volume market in which the incumbents express interest is that for cordless telephones. This market is expected to account for 10% of all handsets by the end of the decade.

(ii) The suppliers believe that liberalisation has enabled consumers to benefit from technological change by speeding up the introduction of new technology, and smoothing the actual process of change. The benefits which liberalisation has granted the supplier firms have not stemmed from the policy itself, however, but from BT's reaction which was to increase its product range and number of suppliers. Because the incumbent firms are not suited to manufacturing relatively small volume products, niches have been created for firms who may have little experience.

The suppliers have found the handset market to be lucrative but severely limited by BT's "make and hold" policy, which can reduce delivery rates even though production levels are unchanged. Small firms, in particular, require that completed products be removed from their premises immediately, and are heavily reliant on the associated sales revenue. These firms were also concerned that BT's loss of monopoly over the primary instrument market would result in fewer orders being placed with suppliers.

The primary goal of the suppliers is simply to remain "viable". Some growth is planned, but this is limited in so far as firms are restricted to markets where volumes are relatively small, ie less than 10,000 units p/a. The suppliers expect to achieve some growth as each

available market niche is exploited, but expect this to be followed by a period of stagnation until new technology, or changing consumer tastes, create further suitable market niches. Each supplier hopes to win a larger share of BT's business and has no intention of undertaking independent product distribution, or manufacturing products for other distributors.

(iii) Two joint venture companies are competing in this market, both of which were established in response to both liberalisation and recent advances in microelectronic technology. These firms are now seeking long term relationships with both BT and other selected distributors.

The joint ventures believe the primary threat to their viability comes from any foreign firms who are attracted to the UK market and unimpeded by the limited entry barriers which exist. For survival, these firms believe they may have to branch out into the much wider market for "Office Communications" equipment. However, by 1986, these firms plan to control an average 5% of the total handset market while maintaining gross profit margins of approximately 25% on the sale of these products.

(iv) Only one multinational company is participating in the handset market. The break up of the Bell Organisation gave this firm the impetus to move outside the US, and liberalisation was simply one of several points in favour of a move to the UK. However, having established a subsidiary, this firm has found the handset market to be too competitive, too variable and too small to assure success. As a result, this multinational intends to create, and move into, other areas of the telecommunications market, including the manufacture of specialised handset products for the hard of hearing. Such products are estimated to have a potential market size of almost 10m units, and the multinational believes it would face little competition.

The major goals of this particular multinational are growth and productivity. Over the next eight years this firm plans to double its capital productivity, and increase labour productivity by 50%, and believes that it could then, with suitable contracts from BT, control

almost 20% of the replacement market.

(v) As far as the small domestic manufacturers are concerned, liberalisation offers present and future opportunities which are limited only by the need for consumers to bear the cost, and inconvenience, of installing the required sockets before attaching non-BT supplied apparatus. This restriction clearly favours BT, and is considered to be unnecessary.

Most of the small domestic manufacturers are attracted to the markets for one-piece, feature and cordless telephones, although growth in the latter market is limited by the requirement that such instruments be employed only as extensions[2]. The success of domestic firms is further constrained by the expected entry of foreign firms who have the potential to benefit from economies of scale which are not available to firms confined to the UK market. This is a particular problem in the market for standard handsets, where firms must produce an output of at least 500,000 units p/a to fully exploit economies of scale and, consequently, require sizeable contracts from BT if sufficient sales are not otherwise ensured.

The limitations facing the small domestic manufacturers restrict these firms to market niches which are relatively unattractive to larger participants. These firms aspire to achieve pre-tax profits of approximately 10% in the market as a whole, although a gross profit margin of 25-30% is not unreasonable in the case of cordless telephones. In that particular sector of the market, an output of approximately 40,000 units p/a would secure almost 30% of the market.

A group of three small domestic manufacturers are involved only in the market for decorative handsets where they face few competitors. The incumbents are expected only to dabble in this particular market, and even BT provides little threat. This sector grew 20% between 1982-84 and is expected to eventually account for 10% of the total handset market, ie subsequent to the liberalisation of the primary handset. In 1984/5, however, competitors were limited to an average production goal of 1400 units per month.

Decorative handsets are generally sourced from the Italian firms who are the world leaders in the sale of such products, and these

products require only "assembly" in the UK.

Having established the identity of competitors in this market, the conduct and market strategies of these firms will be analysed, in section (III), using the same structure as was employed in Chapters 5 and 6 above. The conduct of several of these competing groups has already been discussed with respect to the markets for large PABX and small business products and some repetition is, again, almost unavoidable. To limit this repetition the following analysis will focus, in the relevant cases, on aspects of conduct which differ significantly from those witnessed in the other two markets.

(III) THE MARKET STRATEGIES OF COMPETING GROUPS

(a) Conditions of Production, Investment, R&D etc.

Incumbent Firms

In the handset market the incumbent firms face a similar problem to that in the large PABX and small business system markets in that products were previously developed in conjunction with other manufacturers and/or with BT, but must now be developed independently and in competition with their previous partners. The incumbents have found their product ranges to be relatively old fashioned and unattractive to consumers, and are now spending 7-8% of the appropriate sales revenue on formal product development.

The life expectancy of telephone handsets has fallen, due to demand for new styles and facilities, from 28 years to only 7-12 years. The introduction of micro-chip technology and the disappearance of induction coils and telephone dials has helped to prolong products' service lives, but the importance of fashion has simultaneously reduced their market lives.

The incumbents believe that some degree of vertical integration is necessary in this particular market where in-house capability offers considerable opportunities for both innovation and technical learning and also provides an assured supply of high quality inputs at reasonable prices. One firm produces, in-house, almost 50% of the value of the printed circuit boards incorporated into its handsets, but has found little advantage to producing either mouldings or the keypads which are now replacing telephone dials. Orders for these products are placed with foreign suppliers, and frequently win preferential terms because of the relatively large volumes involved.

The production methods employed in the manufacture of handsets has altered significantly in recent years. The increased use of software and computing had led to a reduction in the number of manufacturing operations and changes in the level of employment and the required

mixture of skills. The need for R&D and marketing staff has greatly increased but there is now less demand for manual component and product testers. One incumbent estimates that 20% of its employees who are involved in product design and testing are educated to degree level, but this firm still faces significant delays in introducing new technology as a result of skill shortages.

The primary intention of the incumbent firms is to compete in the high volume market for standard handsets where they estimate the minimum efficient scale of production to be such that it is unprofitable to produce less than 0.5m units p/a. It is only by participating in this high volume market that the incumbents can justify their investment in design and manufacturing equipment, and accrue sufficient benefits from economies of scale. One firm estimates that the "Statesman" telephone, ie the present standard model issued by BT, would have to be produced at the rate of 4,000 per day if the "minimum" cost production level was to be achieved. If this firm doubled its output from £0.75m to £1.50m it believes its costs would be reduced by 10p per unit - which could be enough to secure further contracts from BT, although such volumes are unlikely to be demanded within the UK market itself. The incumbents believe it is the high cost of labour which has, so far, prevented them from achieving the unit costs of £7-8 which are now achieved in the Far East.

Suppliers

The supplier firms manufacture products which are either designed or licenced by BT, but require R&D facilities for product enhancement and the investigation of alternative methods of manufacturing. One supplier recently spent £100,000 establishing a larger and more modern R&D facility than it operated before entering the handset market, and presently employs 8 electronic engineers to work on joint R&D projects with BT Martlesham. This firm also undertakes a limited amount of R&D work which has been subcontracted by other firms.

The supplier firms have generally increased their R&D expenditure by 3-400% since liberalisation, but attribute this to the

applicability of new technology rather than liberalisation itself. Finance for all development work is sourced internally, from the proceeds of subcontracted work or from BT itself. BT patents all relevant handset developments and registers the designs, which it supplies to these firms, and any trade names which are appropriate. The suppliers, however, consider such conduct to be ineffective.

The suppliers believe that "fashion" has transformed handsets into throwaway items. The average life expectancy of handsets manufactured by these firms is now 7 years but is expected to fall, to 4-5 years, in the near future.

Although these firms manufacture handsets exclusively for BT, and work to BT's input specifications, they exhibit some degree of vertical integration. These firms each manufacture inputs which are employed in their own production and distributed to other manufacturers who are producing products for BT. If the products manufactured by the supplier firms are not designed to incorporate standard components, then BT either supplies the necessary inputs or pays the cost of their securance. Inputs presently account for an average 74% of the suppliers' total costs[3].

Because the suppliers are employed by BT primarily to manufacture those products which require relatively small production runs, least cost production is of less importance than it would be in the case of larger volume products, and the fact that BT is also encouraging these firms to manufacture "programmed" products, which employ customised chips, implies that it is not concerned with achieving high levels of standardisation.

Although the suppliers believe that, being relatively small, they must be particularly careful about their investment policies, they have increased investment four-fold, on average, since liberalisation. This increase has primarily financed the purchase of CAD/CAM and computerised testing equipment. The pattern of this investment reflects the recent move, by these firms, from mechanical technology which involved inserting resistors and capacitors into printed circuit boards, towards micro-chip technology and electronic assembly. The latter technologies are deemed necessary to cope with the product varieties and volumes which are presently required. The suppliers lack

the financial muscle required to borrow investment finance at preferential rates, but have received grants of up to ₤50,000 from the development agencies. Each supplier attempts to write off its investment expenditure within one year.

Joint Ventures

The product bases of the two joint ventures have been sourced from their foreign parents although each firm estimates that it adds 40-60% value onto each product. Primarily, the work undertaken is related to product anglicisation and, although they have suitable resources to carry out some design and development work, the limited size of these firms is expected to encourage them to continue sourcing products from their foreign parents. The products supplied by the joint ventures are manufactured with life expectancies of 5-10 years but early replacement is now expected, ie after only 3 years, due to the present state of product innovation.

The joint ventures estimate that 50% of their present input requirements are sourced abroad, but expect this to alter in favour of increased in-house production and domestic supply. Inputs required for telephone handsets have already halved in price, over four years, but prices are expected to fall even further due to :

a) "learning" on the part of input manufacturers which will produce cost falls in the production of components, and
b) an increase in the level of competition between the relevant distributors.

Although input prices are expected to fall, the potential for total cost reduction is limited by relatively high labour costs. The direct manufacturing cost of handsets has halved, as a result of technical advance in the relevant materials and electronic components, but a large proportion of handset production is non-electronic in nature, and the total cost of this manufacture is not expected to fall below its present level, in the case of standard products, of ₤12 per unit. Most scope for cost reduction is, therefore, provided by moving away

from the manufacture of basic models by introducing, for example, repertory dialling and memory facilities. These facilities can be provided at an average additional cost of only 50p per handset unit, but increase the retail value of the product by several pounds.

Multinationals

The multinational firm has established a formal R&D facility in the UK in which it spent £166,000 in its first 6 months of operation, in addition to previous expenditure abroad. This firm plans to spend £2-3m on R&D over the next few years ie, almost 20% of its expected turnover, but considers this to be relatively low; the development of a basic handset costs at least £450,000 and a cordless telephone costs almost £950,000. This firm generates finance for R&D internally, or receives funds from its foreign parent; no finance has been received from any other source, as yet.

The multinational believes that a patent policy is vital in this market, and criticises domestic firms, in particular, for giving insufficient attention to patents. This firm also has little objection to paying any royalties or licence fees which will enable it to supply the very products which consumers are demanding. The present life expectancy of any handset supplied in the UK market is estimated to be 5 years, and this is regarded as a consequence of BT's competitive strategy, which has encouraged rapid product replacement.

The multinational buys in almost 100% of its input requirements. Some components are sourced from its parent company, through arms length trading arrangements, but the UK subsidiary sources other chips from the cheapest supplier who can fulfill the necessary specifications and be second sourced. Bulk orders are placed to ensure low prices, and standard components are employed in the effort to achieve maximum commonality between product ranges. This firm is ultimately aiming to place "one set of guts" into 98 different handset designs, which will require the use of "disabling", whereby some of the capabilities of chips inserted into products are deliberately destroyed. This procedure is less costly than securing supplies of a

different chip for each model of handset produced. In the long run this firm hopes to secure supplies of high quality inputs at preferential prices, but has no plans to establish its own input design and manufacturing facilities in the UK; the parent company's production of suitable components suggests that any such move would be inefficient.

