Economic impact of the use of radio spectrum in the UK

A report by Europe Economics

Europe Economics
Chancery House
53-64 Chancery Lane
London WC2A 1QU
Tel: (+44) (0) 20 7831 4717
Fax: (+44) (0) 20 7831 4515
www.europe-economics.com

16 November 2006

TABLE OF CONTENTS

1 EXECUTIVE SUMMARY

Introduction

1.1 This study seeks to measure for Ofcom the economic impact of the use of radio spectrum in the UK for the year ending 31 March 2006. The importance of and increasing demand for radio spectrum makes it important for Ofcom to understand the current uses of radio and its benefits, including the contribution of radio spectrum use to the UK economy. This study is an update of and uses similar methodology to that employed during previous similar studies conducted for and by Ofcom's predecessor, the Radiocommunications Agency (RA), most recently in 2000 and 2002, while additionally calculating the economic impact of radio spectrum using an alternative GDP effects methodology.

1.2 This current study indicates an estimated economic benefit arising from the use of the radio spectrum of £42 billion in 2005/6, based on calculations of consumer and producer surplus. This compares with an estimated benefit of £28 billion in 2002 (result expressed in 2006 prices).

1.3 The alternative methodology calculated that the estimated net GDP impact of the use of radio spectrum is around £37 billion and 240,000 in employment (see Chapter 12 of this report for further details).

The use of radio spectrum

1.4 This study focuses on the use of the radio spectrum to supply a radio service, including the firms providing those services, the equipment manufacturers and service companies which supply them and the retailers which sell their services. Consumers who benefit from the services thus supplied include both private individuals and business users.

1.5 For the purposes of this study, we have analysed the radio industry in seven sectors:

(a) Public mobile, including cellular mobile, paging, public mobile data networks, and public access mobile radio;

(b) Broadcasting, including analogue and digital TV, and analogue and digital radio;

(c) Satellite links, meaning the operation of satellite links, such as VSATs and permanent earth stations;

(d) Fixed links, meaning the operation of radio fixed links, for example to substitute for or supplement cable links in telecommunications infrastructure;

(e) Wireless broadband, meaning the provision of WiFi and other wireless access services;

(f) Private mobile radio, meaning mobile radio communications services provided for non-public use, such as by emergency services, taxi companies and transport companies; and

(g) Other, including non-commercial aviation, amateur radio, citizen's band and other radio uses (but excluding commercial aviation and Government, including MOD, use).

1.6 The study calculates the benefits accrued by producers (producer surplus) and consumers (consumer surplus), as well as the estimated contribution to UK GDP of the use of radio spectrum. Producer and consumer surplus are defined in more detail in Chapter 3 of the study.

Results

1.7 Table 1.1 presents the results of the study and compares these to the 2002 results (expressed in 2006 prices). The total economic value of the radio industry in 2005/6 is around £42 billion.[1]

Table 1.1: Estimated net economic benefits to the UK economy

	2006		2002	
Sector	**Value (£ billion)**	**Percentage (%)**	**Value (£ billion)**	**Percentage (%)**
Total	**42.4**	**100**	**28.2**	**100**
of which:				
Public mobile	21.8	51	14.4	51
Broadcasting	12.3	29	5.9	21
Satellite links	2.8	7	2.9	10
Fixed links	3.9	9	3.8	14
Wireless broadband	0.3	1	-	-
Private mobile radio	1.2	3	1.1	4
Other	0.1	0	0.1	0

Note: 2002 results expressed in 2006 prices

"Other" is defined to include: amateur, citizens' band, non-commercial aviation, maritime and other equipment and services

Source: EE

1.8 Therefore, we estimate that, in real terms, the net economic benefit to the UK economy of radio spectrum has increased by around 50 per cent between 2002 and 2006.

[1] Hereafter 2005/6 is referred to as 2006

1.9 Table 1.2 below disaggregates these overall figures to show separately the contribution of producer and consumer surplus by sector.

Table 1.2: Estimated consumer and producer surplus

	2006		2002	
Sector	**Consumer surplus (£M)**	**Producer surplus (£M)**	**Consumer surplus (£M)**	**Producer surplus (£M)**
Total	**37,783**	**4,619**	**27,491**	**741**
of which:				
Public mobile	[2]18,964	2,821	13,642	771
Broadcasting	10,579	1,690	6,057	- 137
Satellite links	2,832	- 5	2,903	- 9
Fixed links	3,883	-	3,793	-
Wireless broadband	292	- 1	-	-
Private mobile radio	1,223	-	1,086	-
Other	10	114	10	116

Note: 2002 results expressed in 2006 prices

"Other" is defined to include: amateur, citizens' band, non-commercial aviation, maritime and other equipment and services

Source: EE

1.10 As can be seen, the major differences to the results of earlier studies are the large increases in benefits calculated for the public mobile and broadcasting sectors, in terms of both consumer and producer surplus.