The multinational has had to invest significantly prior to entering the liberalised handset market, although this expenditure has been primarily devoted to securing automatic manufacturing technology and suitable test equipment. Process innovation is viewed as especially important and both the parent company, and some university teams in the UK, are presently employed in projects to design suitable equipment.

The multinational expects its future investment to remain high, and will channel this into projects focusing on the integration of telecommunications and computing. Finance for all investment is generated through export sales, or sourced from the firm's parent company, one of the development agencies, through regional development grants or from the EEC. The appropriate payback period for investment in the handset market is deemed to be 2-3 years in theory, but 5 years in practice, given that firms are having to compete with a very dominant BT.

Formal training is given to all engineers and marketing staff, but the multinational has had to face an apparent shortage of engineers and suitably skilled programmers. At present, 5% of this firms' employees work in administration, 4% in personnel, 21% in product development, 41% in manufacturing and the remaining 22% cover all other functions. UK labour costs are judged to be relatively high and this encourages increased automation. Labour presently accounts for 26% of the multinational's total costs, but this is expected to fall to 9-10% over the next few years.

Volume production of handsets is expected to keep costs low and the multinational consequently plans to produce 1.25m handsets p/a in its UK subsidiary, to complement the 5m units p/a it produces worldwide. If this volume can be achieved, this firm estimates that benefits from economies of scale will reduce the present average unit costs of

£15.28, ie £11.28 for materials and £4.00 for labour, to a total unit cost below £10.

Small Domestic Companies

The small domestic manufacturers are generally designing their own products, but find the established specifications to be a limiting factor. One of these firms has recently established a formal R&D facility, in which 1% of its employees are based, but carries out further R&D through :

a) selected foreign firms with which it has established close ties;
b) work subcontracted to domestic universities, and
c) work undertaken in conjunction with other domestic firms, particularly in relation to product reliability and testing.

To date this particular firm has spent £1m, as a direct consequence of liberalisation, and this has been mostly devoted to product development and appearance, and achieving the established standards. Some support for this R&D, ie £60k, has been received from the Dept. of Trade & Industry.

The small manufacturers are generally doubtful as to the benefits of operating a patent policy which is judged to be expensive, complicated and relatively speculative, ie the interpretation of what constitutes an "innovation" is frequently revised in this particular market. Each company does, however, register product designs in a attempt to secure brand image.

Products manufactured by small domestic firms have relatively long average life expectancies, ie 20 years in the case of basic handsets, and 4 years for cordless telephones. Spare parts will be supplied for an average of 7 years after any model of handset has been removed from the market, but products will generally be remodelled every 2 years, to keep abrest of the latest technology.

The typical small firm does not have the resources to manufacture in the UK, and has chosen to subcontract manufacture abroad. The major benefit of such manufacture, through foreign firms, concerns the

economies of scale which can be exploited, and which enable subcontractors to manufacture at 30-40% below the lowest cost which could be achieved through domestic manufacture. The basic disadvantage however, is that both components, which are also sourced abroad, and completed products, must be paid for in US dollars, causing costs to rise whenever sterling decreases in value. Arranging suitable transport to bring completed products back to the UK can also be problematical. Firms must select either transport by sea, which is relatively cheap but very slow, or transport by air freight, which is much faster but almost prohibitively expensive.

Although most of the small domestic firms subcontract the majority of their manufacture, they generally intend to manufacture in the UK should this become viable. The first step towards this goal would be the introduction of domestic product assembly using inputs and components sourced from abroad; foreign inputs are almost 50% below the cheapest UK supply at present. The average member of this group has no manufacturing employment within the UK, but employs 25% of its present domestic employees in marketing, 30% in R&D and 45% in administration and all other functions.

These firms are investing heavily in process technology, such as CAD/CAM technology and automatic insertion equipment, but transfer this technology to their manufacturers abroad. Future investment, while remaining high, will be directed towards product development. All investment finance is necessarily generated internally; the development agencies, in particular, are said to be disinterested in providing support to "domestic" firms.

The products introduced by those firms participating in the decorative handset market are frequently copies of existing antique telephones which require little development. New models are quite simply introduced by replacing the casing on what is a standard push button or dial telephone handset, ie only cosmetic alterations are necessary, and these involve relatively little development expenditure. The registration of product designs may be applicable in this market, but these are not the responsibility of the domestic firms. These firms are undertaking domestic assembly-type work only, and all designs and casings, and the majority of components, are

sourced from the Italian companies who are the world leaders in the production of these products. These firms are, however, making a conscious effort to increase the domestic share of their input purchases each year and, by 1984, were sourcing 80% of inputs from Italy and 20% from UK suppliers. Although only assembly-type work is undertaken in the UK, these firms found initial investment levels to be high, and presently re-invest 11-15% of turnover.

Skill shortages are not generally relevant to these firms; one firm had 70% of its employees involved in product assembly in 1983, 75% in 1984 and expected 80% in 1985. This firms's administrative staff had simultaneously decreased from 16% of total staff in 1983 to 15% in 1984, and was expected to account for only 10% in 1985. The sales and marketing functions in this particular firm were undertaken by the managing director.

Increases in the output of decorative handsets do not lead to unit cost reduction because production is labour intensive and labour costs are not decreasing. To benefit from any economies of scale which are available, these firms estimate a required output of 50-100,000 units p/a, but are presently producing less than 17,000 on average. The average unit manufacturing cost of a decorative handset was approximately £40 in 1984, to which a mark-up of almost 100% would be added to cover promotional and distributional costs.

(b) **Product Testing and Approval**

Incumbent Firms

The incumbents view the testing and approval procedure for telephone handsets as the most straightforward and least bureaucratic. Less time is involved than is the case with other types of equipment, and delays only occur if manufacturers have failed to test products sufficiently, prior to submission. The incumbents complain, however, that the approval of their own products has been delayed by some small firms effectively using BABT as a product test laboratory, and propose that independent testing houses be established for use by these firms.

The incumbents have no complaints about the cost of handset approval which ranges from £10-30,000 for a well designed product which is immediately approved. However, these firms have recently installed their own handset test equipment, at an average cost of £300,000 which will be depreciated over 3 years, and now test products under the MDT scheme, although this produces smaller advantages than are available in the case of larger and more complicated products. On average this test equipment was employed to test 40 models of handset in 1984, with an implied cost of £2000-2500 per model plus associated labour costs of almost £1000 per unit. The incumbents are satisfied that BABT's product approval costs are comparable their own, and do not consider the approval and testing procedure to represent an entry barrier in this market.

Suppliers

The suppliers to BT argue that liberalisation can only be beneficial if appropriate technical standards are established and adhered to, and consequently regard the approvals process as important. Although the costs involved in the present system are quite high, the suppliers accept that BABT must be self-financing and that these costs, when spread over total output, will be easily paid by the

consumer. These firms do not, however, submit any products to BABT for approval - BT assumes this responsibility.

The suppliers have found some product specifications almost impossible to meet, and view the achievement of the required level of quality as especially difficult. However, these firms have not suffered any delays in getting products through the approval procedure because their products have either been "grandfathered" or submitted with the considerable benefit of BT's support. These firms believe BABT's primary function should be to ensure continuity in product manufacture as it is first approved, ie to ensure that standards are observed as rigorously at the end of the production process as at the beginning.

Joint Ventures

The joint ventures believe that the concensus approach adopted when product standards were written has resulted in too many delays. Not only do these firms view the cost of obtaining product approval as being far too high, at approximately £2400 per handset, but they also resent the cost and time involved in providing the necessary back-up engineering in a procedure which can take up to 2 years, although this is expected to fall to around 6 months. The criticisms of the joint ventures are basically directed at the bureaucracy surrounding BABT and these firms question why handsets, which retail for £30, must be subjected to more numerous and stringent tests than are applied to £400 video recorders etc. These firms believe that BABT should test only product safety, and that all other product features should be determined within the market itself.

Multinationals

The multinational in this market had not obtained product approval by 1984 and was, consequently, manfacturing only for export. This firm accepts that an organisation, such as BABT, was required after

liberalisation, but regrets that it has been created with a "pontificating" attitude which has resulted in considerable costs and time delays. This firm is particularly sympathetic to any firms who do not have the advantage of being able to manufacture for export while awaiting approval in the UK.

The multinational objects to the amount of time which highly qualified engineers must spend with civil servants before product approval is given, and argues that the effective loss of working hours, usually over a 16-18 week period, is a considerable but unnecessary cost. This firm, consequently, favours the adoption of an approvals process similar to that established in the US, ie where the approvals authority, the FCC, has only 30 days in which to test products, and conclude on their suitability. After that time has passed, any supplier can automatically enter the market.

Small Domestic Companies

The small domestic manufacturers accept that the approvals procedure protects both manufacturers and consumers, but find it frustrating that product specifications must be written before innovative products can be introduced. As the first supplier of one-piece telephone handsets, one of these firms faced considerable problems in attempting to manufacture to standards which had not been established, and over which it had little control. Product approval eventually cost £350,000, which is significantly higher than the £30,000 this firm would expect to pay now that suitable specifications have been established. Because of these delays and high costs, it is estimated that the cost of introducing some models of handset into the UK market is at least £0.5m higher than in the US. The small firms propose that BABT should test only product safety, and that the market should be allowed to determine all other features. Poor quality, or faulty handsets, will reflect badly on the guilty manufacturer, but will have little effect on BT or any other market participant.

(c) Retail Distribution, Price and Non-Price Competition

Incumbent Firms

The incumbent firms found retailing low value products to be extremely difficult until a suitable distribution network had been established. When liberalisation was first introduced the incumbents entered the retail market directly but each has since withdrawn and established product supply through dealers and distributors.

The largest proportion of the incumbents' sales are made to BT, despite what these firms view as its arrogant attitude and ruthless purchasing policy. One of the incumbents has benefitted from increased orders from BT, amounting to more than 1.5m handsets in 1984/5, ie 80% of that firm's total handset production. The public still view BT as the primary supplier and the incumbents are, consequently, keen to supply BT. BT, however, objects to any handsets which it distributes being simultaneously distributed through alternative channels, and is pressurising the incumbents into satisfying the needs of the private market through other products.

The incumbents recognise a dichotomy between the supply of products to residential and business users. Businessmen do not wish to "shop around", and the incumbents retail handsets to such consumers through salesmen and exhibitions. In the case of residential consumers, however, the majority of sales are made through BT or high street stores. In 1984, this latter category of sales accounted for 0.5m in a total market of 5.5m units.

Retailing to residential users can also be achieved through mail order catalogues, and the use of independent dealers and distributors. The incumbents also export handsets to both business and residential users in the US, New Zealand, the Pacific and Hong Kong, but such export opportunities are limited and unlikely to improve until some degree of reciprocity is achieved.

The true impact of competition on handset prices is quite difficult to determine, given that a significant proportion of handsets are still "rented" from BT, but the incumbents have reduced their prices

by 20-30% since liberalisation. The average ex-factory price of a handset manufacturered by the incumbents has fallen from £30 to £15 over the last 3-4 years, but distributors, including BT, commonly demand a 100% mark-up, and retail products at £30-200. Business users who buy products direct from the incumbent are omitting the distributor, and pay prices which are quite close to the wholesale level.

The incumbents' pricing strategy in this market is to keep product prices in line with competitors' although refusing to automatically follow any price reductions. Given that prices can rarely be revised upwards, the incumbents set new model prices relatively high, and subsequently reduce these as required. Handset prices are not set on the basis of cost and the falling cost of technology is, therefore, not adequately reflected in prices in this particular market. The incumbent firms believe that price competition is present, because the market is still quite immature, and consumers have insufficient knowledge about the products offered. Firms are, therefore, under pressure to lower prices, although they would prefer to compete on non-price terms. Although present prices are deterring some entry to this market, these are also producing profits which are significantly lower than expected.

The incumbents view handset quality as more important than price but appreciate that each segment of the handset market has different quality requirements. The most obvious distinction is that between residential consumers and business users, ie the former group makes less use of products and is influenced more by price than by quality, but the latter group are more interested in the facilities and quality offered than in price. Handset maintenance is carried out by BT, or by the incumbents through the national maintenance networks already established to deal with other CPE products.

The incumbents admit that marketing is now important and, in response to this, have introduced product marketing teams and employ market research consultancies. These firms believe it important that consumers recognise the manufacturer behind each product, but accept this to be unlikely if products are distributed by BT. Advertising budgets, for handsets, have only recently been introduced; before

liberalisation the incumbents had little need for promotion, but they now spend an average 0.7% of sales revenue on advertising. These firms also benefit from secondary advertising undertaken by their distributors, including BT itself.

Suppliers

All handsets manufactured by the suppliers are sold to BT through one year contracts which guarantee a minimum level of production but are otherwise favourable to BT itself. The suppliers, however, believe the advantages of working for BT far outweigh the disadvantages, and have found BT to be faithful under changing market conditions. Most of the problems facing these firms arise, not from BT's own actions, but as a result of fierce competition to supply BT.

BT is responsible for establishing the market price of the suppliers' products but, in pricing products for sale to BT, the suppliers aim for margins of 8.5% on cost. This is rarely achieved however, because BT undertakes extensive cost investigations and will pay only for the added value created by the suppliers, often through two year fixed price contracts.

The suppliers view competition in the handset market as being based on non-price factors if prices lie within an acceptable range of the average. Product differentiation is particularly important, but the suppliers are limited, with regard to this, by BT's detailed product specifications. Products can be differentiated through quality, however, and the suppliers are seeking levels of quality which are high enough to attract consumers, but not so high as to involve an unrealistic level of manufacturing cost.

BT assumes total responsibility for product marketing and after sales services etc, and the suppliers have very little say in how this should be done. But these firms appreciate the benefits of BT's massive advertising campaigns, which they could never equal independently, even though they would prefer BT to promote individual products rather than the general image of the telephone.

Joint Ventures

The retail policy of the joint ventures encourages product sales to large distributors, bulk suppliers or companies requiring handsets in addition to PABX systems. Products sold to BT, on a spot market basis with no scheduled contracts, represented an average 50% of the handset output in 1984, but the joint ventures are sceptical about future sales through BT. They consider BT to have insufficent inexperience of a large "liberalised" market, and expect it to lose market share.

The joint ventures primarily supply handsets to business users who expect to benefit from bulk purchasing arrangements. Product prices, therefore, depend on whether consumers are business or residential users but fell from an average of £60, in 1981, to £30 in 1984, in current prices. These firms are reluctant to lower prices any further; they offer after sales and maintenance services throughout the country, through depots established by their domestic parent companies, and view high product quality and good product services as more important than a low price.

Product marketing is important in any competitive market and the joint ventures believe that the successful products in the handset market will be those introduced at the "right" time. One firm has suffered two product failures in the UK market; both of these products were engineering led, as opposed to marketing led, and were introduced into markets which were ill-prepared to receive them. The joint ventures have found a general shortage of marketing staff, but do not believe this to be a significant problem in the handset market.

Each joint venture spends approximately 12% of sales on general product promotion and is prepared to advertise extensively. These firms believe that relatively more advertising should be geared towards publicising handsets and intend, consequently, to reduce the promotion of their corporate names and to increase the promotion of their product bases. Each joint venture establishes an advertising budget of which almost 50% is spent on pre-ordained methods of promotion.

Multinationals

The multinational is in the unusual position of being unable to retail products within the market in which it has located. This firm is making export sales to Switzerland, Norway, France and the USA, and expects such sales to remain high even when retail is permitted in the UK.

The multinational's competitive strategy in the UK market will be to establish prices at a level which is competitive, but which is unlikely to be the lowest. The high levels of quality incorporated in this firm's products should enable it to command a relatively higher price. Competition will take place on the basis of both price and non-price factors, with price reductions introduced as an almost automatic response to low sales volumes. In retailing products suitable for both business and domestic consumers, the multinational believes it important to ascertain the potential benefits of the product in each case, to gauge the consequent value of the product to the consumer in question, and to set price accordingly. The multinational does not believe that the established price levels in this market constitute a barrier to entry.

Given that non-price competitive strategies are also important in this market, the multinational has already undertaken a series of interviews with "typical" consumers, which were designed to gauge preferences and highlight potential opportunities for product differentiation. In the handset market, product design and appearance are as important as technology and the facilities offered, and this firm has contracted Yves St. Laurent, on a consultative basis, to ensure that its products complement contemporary home fashion.

The multinational is aware of a distinction between residential consumers, who are primarily interested in product appearance, and business users, who are more concerned with technology and product quality. In both cases quality is relatively more important than price, but most consumers have insufficient knowledge, as yet, to appreciate which products offer the highest levels of quality.

This firm views marketing as important and intends to increase such expenditure, from its present level of 18-20% of turnover, to 30% of

what is expected to be a significantly larger turnover. This firm has not, yet, developed a definite advertising policy for the UK market, and intends to keep both advertising and product promotion "flexible" in practice. Advertising will, however, be of high quality, and will emphasise both product details and the name of the company itself. The multinational spent 10% of turnover on product promotion in 1984, of which 4% was spent on advertising and 6% on other forms of promotion.

Small Domestic Companies

The small domestic firms have found the liberalised market to be more competitive than was first expected. Given that BT has retained the majority of its customer base, and remains the supplier most consumers approach, these firms are relieved to be supplying BT with an average of 24,000 units p/a, but are aware of their need for other channels of distribution. Having BT as a customer is important, but not necessary, for survival, and these firms would never agree to be wholly dependent upon BT. They also object to manufacturers' names being omitted from any products distributed by BT, but recognise this as a problem of "subcontracting" in general, rather than a problem of working with BT in particular.

The small domestic firms retail some products through high street outlets, independent dealers, distributors and cash and carry stores. Export mechanisms were being established in 1984 with the handset markets in New Zealand, France, Guernsey and Jersey appearing particularly attractive. However, these firms were concerned that the specifications, to which products must be manufactured in the UK, make products relatively expensive and uncompetitive abroad.

Although most prices have fallen only marginally since products were first introduced, price falls in the case of cordless telephones have been more significant. One firm had reduced the price of its cordless handset from £169 to £129, in current prices, over two years to the end of 1984, and attributes this to slow initial market growth which caused products to be overordered, overstocked and retailable only at considerably reduced prices.

In pricing, the small domestic manufacturers make a conscious effort not to discriminate between business and residential users, although favourable terms are usually given to consumers placing bulk orders. In the case of mature products, a price reduction may be the best reply to a decline in sales, or to a price reduction by competitors but, in the case of young products, a different selling approach would be preferred. In general, prices will be reduced only in response to significant component price reductions or significant increases in manufacturing efficiency. Prices are viewed as entry deterrents because the resulting profit margins are too low.

In the business market quality appears to be more important than price, but in the residential market it is product appearance which provides the basis for most sales. It is, therefore, important for all manufacturers to monitor consumer preferences, and the small firms do this through sales returns, reports from salesmen, and a large amount of guesswork; market survey reports are judged to be too expensive. These firms are willing to accommodate consumer suggestions whenever possible, but refuse to be "dictated to", given that the associated cost level may be too high to justify.

Promotional expenditure presently accounts for 8%, on average, of the turnover of small domestic firms, and is expected to increase. Very little advertising is undertaken, but agents and distributors are encouraged to undertake such promotion.

The manufacturers of decorative handsets differ from other small domestic companies by each owning at least one retail outlet. This is a consequence of the high street stores being initially unsure of these products, and showing some resistance to providing suitable channels of distribution. These firms also sell products through BT and through mail order catalogues, and are establishing export facilities. In particular, these companies hope to export to Saudi Arabia, Australia and the US market, where the opportunities are especially attractive, but must first obtain suitable export licences.

Price competition does not appear to be an important factor in the decorative handset sector. Prices are similar and relatively stable, and each firm is, consequently, attempting to compete on the basis of product appeal and quality. Firms are aiming at high levels of product

differentiation, through good design, and aesthetics are considered to be equally important as technical wizzardy and more important than price. The fault rate in decorative handsets is lower than 1%, and these manufacturers operate postal repair services, although product replacement is usually cheaper than repair.

Marketing is of considerable importance in this particular sector and is usually undertaken by the managing director. Advertising expenditure, at an average 5% of turnover, appears almost negligible in comparison to that undertaken by BT, but these firms believe this to be adequate because they also benefit from the spin-off effects of BT's own campaign.

(IV) ANALYSIS OF QUESTIONNAIRE DATA AND HYPOTHESIS TESTING

The analysis presented in the following section closely follows that presented in Chapters 5 and 6 above, where the three hypotheses regarding market structure, participant conduct and performance, especially international competitiveness, were discussed for the large PABX market and small business system markets. The same basic approach is adopted in this sector of the market, but with one significant difference - this sector can itself be split into 5 different product areas and, in the case of market conduct, the relevant hypotheses will be tested for each of the 5 product areas rather than for the market as a whole.

Market Structure

At first glance the market for telephone handsets appears to be the most competitive with regard to the number of firms choosing to participate, but the division of this market into several product sectors produces different levels of competition in each independent sector. In 1984/5 the total annual market for telephone instruments consisted of 5.5m units of which approximately 732,000 were sold in the "free" sector, 4.5m were sold or rented through BT and the remaining 297,000 were sold to other network operators, particularly the Hull Telephone Company[4], but including business users who operate private networks. This market size reflects an increase of 12.2% since 1980, which is too large to be attributed soley to natural levels of growth and replacement. Liberalisation, the new products introduced as a result of this, and BT's product replacement policy appear to have had a significant impact on the handset market.

Within the 1984/5 market, business and residential customers accounted for 55.7% and 44.3% of sales volume respectively. While business customers accounted for 51% of BT's total sales, residential customers were responsible for 49% and, in the non-BT market, business and residential users accounted for 28.3% and 71.7% of sales

respectively. The total sales value of the market was estimated to be worth just over £110m of which 78% accrued to BT, including estimated rental fees, even though it controlled 82% of sales in volume terms, ie BT's average unit price appears to have been lower than in the free sector[5].

The relationship between firm type and participation was discussed in Chapter 5, Part A, where it was established that firms either participate in this market alone, or else participate in all three product sectors considered in this study. One potentially interesting relationship which can be analysed is, therefore, that between firm size, measured by telecom related turnover, and market presence :

Turnover (£m)	$0<x\leq5$	$5<x\leq20$	$20<x\leq50$	$x>50$	Total
Participants	7	5	1	4	17
Non-Participants	2	5	1	1	9
Total	9	10	2	5	26

These figures suggest the prevalence of smaller sized firms in this particular market. The only large scale competitors present, ie those with annual turnovers exceeding £20m, also participate in either the small or large PABX market sectors and do not focus exclusively on handsets. Given the distribution of firms within the above table it seems reasonable to propose a hypothetical relationship between firm size and participation but, on the basis of a χ^2 test, such a hypothesis must be rejected, ie the relationship between firm size and market presence is not statistically significant.

The extent to which price competition can be employed as a competitive weapon depends upon many factors, one of which is the achievement of suitable cost reduction through vertical integration. The importance placed, by firms within and outside this sector, on vertical integration is best illustrated through the following table

where A : firm displays both forwards and backwards integration

B : firm displays only forward integration

C : firm displays only backward integration

D : firm displays no vertical integration

Category	A	B	C	D	Total
Incumbents	2	0	2	0	4
suppliers	0	0	0	3	3
Joint Ventures	0	0	2	0	2
Multinationals	0	0	0	1	1
Small Domestic Firms	0	0	0	7	7
Participants	2	0	4	11	17
Non-Participants	0	1	3	5	9
Total	2	1	7	16	26

The small domestic manufacturers, who exhibit no integration, could face considerable problems in that they buy completed products off-shore, thus paying higher costs whenever sterling depreciates. This strategy, however, which will be further discussed below, enables small firms to have domestically self-designed products manufactured at a cheaper cost than could be achieved within the UK. This removes the need for vertical integration in a backward direction, but forward integration, if possible, would still enable these firms to ensure their products reached the market quickly and effectively.

The firms displaying the highest level of integration are the incumbents, although these firms must still improve the relationship between their in-house semi-conductor developments and the manufacture of telecommunications equipment. These firms also employ the same integrated structure to provide their requirements for higher value products such as large PABX and small business systems and the specific requirements of handsets are often overlooked.

The one multinational operating in the UK market does not have an integrated structure as yet and simply sources its input requirements from the cheapest source. The joint ventures both benefit from backward integration through their parents, although some of the inputs produced through this structure are not relevant for the manufacture of anglicised products.