1.11 In the public mobile sector, much of the increase can be explained by the additional consumer surplus generated as a result of the very significant 36% increase in the number of mobile phone subscribers since 2002. Producer surplus for the cellular mobile sector also increased significantly, partly as a result of increased average revenue per user and partly as a result of an increased level of data usage associated with enhanced 2G and 3G mobile services.

1.12 In the broadcasting sector, our calculations were significantly influenced by recent data indicating that consumer willingness to pay for broadcasting services (both for television and for radio services) was considerably higher than had previously been recorded. We attribute this increase partly to possible under-recording of consumer willingness to pay figures in previous studies and also to the recent growth and availability of digital

[2] It should be noted that we have calculated a range for consumer surplus in the public mobile sector. This is the mid point, which was used for the total calculations.

television and digital radio services, although very high WTP results were also recorded for the traditional five terrestrial television channels. We note that digital television (DTT and satellite) is now received by over 18 million households in the UK, an increase of more than 70% compared with 2002[3]. In respect of digital radio, research undertaken in 2004 by Ofcom[4] indicated that 6 out of 10 people had accessed digital radio and that 40% listened to more radio as a result of having accessed digital radio.

[3] Ofcom – Digital Progress Report, 2006 Q1
[4] Ofcom's "Radio Review – Preparing for the Future", December 2004

2 INTRODUCTION

Background

2.1 The objective of this study is to measure the economic impact of the use of radio spectrum in the UK for the year ending 31 March 2006.

2.2 Radio spectrum is a major asset to the UK and underlies many aspects of our lives, being critical to areas such as air travel, emergency services, cellular telephony, sound and television broadcasting, defence and the utilities. The use of the radio spectrum also facilitates the existence of a number of industries, which in turn make a crucial contribution to the UK's economy. One of Ofcom's key statutory duties is to secure the optimal use of the radio spectrum under its management and, as the custodian of the radio spectrum, Ofcom has an interest in monitoring the economic impact of its use.

2.3 Ofcom's predecessor, the Radiocommunications Agency, commissioned several studies to quantify the economic impact of the radio spectrum, the most recent studies being in 2000 and 2002. The economic impact of the use of radio spectrum was estimated to increase from around £20.3 billion in 2000 to £24.7 billion in 2002 (£28.1 billion in 2006 prices). The approach used in those earlier studies was to calculate the total benefit to radio industry producers and their consumers, and we have been asked to adopt a comparable approach in this updated study.

2.4 This study updates these figures for 2006 and uses them as reference points. Since 2002, the emergence of a number of new technologies and services that utilise the radio spectrum, such as 3G mobile and wireless broadband, in addition to the continuing development of 2G mobile and digital broadcasting services means that the potential contribution of the radio spectrum to the economy is likely to be significantly higher than the estimates made in previous years.

2.5 To provide comparability, this study has retained the same sectoral breakdown as was used in the 2000 and 2002 studies but with the addition of a new sector, wireless broadband. This extra sector has been added in recognition of the development of new technologies and services in this area, and in acknowledgement of the likely substantial growth and importance of such services in the near future.

2.6 We were also asked specifically by Ofcom to investigate the possibility of including some analysis of the commercial aviation sector, which had not been included in the previous economic impact studies. However, due to methodological complexities, data limitations and resource constraints, we were unable to derive a figure for this sub-sector.

2.7 In this study, the radio industry is defined as those firms that make direct use of the radio spectrum to supply a radio service, as well as equipment manufacturers and service companies that supply those firms. Taking one important sector, in the case of broadcasting, firms might include:

(a) Transmission companies;

(b) Terrestrial and satellite TV broadcasters and schedulers; multiplex operators;

(c) Radio broadcasters;

(d) News Services, Programme Makers;

(e) Advertisers; and

(f) Equipment manufacturers.

2.8 Given that this study does not cover some radio sectors at all (eg. commercial aviation, Government and MoD use of radio spectrum) and that, for some sectors studied, we were not able to find data on certain activities, the figures we have calculated for the economic value of the UK radio spectrum are likely to be under-estimates and therefore to understate the full contribution from radio spectrum usage to the UK economy.

Scope of the study

2.9 As stated above, the objective of this study is to measure the economic impact of the use of radio spectrum in the UK for the year ending 31 March 2006 (hereinafter referred to simply as 2006). The economic impact is measured by two alternative approaches:

(a) Estimation of the impact on consumer and producer surplus of the use of radio spectrum; and

(b) Estimation of the contribution to UK GDP of the use of radio spectrum.

2.10 The terms of reference for the study also required us to adopt a methodology which would be updateable at low cost and which would take into account suitable publicly available input data. The chosen methodology is also broadly consistent with the methodology adopted in the previous studies to allow for comparability of results.

About Ofcom

2.11 Ofcom is the UK's regulator for the communications industry. Its responsibilities cover television, radio, telecommunications and wireless communications services and its statutory duties are set out in the Communications Act 2003, in particular:

"3(1) It shall be the principal duty of Ofcom, in carrying out their functions;

(a) to further the interests of citizens in relation to communications matters; and

(b) to further the interests of consumers in relevant markets, where appropriate by promoting competition."