The firms with least concern about input supply are the suppliers; these firms either source their inputs direct from BT, or are provided with lists of approved suppliers and the knowledge that BT will cover all costs. These firms also produce some categories of inputs which can be sold, with BT's approval, to other manufacturers.

The spread of firms in the above table provides some evidence of a relationship between firm type and integration. However, there is no evidence to suggest the presence of a relationship between integration and market presence; out of seventeen participants in this sector eleven display no integration, two display forward and backward integration and four display backward integration only.

Another structural variable of some importance is that of diversification. To test the significance of diversification as a structural feature of the handset market, the twenty-six sample members are classified, in the following table, into four groups as :

A : diversified within telecoms and externally

B : diversified within telecoms only

C : external diversification only

D : no diversification

Category	A	B	C	D	Total
Incumbents	2	2	0	0	4
Suppliers	0	3	0	0	3
Joint Ventures	0	2	0	0	2
Multinationals	0	1	0	0	1
Small Domestic Firms	0	2	1	4	7
Participants	2	10	1	4	17
Non-Participants	1	6	0	2	9
Total	3	16	1	6	26

Only two sample members participating in the handset market exhibit both external and telecommunications related diversification and these firms also participate in both the larger product markets. The three supplier firms who have recently entered the market supply other products, but these are all considered to be telecom related in some way. Of the seven small domestic firms who have entered the market since liberalisation, only three exhibit any form of diversification - two into telecom related areas and one into consumer electronics.

Using the appropriate χ^2 distribution, with 3 degrees of freedom, to test for a significant relationship between the rows and columns in the lower tier of the above table, confirms the independence of market presence and diversification. Participants do not exhibit significantly more or less diversification than is witnessed among the non-participating sample members, but there does appear to be a link between firm type and the extent of diversification.

As in the two case study chapters above, we can examine possible entry barriers to this sector by analysing the role of patents, product differentiation and both price and non-price barriers. To discover the importance of patents in this particular market each firm is classified into one of four groups as:

A : firm/parent controls patents and registers product designs

B : firm/parent controls patents only

C : firm/parent registers product designs only

D : firm/parent neither controls patents nor registers product designs

Category	A	B	C	D	Total
Participants	5	2	3	7	17
Non-Participants	0	4	0	5	9
Total	5	6	3	12	26

Of the seventeen firms competing in this market only seven control patents and eight register product designs. Seven firms elect to take neither action. Of the firms who patent and/or register product designs, the majority also compete in other sectors of the market where this strategy appears to be more important. Testing the relationship between rows and columns statistically confirms a significant relationship at the 10% level - ie there is a relationship between market presence and the control of patents/designs. However, in this case the relationship differs from those exhibited in the larger product markets where patents represent considerable barriers. In this sector firms can enter and compete without the control of patents, and without registering product designs, signifying a much weaker barrier.

Product differentiation represents an important structural variable in the handset market given that five distinct product areas can be identified and firms may decide to locate in just one of these, or to be more diverse in strategy. As a rough means of gauging the relative importance of product variety, as opposed to volume production, each participant firm can be classified on the basis of the number of products offered as :

No. of Models	1	2-5	5-10	>10	Total
Incumbents	0	0	2	2	4
Suppliers	0	2	1	0	3
Joint Ventures	0	2	0	0	2
Multinationals	0	0	0	0	0
Small Domestic Firms	1	1	1	4	7
Total	1	5	4	6	16

In the above table the multinational does not appear in any of the classifications given that it was awating product approval at the time of this study and had no products available in the market - this reduces the number of participants, in this particular case, to sixteen.

The relationship between firm type and variety does not appear to be significant. Only one firm in this market, a relatively new domestic firm, provides only one model of handset. Six firms provide product ranges consisting of more than ten models. In the case of the incumbent firms these models may vary quite significantly from each other but, in the case of product ranges offered by small domestic firms, product variety can be minimal and may consist only of additional features, such as memory or recall buttons, or different materials such as wood, brass or onyx. These small firms attempt to introduce as many products as possible on the basis of each single approval.

Differentiation is so strong in the handset market that five distinct product areas have been outlined as :

a) two-piece standard telephone handsets;
b) one-piece telephone handsets;
c) cordless telephones;
d) feature telephone and
e) decorative handsets.

The relationship between firm type and products offered can best be summarised as :

a) the incumbent firms have chosen to participate in every sector except the decorative market;
b) the suppliers do not participate in any of the "free" sectors in that they supply only one and two-piece products to BT;
c) the joint venture companies are also involved in the one and two-piece sectors but make only a small proportion of sales through BT;
d) the small domestic manufacturers make very few sales through BT and have focused their attack on the one-piece, cordless, decorative and feature phone markets, and
e) the multinational has yet to retail in the UK but intends to participate in the two-piece and the decorative markets.

The division of the market into five product sectors is illustrated in Diagram 7.1 which highlights the relative importance of each sector, in 1984/5, on the basis of sales volume. The majority of sales, ie 77%, were accounted for by two-piece products - within this sector BT was responsible for more than 89% of sales, less than 5% of sales were made by the "free" sector and the remainder were made by Hull etc.[6] The situation was similar in the second largest sector which deals with feature telephones, where the "feature" involved may be quite trivial in nature. These products accounted for 10.21% of total output and BT captured almost 76% of such sales; a further 19% of sales were made through the "free" sector and just over 5% were made by other network operators.

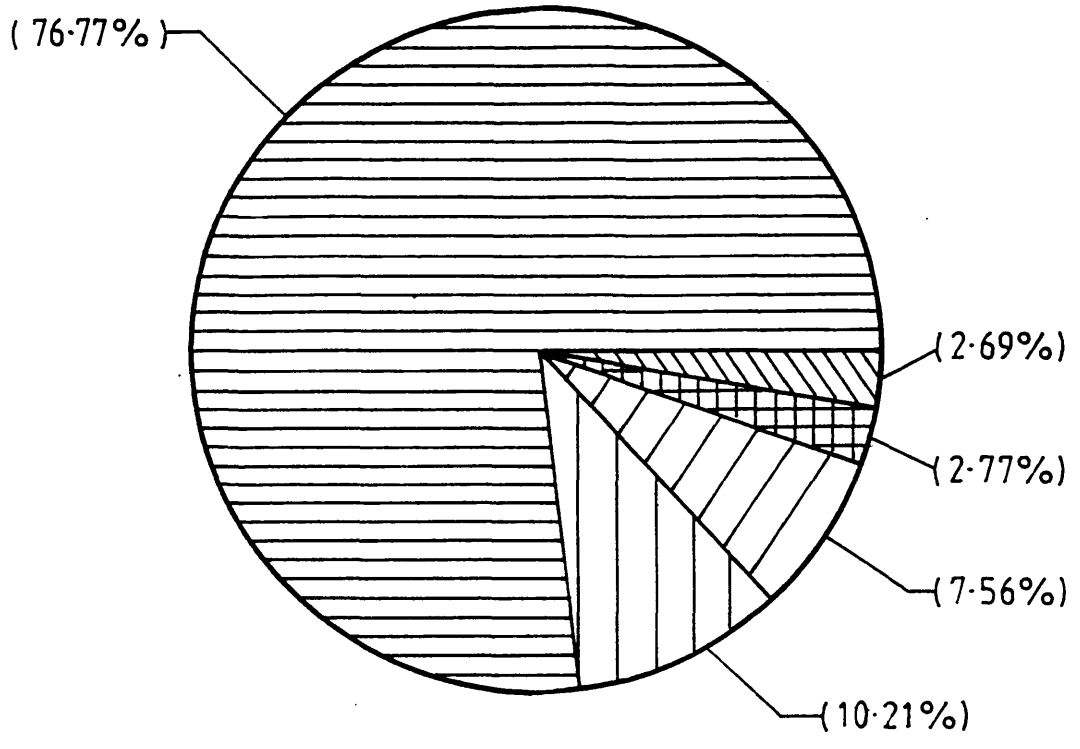
In 1984/5, BT controlled less than 50% of sales in each of the three remaining product sectors. The decorative handset market accounted for 2.77% of total market output and, in this sector, BT made just over 45% of all sales, 52% were made by the free sector and just over 3% by Hull. In the one-piece market, which accounted for 7.5% of the total market, BT made 42% of sales, the free sector was responsible for 56% and Hull made only 2%. Finally, in the market for cordless telephones, which accounted for 2.69% of total market output, BT's performance was at its poorest with under 36% of sales, while the free sector won 62% and Hull accounted for 2%.

One of the implications of the above results is that the extent to which firms are successful will depend upon their choice of product

DIAGRAM 7.1

THE HANDSET MARKET 1984/5

(Product market share by volume)



TOTAL MARKET VOLUME = 5.5m units

TWO PIECE PHONES

FEATURE PHONES

ONE PIECE PHONES

DECORATIVE HANDSETS

CORDLESS PHONES

sector. Given that BT controls 82% of the entire market and 89% of the sector for standard two-piece products, it is clearly necessary for any participant in the latter sector to win sizeable contracts from BT itself. In this respect the incumbent firms have retained a considerable advantage because, three years after liberalisation was first introduced, these firms continued to supply BT with approximately 80% of its product requirements. It is expected that, even in the long run, BT will continue to source at least 70% of its product requirements from the incumbents suppliers - given BT's dominance as a buyer, this structural feature of the handset market must surely represent a considerable barrier to firms wishing to become established in this sector.

To establish the general identity of other barriers to entry in this market, each firm was asked to classify the source of significant barriers as :

A : both price and non-price sources and securing BABT approval
B : price sources and BABT approval
C : non-price sources and BABT approvals
D : price sources only
E : non-price sources only
F : BABT approvals only
G : a mixture of price and non-price sources
H : no significant barriers

where non-price sources include quality, advertising and R&D expenditure etc.

Category	A	B	C	D	E	F	G	H	Total
Incumbents	0	2	0	0	0	1	0	1	4
Suppliers	0	0	0	0	0	1	0	2	3
Joint Ventures	0	0	0	0	0	2	0	0	2
Multinationals	0	0	0	0	0	1	0	0	1
Small Domestic Firms	0	0	1	1	2	1	0	2	7
Participants	0	2	1	1	2	6	0	5	17
Non-Participants	0	0	0	1	1	4	0	3	9
Total	0	2	1	2	3	10	0	8	26

Nine of the seventeen particpants in this sector view the approvals process as a significant barrier to entry. Two of the incumbents, who compete in the standard, high volume sector, also view price as a limiting factor while one of the small domestic firms cites non-price factors, namely quality and brand loyalty to BT. Five participants do not regard any barriers surrounding the handset market as significant, but two of these firms work exclusively for BT who provides product designs and secures the necessary approvals before ensuring contracted levels of output. Undoubtedly the approvals process still represents some form of barrier to entry but, in the handset market, this barrier does not appear as significant as in the two sectors examined above.

Given that the majority of firms cite BABT and the approvals process as representing a barrier, regardless of firm type, there is no possible relationship between firm type and entry barriers. Using a χ^2 distribution with 5 degrees of freedom, which produces a test statistic of 1.95, also confirms the absence of a significant relationship between views concerning entry barriers and market participation.

One interesting feature of the structure of the handset market is the apparent lack of foreign competition. This is not to say, however, that the "threat" of foreign competition is not considerable. Foreign products presently find their way into the market through three major

channels ie the multinational, who has yet to win product approval, the joint ventures, who are distributing products sourced, at least in terms of design, from their foreign parents, and the small domestic firms. In several cases the small domestic entrants have produced UK designs for handsets, but are subcontracting manufacture off-shore - mostly to the Far East. This strategy enables these firms to compete on cost terms with their larger rivals, but also introduces an element of foreign competition - if these products can be produced more cheaply abroad, they will replace domestic manufacture in the market.

However, the threat of direct entry into the market by foreign producers remains considerable. Twelve of the seventeen competitors believe foreign entry is both imminent and "threatening", and two of these firms, both small companies, are also threatened by the possible entry of domestic firms. Only five competitors believe their position is strong enough to withstand competition from new entry.