2.12 Ofcom inherited responsibility for radio spectrum management issues from the Radiocommunications Agency and has a specific duty to ensure the optimal use of the electro-magnetic spectrum.

About Europe Economics

2.13 Europe Economics is an independent economics consultancy, specialising in economic regulation, competition policy and the application of economics to public policy and business issues. The firm advises a wide range of clients including government departments, regulators, international bodies, law firms and private sector companies. It is especially experienced in network industries generally and in the communications sector particularly. It has also carried out a number of economic impact assessment studies which involve the quantification of non-market goods and services.

2.14 More details of the firm can be found at www.europe-economics.com.

Structure of the report

2.15 This report is structured along the following lines:

(a) A discussion of the meaning of economic impacts, in particular consumer surplus and producer surplus;

(b) A description of the general methodology used to calculate the economic impact (specific methodologies used for any sub-sectors are detailed in the respective sector analyses);

(c) Calculation of the economic impact by sector; and

(d) Calculation of the contribution of the radio spectrum to the UK economy using a GDP effects methodology.

3 CONSUMER AND PRODUCER SURPLUS

3.1 This chapter provides details about the economic impacts, known as consumer and producer surplus, that this first part of the study seeks to quantify. We begin by discussing the net benefits of radio spectrum to its users and then discuss how the radio spectrum might impact on the wider economy.

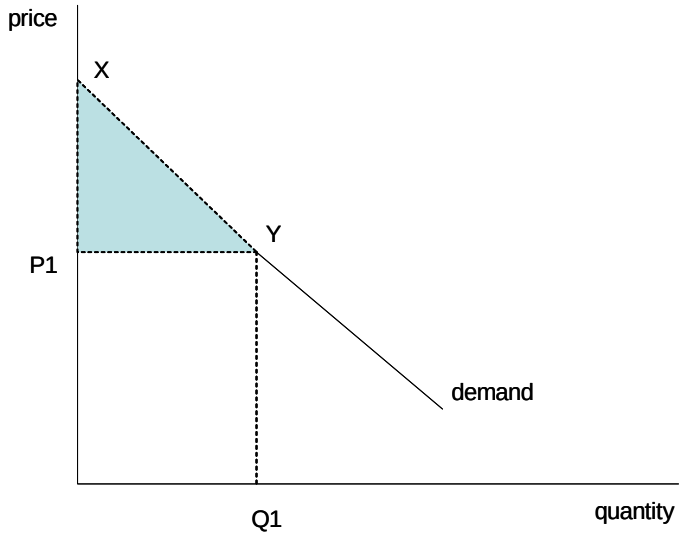
Consumer surplus

3.2 Consumer surplus was formally explained by Alfred Marshall in his Principles of Economics. It can be defined as the excess utility (or surplus) above the price actually paid. In Marshall's words:

> "the price which a person pays for a thing can never exceed and seldom comes up to that which he would be willing to pay rather than go without it: so that the satisfaction which he gets from its purchase generally exceeds that which he gives up in paying away its price; and he thus derives from the purchase a surplus satisfaction. The excess of the price which he would be willing to pay rather than go without the thing, over that which he actually does pay, is the economic measure of this surplus satisfaction."

3.3 The diagram below gives a simple illustration of consumer surplus. Point X is the maximum price that the customer is willing to pay for this particular good or service. P1 is the actual price paid and Q1 the associated quantity consumed at this price. The area XYP1 is the consumer surplus for the marginal customer – or economic benefit.

Figure 3.1: Consumer surplus



3.4 As the price of the good increases, the consumer's surplus will decrease – as we come closer to her willingness to pay price. Further, the more inelastic the demand curve is, the greater the consumer surplus. [5]

3.5 One difficulty with the standard definition of consumer surplus is that, as the price varies, the real income of the consumer changes. Thus, to calculate a more accurate indication of the benefit of the surplus, an adjustment needs to be made to offset the effect of the difference in real income at different price levels (the compensated demand curve). When the income effect is not large, however, consumer surplus, defined as the area below the market demand curve, is usually considered a reasonably good way of measuring welfare. In this study, we have not taken this income effect into account.