Following the pattern of the above two chapters, the final structural variable to be considered is that of financial support. Firms are again classified on the basis of aid received as :

A : support from the government and development agencies

B : government technical support only

C : development agency support only

D : no support received to date

Category	A	B	C	D	Total
Incumbents	1	3	0	0	4
Suppliers	0	1	2	0	3
Joint Ventures	0	0	1	1	2
Multinationals	0	0	1	0	1
Small Domestic Firms	0	2	0	5	7
Participants	1	6	4	6	17
Non-Participants	2	2	2	3	9
Total	3	8	6	9	26

Using a χ^2 test to test a possible relationship between market presence and aid received leads to rejection of such a hypothesised relationship. However, although the relationship cannot be adequately tested statistically, examination of the upper tier of the table suggests a possible relationship between firm type and aid received. The incumbents each receive technical support from the government and one group member also receives assistance, for one of its plants, from the Scottish Development Agency. Two of the suppliers also receive development agency support, both being based in Wales, as does one joint venture and the multinational. The firms given least support, being those who probably require most assistance, are the small domestic entrants. Five of these firms receive no aid at all, and two receive only minor technical support. These firms generally complain that the development agencies are keen to help foreign companies, but are actually reluctant to help domestic firms. They also complain that their applications for technical support are generally rejected on the grounds that their work is not innovative enough.

TABLE 7.1 SUMMARY OF STRUCTURAL RESULTS

VARIABLE	HYPOTHESISED DIFFERENCE BETWEEN PARTICIPANTS & NON-PARTICIPANTS
(1) SIZE	NOT SIGNIFICANT
(2) VERTICAL INTEGRATION	NOT SIGNIFICANT
(3) DIVERSIFICATION	NOT SIGNIFICANT
(4) PATENTS	SIGNIFICANT
(5) ENTRY BARRIERS	NOT SIGNIFICANT
(6) THREAT OF ENTRY	NOT SIGNIFICANT
(7) SOURCES OF AID	NOT SIGNIFICANT

These results highlight some interesting features of the structure of the handset market and partly reflect the effect of the structural division of the market into five identifiable sectors. Vertical

integration is not a significant factor within the handset market and, in this respect, a significant difference has been established between participants and non-participants. By choosing their market location carefully, small firms, for example, can participate in sectors where vertical integration is not important. For this reason the market offers opportunities to many firms - from the large incumbents who focus on volume production and the pursuit of economies of scale, to the smallest entrant who is exploiting a tiny market niche in, for example, the decorative market.

Given that differentiation is an important feature of this market, and that many firms have been attracted, it is necessary to judge whether the amount of competition introduced has been "excessive" ie more than is desired on the basis of social welfare. Social welfare is influenced by both product choice and low unit cost and, for this reason, Hypothesis 1 is rejected on the basis of the above results. The segmentation of the market and the entry of new firms has undoubtedly increased the welfare of consumers and provided opportunities for new firms, but within each sector there appear to be too many competitors offering too many varieties of product. If each sector contained one, or at most two, firms then economies of scale could be exploited more fully. The loss in product variety would be minimal, given that the differences observed between products offered within sectors are often trivial in nature. This is especially noticeable in the one-piece, cordless and decorative handset sectors. On the basis of above findings this study accepts that the government has successfully introduced competition into the market, but proposes that this competition is not socially efficient, for which fewer competitors are required.

Conduct of Market Participants

The structure of the telephone handset market cannot be said to approximate oligopoly - monopolistic competition appears to more closely approximate market structure in this particular case, although the intensity of competition varies between sectors. Such a structure

can be expected to influence the market conduct of participants and, in this section, pricing policies, R&D, advertising and investment will be examined prior to testing Hypothesis 2 which proposes the prevalence of non-price competition.

The question of investment in plant is only of limited relevance in this market sector. The large firms who participate in other sectors tend to treat their handset activities as "secondary" and gear all investment decisions to the needs of their larger products. At the same time small firms, entering only this market, have little need for investment in plant given that their production work either takes place off-shore, or is simply of an assembly type nature, requiring few facilities or skills. These observations are verified through the following classification of firms on the basis of competing groups, market participation and investment expenditure (x) where the latter is expressed as a proportion of turnover :

Investment (%)	$0<x\leq0.5\%$	$0.5<x\leq5\%$	$5<x\leq10\%$	$x>10\%$	Total
Incumbents	0	3	1	0	4
Suppliers	3	0	0	0	3
Joint Ventures	0	0	1	1	2
Multinationals	0	0	0	1	1
Small Domestic Firms	1	1	0	5	7
Participants	4	4	2	7	17
Non-Participants	1	2	0	6	9
Total	5	6	2	13	26

Employing a χ^2 distribution to test for a significant relationship between market presence and investment levels leads to the refutation of that hypothesis, on the basis of a test statistic of 2.28 with 3 degrees of freedom. Within the market, however, there does appear to be some relationship between firm type and investment expenditure. The

suppliers record minimal levels of investment, the incumbents record approximately 3% on average, the joint ventures and multinationals are recording expenditure which exceeds 5% of turnover, although this must be attributed to the establishment of production facilities and the low levels of turnover recorded by these firms during their initial period of competition. Five of the small domestic companies recorded levels of investment in excess of 10% of turnover, but such levels are again due, primarily, to the low turnover recorded and the high level of expenditure required for entry.

Participants in any of the three market sectors examined in this study must consider investment in the introduction of new products and production processes. In the case of the handset market, each firm is classified on the basis of the primary direction of such expenditure in the following table, where classes A-E represent :

A : the development of new products

B : the move into other telecom markets

C : the development/introduction of process technology and/or test equipment

D : the integration of computing and telecommunications

E : the establishment of better channels of distribution

Category	A	B	C	D	E	Total
Incumbents	0	0	4	0	0	4
Suppliers	1	0	1	0	1	3
Joint Ventures	0	0	2	0	0	2
Multinationals	0	0	0	1	0	1
Small Domestic Firms	2	2	0	1	2	7
Participants	3	2	7	2	3	17
Non-Participants	2	3	2	1	1	9
Total	5	5	9	3	4	26

The focus of the incumbent firms, and to some extent the joint ventures, on the high volume sectors of the handset market is reflected in their priority for expenditure being the introduction of process technology and test equipment. Small market participants who are seeking suitable niches in the market appear relatively more concerned with the development of new products, channels of product distribution and even the move into other market areas - not one of these firms cited process technology as the primary area of expenditure. The relationship between market presence and investment strategy is insignificant, ie the pattern of results obtained from participating firms is not very different to the pattern displayed by non-participants. This is confirmed by a χ^2 test statistic of 2.25 when there are 4 degrees of freedom.

Given that some firms appear relatively more interested in the introduction of process technology, rather than new product varieties, it is interesting to determine whether this has a significant bearing on R&D expenditure (x), expressed as a proportion of turnover :

R&D Expenditure (%)	$0<x\leq5\%$	$0.5<x\leq5\%$	$5<x\leq10\%$	$x>10\%$	Total
Incumbents	0	0	3	1	4
Suppliers	2	1	0	0	3
Joint Ventures	0	0	0	2	2
Multinationals	0	0	0	1	1
Small Domestic Firms	3	3	0	1	7
Participants	5	4	3	5	17
Non-Participants	5	2	2	0	9
Total	10	6	5	5	26

Participants in the handset market are quite evenly split between those favouring low levels of R&D expenditure, taken to be less than 5%, and those favouring relatively higher levels. Within the group of

non-participants there is an obvious bias towards low levels of expenditure; all five firms spending more than 10% of turnover on R&D are participants in the handset market.

Using a χ^2 distribution with 3 degrees of freedom, and constructing the test statistic of 3.46 confirms the absence of any significant relationship between participation and expenditure. However, there again appear to be a relationship between firm type and expenditure although, as discussed above, this is difficult to test statistically given the nature of the sample data. The lowest levels of expenditure are recorded by the suppliers and small domestic firms, even though their turnovers are also relatively low. The suppliers have little need for such expenditure and rely on BT for both product ideas and development finance. Three of the small domestic firms, those recording the lowest levels of R&D expenditure, participate in the market for decorative handsets and simply offer "repackaged" versions of what is, essentially, a basic product sourced originally from Italy.

High levels of expenditure were recorded by one incumbent firm and two joint ventures[7]. The incumbent's expenditure was not geared towards handsets alone but included spending related to small PABX - an argument which also helps to explain the high levels of expenditure recorded by the joint ventures. The high expenditure recorded by the multinational appears as a consequence of the low level of sales achieved by this firm, and the high levels of expenditure required prior to entry into the UK market.

The final table presented with relevance to R&D illustrates the extent to which participants focus on possible areas of research ie :

A : basic research
B : product development/enhancement
C : product design
D : process work
E : software
F : none of the above

where firms can be place in more than one category.

Category	A	B	C	D	E	F
Incumbents	2	4	4	0	4	0
Suppliers	0	3	2	0	0	0
Joint Ventures	0	2	1	0	0	0
Multinationals	1	1	1	0	0	0
Small Domestic Firms	1	5	5	0	0	2

The incumbents are heavily involved in R&D work related to product design, development and enhancement but two of these firms also undertake some basic R&D work related to telecommunications. The suppliers spend only minimal amounts on R&D, but their work focuses on product enhancement and some product design, both of these functions being undertaken in conjunction with BT. The multinational firm is sourcing its products from its parent company in the US, but must develop these to comply with UK standards and specifications.

There are only two companies in the handset market who do not undertake any R&D work - both of these firms are small domestic firms, and both participate in the decorative sector of the market, sourcing products from Italian producers. The remaining five small domestic firms focus their R&D expenditure on a combination of product design and development. One firm also undertakes a minimal amount of "basic" research which it deems necessary for successful participation in the cordless handset sector.

In a market where product variety is considerable and firms are keen to differentiate products, consumer preferences should be valuable and closely monitored. However, the following table confirms that there is no relationship between market presence and methods of preference monitoring. In this table firms are classified on the basis of their primary method of monitoring consumer preferences as :

A : no identifiable method is employed

B : sales figures are used

C : market consultants are employed

D : consumer panels are used

Category	A	B	C	D	Total
Incumbents	1	0	2	1	4
Suppliers	1	2	0	0	3
Joint Ventures	0	2	0	0	2
Multinationals	0	0	0	1	1
Small Domestic Firms	0	5	0	2	7
Participants	2	9	2	4	17
Non-Participants	3	5	0	1	9
Total	5	14	2	5	26

Participants in the handset market favour the use of sales figures to provide information concerning consumer references - but such figures are of limited use given that they only reflect the choices made available between products which are already offered, and provide no information about other preferences which are not yet catered for. Six firms are making a more serious effort to determine preferences through the use of market consultancies and research panels, but three of these firms, the incumbents, are already employing such methods in the larger business product sectors and the weight given to seeking residential consumer preferences may be negligible. The only other competitors displaying a serious effort to determine preferences are the multinational, who is keen to establish the peculiarities of the UK market, and three of the small domestic firms. This latter group place considerable weight on product differentiation and niche-filling and are keen to ensure that their products fulfill true consumer wants.

The relationship between market presence and consumer monitoring produces a test statistic of 2.94 which is not significant when the relevant χ^2 distribution has 3 degrees of freedom.

As in the two preceeding chapters, firms can be classified on the basis of their advertising expenditure (x) which is expressed as a proportion of turnover as :

Advertising (%)	$0<x\leq0.5$	$0.5<x\leq5$	$5<x\leq10$	$x>10$	Total
Incumbents	0	3	1	0	4
Suppliers	3	0	0	0	3
Joint Ventures	0	2	0	0	2
Multinational	0	1	0	0	1
Small Domestic Firms	3	3	1	0	7
Participants	6	9	2	0	17
Non-Participants	2	5	1	1	9
Total	8	14	3	1	26

Six participants in this market spend very little on advertising and product promotion but, in the case of the suppliers, this is explained by the fact that BT assumes total responsibility for product distribution and promotion. The three small domestic firms placed in the same category of expenditure appreciate the importance of advertising, to establish trade names and inform consumers about products, but have inadequate finance as yet. The primary objective of these firms is to ensure adequate product design and development, plus suitable channels of product differentiation, and expenditure on these objectives is given priority. The seven small domestic firms spend an average 1.2% of turnover on product promotion.

The incumbents spend an average of 0.7% on advertising, and 3-4% on general product promotion, but receive additional promotion through BT's own campaigns. Consequently, these firms have no plans to increase their expenditure in the immediate future. The joint ventures, who spend an average 2% of turnover, also benefit from BT's campaigns, but through its promotion of the telephone in general, rather than promotion of particular models. The multinational firm, who has yet to secure entry to the market, undertook some advertising to establish its corporate image and create demand for its products.