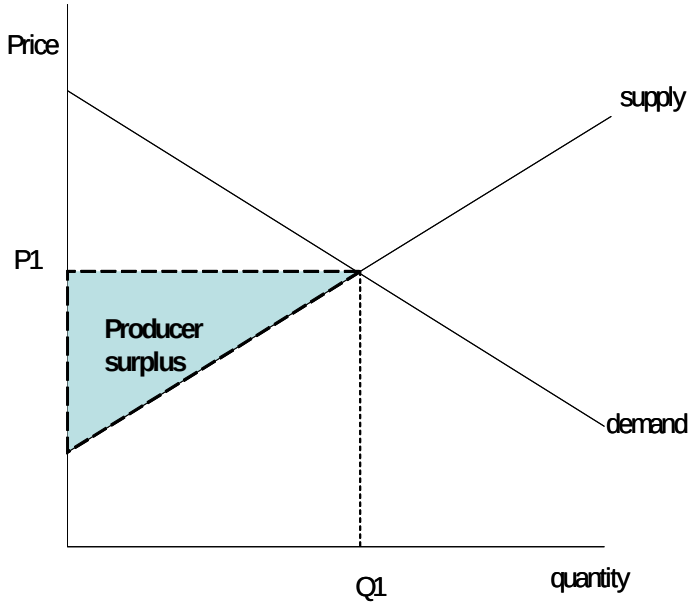
Producer surplus

3.6 Producer surplus is related to the notion of consumer surplus. It can be defined as the revenue received by a supplier of any particular good or service over the minimum amount he would be willing to accept to maintain the same level of supply. In other words, producer surplus measures the quasi rents that accrue to the producer and that can be defined as the difference between turnover and avoidable economic costs[6]. The diagram below illustrates.

[5] Elasticity in economic terms refers to how responsive consumption and production are to changes in price. If a good is demand price inelastic, this means that changes in price have a less than proportionate effect on demand. A good along these lines might be an essential commodity such as bread. Conversely, a good that is said to be demand price elastic will exhibit large shifts in demand in response to price changes.

[6] Church and Ware "Industrial Organisation, A Strategic Approach" McGraw Hill, 2000

Figure 3.2: Producer Surplus



3.7 Obviously, as the supply curve varies, the level of producer surplus will vary. Thus, when supply is more elastic, one would expect producer surplus to be less than if supply were relatively inelastic.

3.8 The above is a theoretical framework. It is important to understand that, in reality, producer surplus, unlike consumer surplus, can be negative. Although a negative producer surplus cannot continue indefinitely, producers may be prepared to accommodate losses at the beginning of a product cycle in order to establish the market. As we shall see, this is the case in some sectors of the telecommunications industry. A typical example is an industry that is in the initial phase of the life cycle; companies would have to invest considerable sums of money that would only start to provide positive returns after a few years and therefore it is likely that, in the initial few years, producer surplus would be negative.

3.9 It is worth noting at this juncture, that reported accounting profits and costs are not equivalent to economic profits and costs. The latter take into account inflation and the real cost of capital. Thus, even a start up company reporting profits in its early years may not be making a true economic profit because its capital costs are not fully accounted for in book values.

3.10 Although not shown, one can easily see that at the point of market equilibrium, both consumer surplus and producer surplus can coexist. The sum of these is the economic benefit from the market.

4 GENERAL METHODOLOGY

4.1 This chapter sets out the methods used in this study to calculate producer and consumer surplus. The methodology used to calculate GDP effects is described (along with the results of those calculations) in Chapter 12. We have largely followed the methods used in the 2000 and 2002 RA studies for reasons of consistency and comparability. We believe that this is a robust, cost effective methodology that can be applied in subsequent years.

Producer surplus methodology

4.2 As described in paragraph 2.7 of the Introduction (above), within each radio industry sector, there are sub-categories of user, for each of which producer surplus needs to be calculated individually.

4.3 To identify the companies in each sector, Europe Economics held discussions with Ofcom staff. These discussions also provided information as to the size of companies and indicators of market share.

4.4 The methodology for calculating surplus builds on the previous studies by the RA. Essentially, it calculates producer surplus using company accounts for the period 2005/6 (or, if these are not yet published and available, for the latest year available).

4.5 The source for this data in the first instance is the Amadeus database. This contains company accounts for over 5 million companies across Europe. The search engine allows one to focus on the UK only and within economic sectors, such as telecommunications. A secondary data source is publicly available annual reports and company accounts.

4.6 In practical terms, producer surplus is derived by calculating the difference between revenue and economic cost.[7] Economic costs reflect the fact that company resources have been engaged in producing radio services – they can be used to produce value in a number of alternative, competing ways. The economic costs are therefore defined as the value of these resources (inputs) in their next best alternative use.

Producer surplus = Turnover – Economic Costs

[7] This is a second best solution in the absence of accurate avoidable costs

Costs

4.7 Whereas turnover can be considered equivalent to company revenue in accounts, economic costs are not straightforward. We have identified four categories of cost:

(a) Labour;

(b) Other non-labour inputs of goods and services, e.g. materials or broadcasting content;

(c) Capital goods such as buildings, vehicles and plant and machinery; and

(d) Stocks.

4.8 Thus:

Economic costs = costs of (labour + non labour inputs + capital goods + stocks)

4.9 For some of the above cost categories, one cannot simply take the cost inputs from the published accounts and plug them into a formula which subtracts them from company revenue. This is for a number of reasons. First, data in company accounts is normally given in nominal terms – that is to say there is no consideration of inflation. For certain historic values, it is important that the figures are recalculated into real terms, such as for capital and stocks. Failing to take this step would mean that the calculations would refer to accounting book values and not the true economic value. An allowance for inflation is made by reference to UK Treasury GDP deflators using 2005/6 as the index year (100) – see Table 4.1 (below).[8]

4.10 Secondly, and related to the above point, company balance sheets typically show the value of tangible assets (capital stock) at historic cost less a provision for depreciation in each given year. For producer surplus calculations, we are interested in the capital stock in the year 2005/6 (year t). However, the reported (accounting) figure in year t is different from its true economic cost.

4.11 To calculate the economic cost, one must first calculate the real level of investment over a number of prior years (taking account for depreciation and inflation). This is done by taking the year on year difference in accounting capital stock (including a provision for depreciation) and then converting this into real 2005/6 prices.

4.12 The real economic capital stock is calculated by defining the level of investment in the first year (say year t-10) as the total capital stock and then adding real investment over the

[8] We have used a general rate of inflation as opposed to specific asset rates of inflation, which might differ. This is a potential weakness as it may cause the figures to be biased upwards or downwards. However, given project time constraints, we were unable to apply specific asset inflation rates to each different class of asset.

period in question (making an allowance for service lives).[9] The final figure is then the economic value of the capital stock in time t, which is the year we are concerned with.

4.13 However, the economic capital stock is not yet a cost input – we wish to derive the cost of capital. The cost of capital is the market rate for investments of a similar risk. The previous RA study derived the cost of capital, R, by using the capital asset model (CAPM). This is given by the formula:

$$R(t) = \text{Risk free rate of return} + \text{Beta} * \text{Equity premium}$$

Where Beta is defined as a measure of a security's or portfolio's volatility or systematic risk in comparison to the market as a whole.

4.14 The final cost of economic capital stock is then given by:

$$\text{Cost in year t} = (\text{cost of capital in year t})(\text{capital stock in year t}) + (\text{depreciation rate of capital stock})(\text{capital stock at year t-1})$$

4.15 The right hand side is the return that the capital invested in the stock could have earned in its next best alternative use plus the depreciation cost.

4.16 Similarly, the cost of stocks is calculated by the following formula:

$$\text{Cost of stock in year t} = (\text{cost of capital at year t})(\text{stocks in year t})$$

Adjustments

4.17 Three types of adjustments needed to be made in various sub-sectors. While these have been done as scientifically as possible, there is an element of subjectivity in some adjustments where data has not been available. Some of these adjustments are performed during the calculation of producer surplus while others are made after the final figure has been derived.

4.18 The first type of adjustment made was to ensure that the company accounts analysed referred only to UK operations. This is important as a number of large multi-national groups make use of the radio spectrum. Since this study focuses solely on the UK producer surplus, only the UK business should be considered. In most cases, the Amadeus database can provide UK only figures; in the cases where it could not, recourse to the company annual reports was made to extract UK only figures. If annual reports are not available or financial figures are not broken down geographically, an assumption is made for the particular company based on similar companies for which data is available.

[9] The total time period varies for companies, depending on the number of historic years of data available on Amadeus. Service life data is taken from OECD ISDB figures (International Sectoral Database).

4.19 The second adjustment is conversion of all figures into 2005/6 prices. For the companies where account information did not end in 2005/6, their figures were inflated by the relevant rate of inflation.

4.20 The third adjustment made was when data from all market participants was not available. It is vital that the entire market is captured, not just a segment of it. Thus, if data was only available for a limited number of companies, the producer surplus figures for that sub-sector were scaled up (based on market share information) in order to calculate the surplus for the entire market.

Consumer surplus methodology

4.21 The methodology for consumer surplus is less general and more tailored to particular sectors. Full details are given in each sector chapter. Here we present the general principles behind the individual consumer surplus methodologies.

4.22 Essentially, the following formula is used:

Consumer Surplus = No. of users * individual consumer benefit

4.23 For example, for users of public mobile phones, the number of users refers to the subscribers of mobile phone companies and the consumer benefit is the difference between their willingness to pay for the service and the actual price paid.

4.24 Of course, the above formula can be refined significantly. The number of users can be split according to user type and that might imply different levels of consumer benefits across different users.

4.25 Ideally, the consumer benefit data derived from willingness to pay surveys should be as recent as possible. However, for most sectors, no such survey work has been carried out (or is publicly available) for 2005/6 so that the calculation of consumer benefit figures for this period requires adjustments to existing figures. Europe Economics has made a number of recommendations to Ofcom regarding the undertaking of any future updates to this study, including the need to conduct new willingness to pay surveys.

Updating for inflation

4.26 As indicated in the preceding paragraph, there were a number of sectors in which no new willingness to pay survey data was available.

4.27 In the case of the public mobile sector, where there were no current willingness to pay survey results, we measured consumer surplus using four different methods in order to ensure, as far as possible, that our results could accurately reflect the actual contribution of this important sector in respect of the overall economic impact of the use of the radio spectrum.