Using a χ^2 distribution to test for the presence of significant relationships between market presence and advertising leads to

rejection of the hypothesised relationship. The relevant test statistic of 2.18 is not significant when the required distribution has 3 degrees of freedom.

Product differentiation has been deemed important in this market but, given that some sectors of the market contain high volume, standard products, price competition may also be important. As a first step towards establishing whether this is true, the following table classifies the participants in this market on the basis of price. In this sector a low price is considered to be less than £25, a medium price is £25-50 and a high price is above £50. Each firm is classified on the basis of its primary product or range as :

Price	High	Medium	Low	Total
Incumbents	0	3	1	4
Suppliers	0	3	0	3
Joint Ventures	0	2	0	2
Multinationals	0	1	0	1
Small Domestic Firms	5	1	1	7
Total	5	10	2	17

Within the handset market, three of the incumbents offer medium priced products and one offers low prices. This result is consistent with the participation of these firms in the high volume markets. Their prices are not as low as might be expected, however, because the bulk of their output is bought by BT for subsequent distribution on a rental basis. For this reason quality is deemed to be of considerable importance and products are not low priced. The suppliers who manufacture exclusively for BT, and participate in the same sectors of the market, also produce medium priced products of high quality.

The two joint ventures in this market distribute only a small proportion of their output through BT, but participate in the high volume, standard product markets. Because these products compete with

such high quality options from BT etc, the joint ventures must also place considerable emphasis on quality, and again offer medium priced products.

The small domestic firms are attracted to market niches where fulfilling consumers' demands is more important than product price. For this reason these companies tend to offer high priced products - especially in the decorative market and in the case of feature phones or handsets offering additional facilities. The small companies competing in the one-piece market must offer low prices, which they achieve only through low cost off-shore production. Without off-shore production these firms could not exploit the economies of scale necessary for viable participation in the handset market.

Given that ten of the seventeen participants in this market offer medium priced products, there is no obvious relationship between firm type and pricing strategy. What appears to be more important than firm type, with regard to pricing policy, is the location of the firm within the market itself. This result is substantiated by the following table in which firms are classified on the basis of whether they are :

A : using a combination of price and non-price competition
B : using price competition only
C : using non-price competition only
D : too early to say

Category	A	B	C	D	Total
Incumbents	1	1	1	1	4
Suppliers	2	0	1	0	3
Joint Ventures	0	1	1	0	2
Multinationals	1	0	0	0	1
Small Domestic Firms	1	2	4	0	7
Participants	5	4	7	1	17
Non-Participants	4	3	2	0	9
Total	9	7	9	1	26

Nine participants regard price competition as important in the handset market - of these firms five presently participate in the standard two-piece markets and two of the three small domestic firms compete in the one-piece market. Non-price competition is viewed as important by a total of twelve firms, a significant proportion of which are small domestic firms. A χ^2 distribution with 3 degrees of freedom confirms, on the basis of a test statistic of 3.88, the absence of a relationship between market presence and competitive strategy.

TABLE 7.2 SUMMARY OF CONDUCT RESULTS

VARIABLE	HYPOTHESISED DIFFERENCE BETWEEN PARTICIPANTS & NON-PARTICIPANTS
(I) CAPITAL INVESTMENT	NOT SIGNIFICANT
(2) OTHER INVESTMENT	NOT SIGNIFICANT
(3) R&D EXPENDITURE	NOT SIGNIFICANT
(4) CONSUMER MONITORING	NOT SIGNIFICANT
(5) ADVERTISING/SALES	NOT SIGNIFICANT
(6) COMPETITIVE STRATEGY	NOT SIGNIFICANT

There is no aspect of conduct for which participants within the handset market display significantly different behaviour to that displayed by non-participants. There are, however, several apparent differences recorded between the conduct of the various competing groups within the market itself. The overall impression is that it is location within the market which determines conduct and, with this in mind, Hypothesis 2 will be tested for each of the five identifiable sectors.

Hypothesis 2 must be rejected in the case of the standard two-piece market. Economies of scale are important in this sector, the incumbents estimate an output of 0.5m units p/a is required for exploitation of the economies available, and product differentiation

is minimal. Although advertising and R&D expenditure are quite important here, these are used primarily to promote the concept of the telephone, rather than specific models, and to introduce only minor enhancements. Investment in process technology and test equipment is deemed important, in so far as these will facilitate low unit cost production. The strategy of firms competing in this sector is one of securing low cost production and high volume demand and, consequently, price competition outweighs non-price competition in terms of importance, even though prices are at a "medium" level and not as low as they could be.

A similar situation prevails in both the one-piece and cordless handset markets. Some differentiation is attempted in these markets, but the differences between products are minimal. The small domestic firms hold leading positions in both markets - in the one-piece market volume production is important and an output of 0.25m p/a is required to fully exploit the economies of scale which are available. However, given that total UK demand for this product in 1984/5 was only 416,000 units, each participant is unlikely to achieve suitable economies unless manufacture is subcontracted off-shore. Through this method of production the small domestic firms can source products at lower cost than could be achieved through domestic production, and can compete successfully on the basis of price. In the cordless market all products offer very similar features and facilities and there is little scope for non-price competition. Given these conditions Hypothesis 2 is rejected for the one-piece and cordless sectors and we conclude that price competition is of relatively more importance.

There are two sectors of the market in which Hypothesis 2 is accepted, however, and these are the decorative market and the market for feature phones. In both these sectors the emphasis of competition is placed on product appearance or capabilities, and price is of secondary importance.

Performance of Market Participants

Given the diverse range of competitors competing in the handset

market, it might be reasonable to expect the goal of many small firms to simply be one of survival, while large firms chase profits and market share. However, the results contained in the following table dispute this theory and show firms to be chasing a wide variety of goals.

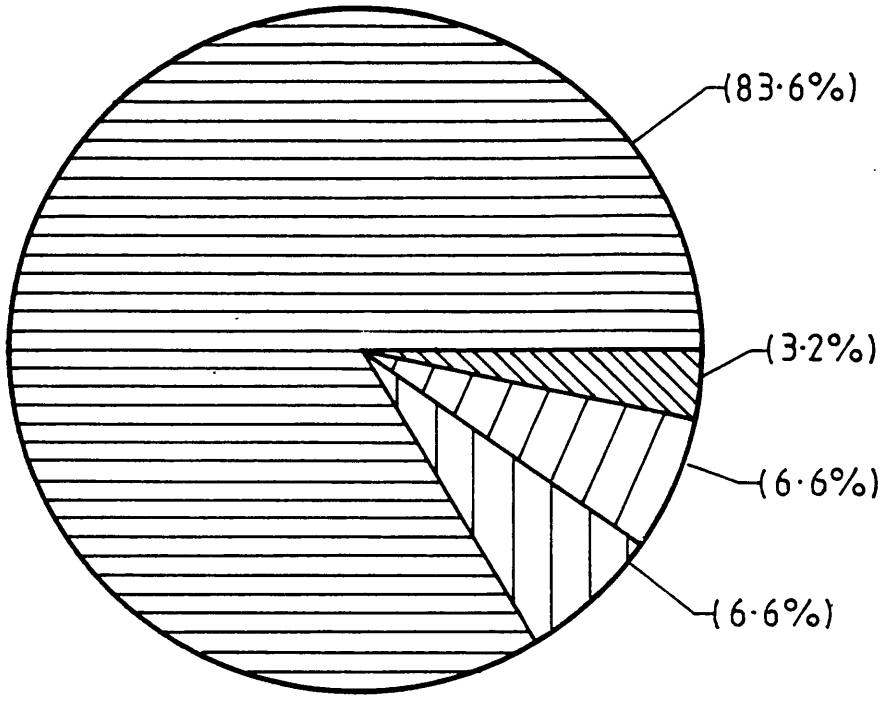
Goal	Growth	Mkt Share	Profits	Survival	Sales	Total
Incumbents	2	0	1	0	1	4
Suppliers	2	0	0	1	0	3
Joint Ventures	0	1	1	0	0	2
Multinationals	0	1	0	0	0	1
Small Domestic Firms	0	4	1	0	2	7
Participants	4	6	3	1	3	17
Non-Participants	1	2	4	1	1	9
Total	5	8	7	2	4	26

The goals pursued by the incumbents and joint ventures tend to be consistent throughout the three market sectors in which they participate, ie the incumbents aiming for growth in this particular sector are also aiming for growth in the markets for large PABX and small business systems. Two of the suppliers are also aimimg for growth, which they hope to achieve through increased sales to BT. The third supplier has, however, placed "survival" as its primary objective, although it wishes to remain an exclusive supplier to BT.

After securing entry to the handset market, the objective of the multinational firm is to secure a sizeable share of the market as a whole, by participating in the two-piece and decorative markets. The small domestic firms are also pursuing market shares and do not apear to be concerned about survival. Two of the small domestic firms are pursuing specific sales targets which will guarantee significant market shares and allow the exploitation of further scale economies.

DIAGRAM 7.2 THE HANDSET MARKET 1984/5

(% market share by value)



TOTAL MARKET VALUE = £110·0 m

INCUMBENTS

SUPPLIERS

SMALL DOMESTIC MANUFACTURERS

JOINT VENTURES

The relationship between market presence and objectives is not significant, ie the spread of objectives among the non-participants is quite similar, although profits is the primary goal among the latter group.

Some attention has already been given to the attraction of some firm types to particular sectors of the handset market, and to the relative importance, in volume terms, of each of these sectors. In Diagram 7.2 the market shares of each category of firm are illustrated, in terms of sales value, in 1984/5. In that year the four incumbent firms controlled 83.6% of the market, the three suppliers and seven small domestic firms each controlled 6.6%,[8] and the joint ventures controlled 3.2%. The multinational had yet to win product approval in the UK and made no domestic sales.

The successful performance of the incumbent firms is due to their participation in most sectors of the market, and their continued role as bulk suppliers to BT. Successful participation in the sizeable two-piece product sector gurantees a considerable market share in the handset market as a whole, but requires continued orders from BT. For as long as BT remains satisfied with the products offered by the incumbents, these firms are assured of success in the market as a whole, in terms of market share if not in terms of profitability.

Because one of the aims of this study is to determine the effect of liberalisation on international competitiveness, one of the variables we are interested in is that of export sales. Expressing such sales (x) as a proportion of turnover, each sample member can be classified in the following table :

Exports (%)	0<x≤1.0%	1<x≤5%	5<x≤10%	x>10%	Total
Incumbents	0	0	2	2	4
Suppliers	2	1	0	0	3
Joint Ventures	2	0	0	0	2
Multinationals	0	0	0	1	1
Small Domestic Firms	3	0	0	4	7
Participants	7	1	2	7	17
Non-Participants	7	0	0	2	9
Total	14	1	2	9	26

These figures highlight some interesting results, not least being that the three sample members who export 1-10% of turnover participate in this market, as do seven of the nine firms who export more than 10%. The figures obtained from both the incumbents and joint ventures are similar to their export patterns in the small and large PABX sectors, and the high level of exports recorded by the multinational is the consequence of no domestic sales being possible as yet. Only one of the supplier firms exports products, but such sales are minimal in relation to turnover and are arranged through BT.

The most interesting group of firms, with regard to export sales, are the small domestic companies. These companies are split between those who export exceptionally high levels of their total output, and those who do not export at all. High export sales are recorded by firms participating in the feature and decorative sectors, although not all participants in these sectors have, as yet, managed to secure adequate export channels for their products. The relationship between market presence and export sales is not significant, reflecting a similarity in the export pattern of firms regardless of their location within the CPE market.

The final performance variable to be examined in the handset market is that of profitability. Each firm is classified in the following table on the basis of profits (x) expressed as net return on telecom

equipment sales. The profit levels recorded by the incumbents and joint ventures are identical to those recorded in the large PABX and small business system markets, given that these firms could not differentiate sufficiently between the three products, but the results give some indication of the performance of each firm type.

Profits (%)	$0<x\leq5\%$	$5<x\leq10\%$	$10<x\leq20\%$	$x>20\%$	Total
Incumbents	0	1	3	0	4
Suppliers	0	3	0	0	3
Joint Ventures	1	0	1	0	2
Multinationals	1	0	0	0	1
Small Domestic Firms	2	1	3	1	7
Participants	4	5	7	1	17
Non-Participants	3	3	2	1	9
Total	7	8	9	2	26

The level of profitability achieved within this market is spread quite evenly across the participating firms - only one firm earns profits exceeding 20% of sales, and this is a small domestic company which operates in the decorative market where costs are quite low and prices are high. Given this spread of profitability, there is no apparent relationship between firm type and profits. What is also of interest, however, is the possible distinction between the profitability of participants and non-participants but, employing a χ^2 distribution with three degrees of freedom, the relevant test statistic of 1.14 confirms that such a relationship is statistically insignificant.