4.28 In other cases, we have had to update the 2000 or 2002 study figures for inflation. It should be noted that in a number of cases, the 2002 impact study adopted the same approach. Mainly, these were the sectors that, in the 2000 and 2002 impact studies, were classified as the "smaller" sectors and therefore we would not expect the methodology we adopted to have a significant impact on the overall results of this study.

4.29 The index of inflation (GDP deflators) is shown below:

Table 4.1: GDP deflators

1996-97	80.347
1997-98	82.683
1998-99	84.785
1999-00	86.500
2000-01	87.716
2001-02	89.798
2002-03	92.576
2003-04	95.328
2004-05	97.925
2005-06	100.000

Source: HM Treasury

4.30 We did not need to adjust subscriber numbers in the same way because recent data on subscribers were generally available.

5 PUBLIC MOBILE

5.1 Within the public mobile sector there are a number of sub-sectors:

(a) Cellular mobile;

(b) Paging;

(c) Data network;

(d) Public Access Mobile Radio;

(e) Content providers;

(f) Retailers; and

(g) Equipment manufacturers

5.2 Compared to the 2000 and 2002 studies, certain sectors are expected to have reduced in size and importance, and others to have expanded. For example, the paging sector is expected to be less important in respect of total producer surplus, whereas one might expect cellular mobile to be a larger contributor to producer surplus.

5.3 Compared to the 2000 and 2002 studies, we included for consideration within this sector a wider range of equipment manufacturers.

5.4 The breakdown of total economic benefits for public mobile is shown below. Consumer benefits have only been calculated for cellular mobile, a similar approach to that adopted in 2002 and reflecting the decline in paging subscriber numbers. Whereas there were close to 2.5 million paging subscribers at the end of 1999[10], this had fallen significantly to fewer than 700,000 subscribers in 2002[11]. Given the relatively small size of consumer surplus derived from paging in 2000 (around £24m) and no indications of any substantial increase in paging subscriber numbers since 2002, we decided not to pursue further calculation of the consumer surplus for paging in this study.

[10] RA consultation document "Spectrum for Public Two-Way Paging", October 1999
[11] RA Spectrum Strategy document, 2002

Table 5.1: Total surplus, public mobile

	2006		2002	
Sub-sector	**Value (£M)**	**Percentage (%)**	**Value (£M)**	**Percentage (%)**
Total benefits	**21,785**	**100.0**	**14,412**	**100**
Of which:				
Consumer benefits	18,964	87	13,642	95
Producer benefits	2,821	13	771	5

Note: 2002 results expressed in 2006 prices

Source: EE calculations

Producer surplus methodological clarifications

5.5 The methodology adopted in calculating producer surplus for the public mobile sector follows that detailed in chapter 4. However, certain adjustments beyond those discussed were made. In particular:

(a) Within the cellular mobile sector, an adjustment was made to ensure that only mobile phone business is captured. This is because operating companies are engaged in activities outside mobile phones, such as fixed line services. Based on annual report data, a figure of 6.66 per cent was deducted from turnover to account for other business revenues and costs.

(b) Similarly, an adjustment was made for mobile phone retailers to take account of the fact that they sell services such as fixed line telephones and other merchandise. On average, 60 per cent of retailer revenue was derived from public mobile business.

(c) The figures for the equipment manufacturers have been adjusted to reflect revenue derived from the manufacture of equipment other than that related to the public mobile sector. Where data has been available from annual reports, adjustments were performed at individual firm level. Where this was not possible, an extrapolated average figure has been used.[12]

5.6 The retailers we have focused on are those whose businesses are based on telecommunications services. Thus, we have not made provision for multi-item retailers who also sell public mobile goods and services. This is because, typically, accounts are

[12] We used our subjective judgement in some cases, based on our knowledge of the industry and likely parallels between different manufacturing companies - most equipment manufacturers have significant non-mobile operations. Where we did not have data, we have assumed that 10 per cent of revenue and costs are derived from public mobile.

not broken down according to item type, and revenue derived from public mobile related business is likely to be only a very small part of their overall business.

5.7 We were unable to find useful recent information relating to content providers. This is because it proved difficult to identify the relevant content providers and any detailed information relating to their UK specific business, especially any financial information. In this respect, we found that our main data source, Amadeus, had industry categorisations that were at too high a level to identify these companies specifically. However, it should be noted that some of the producer surplus for this sub-sector is likely to be captured in cellular mobile operator accounts.[13]

5.8 The table below summarises producer surplus by sub-sector for public mobile.

Table 5.2: Producer surplus by sector

	2006	
Sub-sector	**Value (£M)**	**Percentage (%)**
Total	**2,821**	**100.0**
Of which		
Cellular mobile	1,819	64.5
Public Access Mobile Radio	136	4.8
Paging	6	0.2
Data Network	24	0.9
Content Providers	26	0.9
Retailers	596	21.1
Equipment	214	7.6

Source: EE, RA

Consumer surplus methodological clarifications

5.9 As with the producer surplus calculations, the methodology adopted was similar to that used in the 2000 and 2002 studies. This multiplies reported consumer surplus figures per subscriber (willingness to pay minus actual price) with the number of subscribers (business and residential).

[13] Typically it is not a separate accounting item, so is assumed to be part of the mobile business.

5.10 As no new willingness to pay surveys had been carried out since 2000, we have used four different methodologies to calculate consumer surplus in the public mobile sector. While recognising that these are essentially all second best solutions, the purpose was to provide a range of estimates, in the expectation that the average figure calculated from the four different methodologies might provide a reliable overall estimate of the consumer surplus figure.

Method 1: Revise 2000 figures by inflation and adjust for new subscribers

5.11 The first round consumer surplus figures simply updated the figures from the 2000 study for inflation. Using this method gives private consumer surplus as £204.07 per year and business consumer surplus as £577.58 per year, compared to £179.00 and £506.64 respectively in 2000. The total number of subscribers in 2006 is taken from the Ofcom Communications Market as 65.5 million. This is divided into business and private users on the ratios used in 2000 (10 per cent and 90 per cent respectively).

5.12 The calculated figures are:

Table 5.3: Method 1 results

	Consumer surplus (£M)
Private users	11,938
Business users	3,754
Total	**15,692**

Source: EE

Method 2: Update consumer surplus on the basis of existing relationships

5.13 According to the Ofcom Communications Market Report, the average revenue per user for mobile users in the year 2005 was £17.50 per month[14] Using trend data for average revenue per user, one can recover the figure for 2000 as £14.60 per month. The assumption then is that trends in revenue/spending are also reflected in trends in consumer surplus, i.e. if consumer spending rose by 10 per cent, this might indicate consumer surplus has also risen by 10 per cent. It is a reasonable assumption that an increase in average revenue per user is generating increased consumer benefits because generally prices have not been increasing. Indeed, the volume of calls made from mobile phones rose by 11 per cent between 2001 and 2006.[15]

5.14 Between 2000 and 2005, average revenue per user cumulatively rose by approximately 20 per cent. Using this figure yields a consumer surplus figure of £17.88 for private users

[14] Data is not yet available for 2006 and this figure cannot be updated for inflation.
[15] See Ofcom Communications Market Report 2006

per month in 2005 (£214.55 in the year). We do not have the equivalent ARPU data for business users, so have not attempted to apply this method to business users.

5.15 Calculating the consumer surplus using this updated figure gives:

Table 5.4: Method 2 results

	Consumer surplus (£M)
Private users	12,551

Source: EE

5.16 This figure is some 5% higher for consumer surplus than the equivalent figure produced by method 1.

Method 3: Using elasticities to calculate consumer surplus

5.17 Another possible method to calculate the consumer surplus is to use price elasticities. Building on standard economic theory, consumer surplus is calculated via the formula:[16]

$$CS = PQ / 2e$$

5.18 Where PQ is price multiplied by quantity sold (revenue) and e refers to the price elasticity (the sensitivity of demand to changes in price changes). This formula is based on the assumption that the long run demand curve is linear. If the demand curve is not linear, these results are likely to be conservative as the linear curve fails to describe the behaviour of consumers at very high prices.

5.19 From the Ofcom Communications Market Report, one knows that the estimated retail revenue of all UK operators is £13.2 billion and business mobile revenue is £5.2 billion.[17]

5.20 The next stage is to acquire elasticities for the service. We have acquired two sets of elasticities. The first come from a study by Teligen Consultants in 2000 on the UK mobile market, where the price elasticity was estimated as -0.47. This figure refers to the entire market (private and households). The second elasticity figure comes from the 2003 Competition Commission Report on mobile termination rates. Ofcom has previously used mobile elasticities from this study, and suggested using a figure of -0.30.

5.21 Using the above formula gives the following aggregated figures:

---

16 See Hausman 2002 in Handbook of Telecommunications Economics, Vol.1, eds. Cave et al.

17 Data is also available on revenue attributable to corporate data services but this is not broken down between mobile and fixed, nor would its use be consistent with the 2000 RA study.

Table 5.5: Method 3 results

	Consumer surplus (-0.47) (£M)	Consumer surplus (-0.30) (£M)	Consumer surplus (average) (£M)
Private users	14,043	22,000	18,021
Business users	5,532	8,667	7,099
Total	**19,574**	**30,667**	**25,121**

Source: EE

5.22 It is not surprising that the second set of elasticities provides higher consumer surplus as it reflects more inelastic demand. Intuitively, one might think that, since 2000, demand has become more inelastic as mobile phones come to be regarded as essential items.