TABLE 7.3 SUMMARY OF PERFORMANCE RESULTS

VARIABLE	HYPOTHESISED DIFFERENCE BETWEEN PARTICIPANTS & NON-PARTICIPANTS
(1) GOALS	NOT SIGNIFICANT
(2) EXPORTS	NOT SIGNIFICANT
(3) PROFITABILITY	NOT SIGNIFICANT

Hypothesis 3 states that liberalisation is not expected to encourage an increase in the international competitiveness of domestic firms. To test the validity of this hypothesis, consideration must again be given not only to the above performance results, but also to the concepts of market structure and conduct discussed above.

The structure of the domestic market has facilitated the entry of several small scale competitors who have found profitable niches. The domestic performance of these firms is satisfactory, but their success in international markets is doubtful. These niches may not be available in the world market as a whole, or may already be exploited by much larger scale competitors who can compete successfully on both price and non-price terms. The high levels of export sales achieved by the small domestic firms are partly a consequence of low levels of turnover and do not suggest significant levels of participation in the world market. However, the small companies are competitive enough to stave off much competition in their domestic market. In the case of those firms who participate in the one-piece market, and are the market leaders there, this is achieved through off-shore production. This facility enables relatively small sized companies to benefit from economies of scale, which would not be available otherwise, and allows them to compete successfully with both foreign and domestic firms.

The international competitiveness of the incumbent firms has not been increased by liberalisation. As in the market sectors discussed in Chapters 5 and 6 above, these firms compete on the basis of volume production and the exploitation of economies of scale, and again face the possibility of increased unit costs should foreign competitors

gain a foothold in the market. This would reduce the profitability of these firms, who would be unable to increase price if competing for contracts from BT, and would reduce the funds available for investment in further cost-reducing technology. The incumbents would face a further reduction in both domestic and international competitiveness.

On the basis of the above discussion, and the objective and subjective evidence presented, Hypothesis 3 is accepted, ie liberalisation is not expected to increase the international competitiveness of domestic firms. New domestic firms may have the capability of dabbling in international markets but their presence will never be significant - their primary role is likely to remain one of niche filling in the domestic market. At the same time the potential entry of foreign firms into the previously protected markets of the incumbents may reduce their output levels significantly and lead, eventually, to a loss of competitiveness.

NOTES

1. Figures sourced from Oftel.

2. Cordless telephones are powered by a battery. If these handsets were employed as primary instruments, and the power supply failed, there would be a complete loss of connexion, and the subscriber would be unable to access telecommunications services. For this reason, it has been legislated that such instruments be employed only as extensions, even subsequent to the liberalisation of the primary instrument market.

3. Total cost is defined, in this case, as including overheads but omitting National Insurance payments and pension contributions.

4. The Hull Telephone Department operates a distribution service which is almost identical to British Telecom's, and which directly replaces British Telecom's in that particular area of the country.

5. Figures are estimated using data sourced from British Telecom and Oftel.

6. These figures have been estimated on the basis of data sourced from the manufacturers, from British Telecom and from the Hull Telephone Company.

7. The joint ventures, and the incumbents, found it especially difficult to isolate R&D expenditure which was directed only towards handset development, because of the high degree of commonality involved in any research pertaining to customer premises equipment.

8. Sales of the small domestic manufacturers can be further categorised; sales by those companies operating in the one-piece, cordless and feature telephone markets accounted for 4.10% of total market output, and the sales of those firms operating only in the decorative handset market accounted for 2.46%

CHAPTER EIGHT : CONCLUSIONS

(I) PREFACE

Although the provision of telecommunications services has long been regarded as a "natural" monopoly, this argument has rarely been upheld with regard to the supply of telecommunications equipment in general, and CPE products in particular.

Traditionally, in the UK, the provision of CPE products was undertaken by a selected group of 4-8 firms who worked closely with each other, and with the Post Office. However, such arrangements, especially the extent to which firms were shielded from competition, resulted in low levels of efficiency, unnecesarily high costs and little product innovation. General dissatisfaction with this situation led to calls, on economic, political and social grounds, for the introduction of at least some element of competition, and a liberalisation policy was eventually introduced, in 1981.

The aim of this thesis has been to analyse the impact of liberalisation in the telecommunications market, with regard to the supply of large PABX, small business products and telephone handsets. The impact of liberalisation in each of these product sectors has been discussed in Chapters 5-7 respectively.

In this concluding chapter, the impact of liberalisation will be discussed in more general terms, ie with regard to the CPE market as a whole. In section (II) the results of the analyses presented in Chapters 5-7 are summarised. Some particular objectives which the government hoped to achieve, through the liberalisation of the telecommunications market, are also outlined, and judgements are made as to whether these objectives have been achieved as yet.

Finally, in section (III), proposals are made regarding the areas of related research which appear to offer most potential.

(II) RESULTS OF THE ANALYSIS

The economic, political and technological development of the UK telecommunications market, and the CPE market in particular, was discussed in Chapter 2. One of the most crucial points to emerge from that discussion was that the Post Office had been keen to assume control of all telecommunications services, at the beginning of the century, because telecommunications posed a considerable threat to the telegraph, over which it had a monopoly. Its wish to control telecommunications was not the consequence of a genuine belief that the Post Office could best develop the industry, and bring maximum benefit to both consumers and manufacturers.

The attitude of the Post Office, immediately after assuming control of the provision of telecommunications services, caused this industry to get off to a bad start. This was only rectified, to some extent, by the establishment of a considerable amount of state and industrial co-operation through the operation of "Bulk Supply Agreements". These agreements entailed significant benefits theoretically, in so far as they encouraged joint research programmes and eliminated any duplication of effort. However, although a considerable degree of harmony was achieved for a time, between participating manufacturers and the Post Office, this form of market structure was not conducive to product development. Also, the fact that the Post Office determined the prices it would pay manufacturers for products, on a cost plus basis, encouraged a considerable amount of inefficiency.

Although the industry developed under the above conditions, this development was slower than was experienced in many other countries, and consumers became increasingly dissatisfied with both the products and services offered. The introduction of at least some element of competition was generally proposed, through a variety of arguments based on economic, political and technological grounds.

The arguments for competition were strongest in the CPE market. The discussion presented, in Chapter 2, highlights this particular sector of the telecommunications market as a prime candidate for the introduction of competition in its own right. However, when competition was finally introduced, through the 1981

Telecommunications Act discussed in Chapter 3, the primary reason was to suitably prepare the market for the transfer of BT, a public monopoly, into the private sector. Only by introducing a more competitive market structure could the government ensure that the sale of BT would not entail some significant and detrimental welfare consequences.

Although liberalisation was introduced as a necessary first step towards the successful privatisation of BT, the consequences of this policy, at least in the CPE market, are arguably independent of the reasoning behind its introduction. One of the objectives of this thesis is to illustrate that "liberalisation" is a policy which can be totally distinct from "privatisation" and which should, therefore, be judged entirely on its own merits.

Expectations

The liberalisation measures introduced, through the 1981 Telecommunications Act, were hastily constructed and proposed almost as a "shot in the dark". No other country, except the United States, had introduced a similar policy which could be used as an example, and even the relevance of US experience is questionable. The fact that liberalisation had been introduced, very gradually, into the US market, through a series of legal judgements over a 20-30 year period, offers little similarity to the situation in the UK, where the intention was to introduce competition immediately wherever this was possible or subject to, at most, a three year delay.

In retrospect, it is easy to criticise the measures contained within both the 1981 and 1984 Telecommunications Acts, and it is apparent that the government constructed these policy measures on the basis of too little information[1]. The government was also faced with the problem of necessarily introducing suitable regulatory bodies to protect consumers, and did this through the creation of BABT and Oftel. However, in any case where regulation is being introduced, it is almost too easy to take this to the extreme and, consequently, to restrict the freedom of the consumer. This point is adequately

exemplified by the apparent reluctance of BABT to test and approve products on the basis of safety requirements only. BABT appears to have been too protective towards the consumer, in so far as it has attempted to test the functionality of products. This problem has been worsened by a lack of suitable technical and industrial knowledge, on the part of BABT employees. This, it has been argued, results in everything being necessarily done "to the letter of the law", and has caused increased manufacturing costs, an increase in market prices, and less product variety than may otherwise have been the case.

Some futher limitations to the expected success of liberalisation policy, as it has been introduced, were discussed in Chapter 4 on the basis of established economic theory. In particular, the achievement of a competitive solution in the CPE market appears certain to be hindered by the exploitation, by large scale participants, of absolute cost advantages and economies of scale. Giving consideration to these limitations, economic theory suggests that, while liberalisation policy could have some success through its encouragement of entry into the CPE market, the extent to which this is even potentially possible is severely limited by the presence of entry barriers. Economic theory also suggests that BT's continued dominance as a buyer of CPE products could have adverse, and significant, effects.

In Chapters 5-7 the impact of liberalisation was examined in three sectors of the CPE market, ie those dealing with large PABX, small business systems and telephone handsets. The results of this analysis will now be summarised prior to a discussion of the wider implications of CPE production for the industry as a whole.

Hyothesis 1

The first hypothesis proposes that liberalisation policy, as introduced by the government, will encourage a socially efficient level of competition. This is found to hold in the large and small PABX markets, but not in the handset market. In the case of large PABX there has been only limited entry into the market, but competition is still judged to be socially efficient. The presence of significant

economies of scale detracts from the need for many competitors and encourages an oligopolistic structure. Thus, although there are few competitors, the structure of the market remains conducive to competition. The most important structural change has been the entry of BT in its role as a distributor. Given BT's apparent success at securing a significant share of the market, firms will be keen to distribute their products through BT and will compete for orders. These firms are both domestic and foreign owned enterprises who are each eager to win significant market shares. The collusive behaviour witnessed between domestic firms in the past does not appear relevant to such conditions and, consequently, a considerable degree of competition has been introduced.

In the small PABX market entry has been more noticeable, and has involved both foreign and domestic firms. This market provides more scope for product differentiation and, although economies of scale remain of considerable importance, these appear to be exploited at lower levels of output. This provides opportunities for smaller scale entrants. In this market BT traditionally held a monopoly but has seen its share of the market already fall to 70%. Firms are competing with each other for direct sales in the remaining 30% of the market, and for sales through BT. The scale of entry into this market appears to have been sufficient to ensure a socially efficient level of competition. This appears to be the most competitive of the three market sectors examined in this study.

In the handset market, there appears to have been excessive entry. This market is characterised by strong elements of product differentiation which have enabled firms to locate in specific sectors or "niches". Although each of these sectors is producing a slightly different product, there appears to be a need for this level of variety, and little inefficiency. However, within each of these product sectors are several firms who are further differentiating products, on the basis of trivial features, and this is inefficient. Within each sector there are significant economies of scale to be exploited but, with several participants, this is not being achieved and unit costs are significantly higher than necessary. This problem does not appear to be too serious in the standard two-piece product

sector, where successful participation requires considerable orders from BT, but it does prevail elsewhere and, for this reason, Hypothesis 1 is rejected. This study judges entry into the handset market to have been excessive and concludes that the level of competition introduced is not socially efficient.

Hypothesis 2

Hypothesis 2 proposes that the interacting strategies of each firm will encourage the prevalence of non-price competition. This is found to hold in some areas of the handset market, but is rejected elsewhere. In the large PABX market, the participants are offering products which have only limited scope for differentiation and are pursuing cost reduction, through economies of scale, to compete on the basis of price. The situation in the small PABX market is, however, much less clear. In that market firms compete on the basis of both price and non-price factors with neither strategy appearing to dominate. For this reason the hypothesis, which suggests the prevalence of non-price competition, is necessarily rejected.

In the handset market price competition prevails in the high volume sectors, notably those dealing with standard two-piece and one-piece handsets. In these sectors there is very little differentiation, few opportunities for non-price competition, and economies of scale are important. Some small domestic manufacturers are competing successfully by subcontracting manufacture off-shore. Domestic production of these products, especially in the early days of competition, would be relatively expensive and the firms involved would not be able to compete on the basis of price. However, off-shore production has enabled these firms to compete successfully with their large scale counterparts and, in the one-piece handset market, it is the small domstic firms who are the price leaders.

Price competition also prevails in the market for cordless handsets, where there are few opportunities for differentiation, but does not prevail in the markets for decorative handsets and feature telephones. In these two sectors consumers are primarily interested in

the specific features of the product, the facilities it offers, or its appearance. In these sectors, non-price competition prevails over price competition, which is of little importance, and Hypothesis 2 is, consequently, accepted.

Hypothesis 3

The third, and final, hypothesis tested in each market sector proposes that competition in their domestic market will fail to make UK firms more competitive on an international level. In each sector this hypothesis is accepted. The primary problem facing domestic firms, especially the large scale incumbent firms, is associated with a loss of market share to new entrants. If this necessitates a decrease in output levels then some of the advantages of economies of scale may be lost, unit costs will rise and domestically produced products will lose competitiveness. So not only is liberalisation unlikely to improve the international performance of domestic firms - it may actually lead to a decrease in their competitiveness. Domestic firms may find it increasingly difficult to compete on either price or non-price terms because of higher manufacturing costs and, consequently, limited finance for new product development and the promotion of present product ranges. In recognition of this effect, Foreman-Peck & Manning (1986) argue that the "loss of scale economies in subscriber telephone apparatus because of liberalisation has to be weighed against the possible stimulus to efficiency provided by foreign competition."

Domestic firms are expected to "lose out" for as long as policy dictates that foreign competitors can enter the domestic market even though domestic firms are debarred from entry into the non-liberalised markets abroad. Even if domestic competition does successfully encourage UK firms to increase their efficiency, and to develop more attractive products, there can be little success, in world terms, until such firms are offered access to other markets. In 1984/5 only the US market was officially open to imported products, but this market is so heavily protected that it cannot be judged as

offering "reciprocal" rights. The results of the above analysis, with regard to all three product sectors, suggest that liberalisation has not encouraged domestic firms to achieve and maintain a leading position in the world market and that, indeed, the reverse may be true.

Further Objectives

In addition to testing the above hypotheses, which were constructed on the basis of established economic theory, some consideration should be given to the question of whether liberalisation has successfully achieved the government's own objectives. In addition to those alrady tested in relation to the above hypotheses, these objectives, cited in Chapter 1, included the promotion of consumer interests, efficiency and economy, research within the UK, and the attraction of multinationals.

The first aim of liberalisation, as far as the government was concerned, was that it be introduced in such a way as to promote the interests of consumers, purchasers and other users of telecommunications. Strict product standards were introduced as part of the effort to achieve this objective, although there is evidence that these have been too protective and have resulted in less product choice for the consumer than would have been available otherwise. But despite such limitations, each product market has displayed a relatively high level of nominal growth. This growth reflects the replacement of old-fashioned products rather than growth in the market base itself, but consumer interests have still been promoted. Liberalisation has encouraged the release of many attractive products onto the market, and has given the consumer a much wider choice of product, at a wider range of prices, than would have been available in the absence of competition.

A second objective of policy has been the promotion of both efficiency and economy within the domestic industry, and again the conclusion to be drawn is that this has been achieved, but subject to some limitations. Most firms have been encouraged by liberalisation to

increase the extent to which they are vertically integrated. Firms are keen to either increase their in-house supply of components and other inputs, or to standardise their input requirements and achieve cost reduction through bulk orders if inputs are sourced externally. Considerable levels of investment are being channelled into achieving faster and cheaper methods of production, but this effect is most noticeable in the two business product markets, ie where the threat of foreign competition is strongest.

In the handset market it is not quite so obvious that both efficiency and economy are being maximised, although firms generally "intend" to increase these. The handset market has attracted less foreign competition than either the large PABX or small business system markets, and is characterised by a prevalence of market "niches". Within these niches even small firms can exert almost monopolistic type control, and may be sufficiently shielded from competition to withstand the effects of some inefficiency and diseconomy.

A third objective of the government has been to promote research in the UK, but it has been established, in Chapters 5-7, that this particular objective has not been achieved. The incumbent firms have confirmed a preference for creating product differentiation through advertising and distribution, rather than product development, and generally reject any option of developing products independently. These firms argue that taking out licences on foreign products provides the best means of securing competitive products. Any foreign firms entering the domestic market have already undertaken most of their product development abroad, and need only "anglicise" product in the UK. Very little "new" development work is undertaken in the domestic market at present, and the UK faces the threat of becoming technologically dependent upon other countries.

One final objective of liberalisation policy has been to attract multinationals to the UK. However, given that the UK market is relatively small, in world terms, and is unlikely to accomodate comfortably both foreign and domestic firms, many multinationals may not view this market as sufficiently attractive to justify the high level of investment required to establish a manufacturing subsidiary.

These firms may enter the market through either the establishment of a joint venture with a domestic firm, or through direct import via a domestic firm selected to act as an "agent"[2].

With regard to the sample of firms participating in this study five multinationals, of foreign ownership, were competing in the market for large PABX products in 1984/5, but only one had recently established independent production facilities in the UK. This particular firm had participated in the market prior to liberalisation. Two of these multinationals had elected to form joint ventures with domestic companies, and two were operating through subsidiaries established before liberalisation. None of the these firms had chosen to export products to the UK through domestic agents.

Seven firms of foreign ownership were competing in the market for small business systems[3]. Only two of these firms had established independent subsidiaries, and one of these was established prior to liberalisation. Two companies were importing products through domestic agents, and three had established joint ventures with domestic firms.

Only one multinational had elected to participate independently in the market for telephone handsets, and this firm had established a subsidiary for that very purpose, even though it had yet to win product approval in the UK. Another two foreign companies had established joint ventures with domestic firms.

In total, the sample contained eleven firms of foreign ownership who were competing in the CPE market in 1984/5. Only two of these firms had selected the relatively low risk option of exporting products through domestic agents, three had selected the medium risk option of establishing joint ventures with domestic firms and five had chosen what would appear to be the relatively high risk option of establishing subsidiaries. Only three of these subsidiaries can, however, be attributed to liberalisation itself, but even these have undoubtedly produced significant levels of inward investment and created at least some employment opportunities in the UK.

The above figures suggest that the government has been quite successful in its objective of encouraging multinationals in to the UK, although an even stronger presence may be desired. The body holding most influence is undoubtedly BT itself. Multinationals will

favour importing products into the UK market unless they are assured of sales volumes which are large enough to justify domestic production. Such volumes generally require sizeable contracts from BT who, correspondingly, is placed in an important position in the market.

Most arguments suggest that BT should make entry easy for multinationals, although this will be met with disfavour by domestic firms. BT, however, is now a private company answerable to shareholders who generally favour a high rate of return on their investment. BT does not manufacture products itself and must, therefore, distribute models which appear most attractive to consumers. In many cases these products will be sourced from foreign manufacturers who will increase their presence in the UK if the volume demanded enables them to establish plants which are large enough to exploit the available economies of scale. In return, BT will have the ability to distribute attractive products to consumers.

One concern facing BT with regard to this issue will be whether BT will lose some of its dominance in the market. But, given that even the largest multinationals will be eager to supply products through BT itself, its dominance as the primary buyer of products, and subsequent distributor of these to end users, appears relatively secure. It is unlikely that multinationals entering this market will be able to compete with BT, and attacking the market through BT appears to be relatively more attractive.

While BT may have few reservations about encouraging the entry of multinationals, especially into the handset market where their presence remains limited as yet, the domestic manufacturers strongly oppose such a move. These firms rely on economies of scale to keep them competitive, and consequently rely on BT for sizeable product orders. If BT's demand were to go elsewhere, these firms would lose significant volume output, may face increased unit costs as a result, or else be faced with surplus output which would be difficult to dispose of, and would steadily lose competitiveness and their favourable position in the market. If BT were still in public ownership it would undoubtedly remain loyal to its traditional suppliers, even though this implied that it distributed products which

were less attractive than those which could be sourced from foreign sources. But, given that BT is now a privately owned company, its first loyalty lies to its shareholders. As a consequence, BT's loyalty to its traditional suppliers is in question, and it has an incentive to make entry easy for foreign firms.

Summary

The material presented in this thesis suggests that liberalisation has been successful in the UK telecommunications market for CPE products in so far as it has encouraged the entry of many new firms, and encouraged some measure of both price and non-price competition. However, the presence of many foreign firms is expected to reduce the market shares of the incumbents, in particular, and may prevent these firms from achieving the economies of scale deemed necessary for effective competition. These firms also appear to be finding it relatively difficult to compete with their international competitors on the basis of non-price competitive strategies.

As it has been introduced, liberalisation appears favourable to the domestic consumer and to foreign and new domestic firms, but is damaging to the incumbents, ie those who participated in the market prior to the introduction of competition. These firms remain dependent upon BT for the majority of their sales and do not believe that liberalisation has offered any opportunities which would not have been available otherwise. Even if they should succeed in both increasing efficiency and developing attractive products these firms, who are losing domestic market share to new entrants, are unlikely to win compensatory sales in the world market until reciprocal arrangements are introduced abroad[4].

In sharp contrast to the attitude of the incumbents, foreign firms welcome the opportunities provided through liberalisation. These firms can presently access the UK market through established subsidiaries, joint ventures with domestic firms or direct export through domestic firms who act as agents. The products offered by foreign firms appear particularly attractive to the domestic consumer, given the limited

choice of product facing him prior to liberalisation, and are relatively successful. Finally, the additional sales made in the UK market may be sufficient to enable these firms to benefit from further economies of scale, either in the manufacture of products, or in the production or procurement of inputs.

On the basis of this study, the conclusion can be drawn that competition has been introduced successfully, but has been subjected to limitations imposed by some particular aspects of market structure. If initial expectations, as to the impact of policy, have not been upheld it is surely because these were formed without giving sufficent consideration to the two most relevant structural variables in this particular market, ie the dominance of BT as a buyer of products and the presence of considerable economies of scale in production.

(III) SUGGESTIONS FOR FURTHER RESEARCH

Although the above conclusions are based on quite a thorough research programme, this project focused on only one sector of the telecommunications industry and did this at one particular point in time, ie four to five years after the policy was first anounced and three years after the implementation of the first measures. The primary advantage of this particular approach is that a deep appreciation of the character of the market has been achieved and, indeed, this was further facilitated by the fact that the CPE market is relatively small in size. The sample of firms interviewed in this project differed only slightly from the "population" of CPE market participants in 1984/5, and conclusions drawn on the basis of that sample can, consequently, be judged as unbiased and highly relevant, although the use of statistical tests of significance is hindered by the small sample size. However, although the results achieved through this approach adequately highlight the initial successes and limitations of liberalisation a longer term perspective would, perhaps, be better able to separate out the effects of "teething trouble", from the lasting effects of policy.

In addition to a longer term study of the effects of liberalisation, a wider perspective would also appear to be of particular value. Such an approach could consider the implications of liberalisation, and possibly privatisation, in several areas of the market, and could focus on the effect of established and potential relationships between the chosen sectors[5]. Such a project requires, however, that policy is effective in these markets; when this particular research programme was first drawn up, there was little evidence of policy being sufficiently established in other sectors to warrant investigation.

NOTES

1. Only in the case of Value Added Network Services did the government commission a report on the expected consequences of liberalisation, ie the Beesley Report (1981) and, even in that particular case, many of the recommendations made by the author were rejected.

2. In the CPE market all products must be registered either by domestic firms, or by foreign firms with a UK address. These firms are not required to have manufactured the products they submit for approval and registration, and may act simply as agents for foreign firms who have no wish to locate in the UK.

3. TMC first entered the market as a domestic firms but was later taken into foreign ownership. This particular firm is, therefore, treated as an "incumbent" and not included in the category of "foreign" firms participating in this particular sector, but is included subsequently when "eleven" firms are deemed to be of foreign ownership.

4. The proposed merger of GEC and Plessey, in 1986, lends support to the argument that large firm size is required for success in the manufacture of telecommunications equipment. However, the primary advantage of the proposed merger, which was not allowed to proceed, was expected to be cost reduction in the manufacturer of telephone exchange equipment. This was expected to outweigh cost reduction achieved in the manufacture of CPE products.

5. One technological relationship of particular interest concerns the integration of both computing and telecommunications.

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