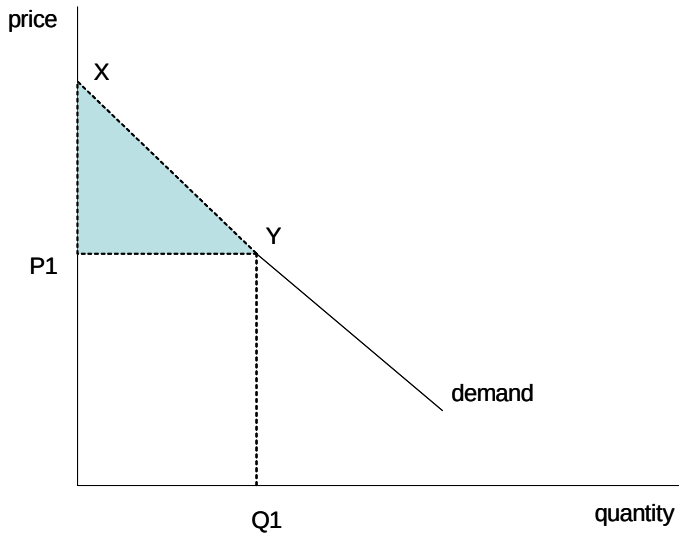
5.23 Given some uncertainty over the correct elasticity figure, the result of our calculations gives a range of £19.6 billion to £30.7 billion, with an average of £25.1 billion.

Method 4: Geometrically deriving consumer surplus

5.24 If one recalls Marshall's definition of consumer surplus, "…the excess of the price which he would be willing to pay … over that which he does actually pay…", we can define the following relationship for the marginal user:

Willingness to pay = Consumer Surplus + Price actually paid

Figure 5.1: Consumer surplus



5.25 Using figures from the 2000 RA study, we can calculate using algebra the maximum willingness to pay in 2000 for private users of public mobile services as £44.43 per

month.[18] In the above diagram this is point X, the choke price, where there is no demand. Q1 will be the number of private subscribers (30.1 million).

5.26 We wish to carry out a similar analysis for 2005/6. In order to do this, willingness to pay must be calculated. The price actually paid is the ARPU of £17.50 per month (2005). If we increase the willingness to pay price by the rate of inflation, we get a figure of £50.66. This gives a figure for consumer surplus as **£11,638M.**

5.27 While the results from this methodology are similar to that from method 1, the methods differ in the way that consumer surplus has been calculated. The first method updated consumer surplus by inflation, not taking into account willingness to pay; whereas this method used geometry to recover the 2000 willingness to pay, and then uses the formula for a triangle to derive consumer surplus.

5.28 We do not have ARPU for business users and so cannot carry out the necessary calculations to apply this methodology to business users.

Final figure for consumer surplus

5.29 A range of consumer surplus figures have been calculated. It is acknowledged there is an element of circularity, but this should be mitigated through the use of averaging the four approaches. Further, as stated previously, the methods chosen are second best compared with using data from a new willingness to pay survey but must be relied upon in the absence of any such survey data.

5.30 The results are tabulated below:

Table 5.6: Consumer surplus estimates

Method	Consumer Surplus (£M)	
1 – Private		11,938
Business		3,754
2 – Private		12,551
3 – Private	(14,043 to 22,000)	18,021
Business	(5,532 to 8,667)	7,099
4 – Private		11,638
Average – Private		**13,537**
Average – Business		**5,427**

Source: EE

[18] The calculated average figure was £29.50 in 2000 (summing average spend and consumer surplus).

5.31 Taking the average of the private and business user calculations gives a total figure for consumer surplus for the private mobile sector of approximately **£19 billion**.

5.32 However, this averaged figure does mask a range of values. This range is between £15.4 billion and £30.7 billion.

6 BROADCASTING

6.1 Producer surplus is calculated as the difference between company revenue and economic costs as described in chapter 4.

6.2 Within the broadcasting sector there are a number of sub-sectors:

(a) Transmission companies;

(b) Terrestrial and satellite TV broadcasters and schedulers; multiplex operators,

(c) Radio broadcasters;

(d) News Services, Programme Makers;

(e) Advertisers; and

(f) Equipment manufacturers.

6.3 The breakdown of total economic benefits for the broadcasting sector is shown below.

Table 6.1: Total surplus, broadcasting

	2006		2002	
Sub-sector	**Value (£M)**	**Percentage (%)**	**Value (£M)**	**Percentage (%)**
Total benefits	**12,269**	**100**	**5,920**	**100**
Of which				
Consumer benefits	10,579	86	6,057	100
Producer benefits	1,690	14	-137	0

Note: 2002 results expressed in 2006 prices

Source: EE calculations

Producer surplus methodological clarifications

6.4 The methodology adopted in calculating producer surplus for the broadcasting sector follows that detailed in chapter 4. However, certain adjustments beyond those discussed were made. In particular:

(a) Channel 4 is not included in the Amadeus dataset and in addition is a non-profit organisation. Therefore, for the purposes of this study, we have assumed that Channel 4 earns the same producer surplus as Five. We take some comfort in this approach from the fact that the turnover of the two entities is comparable, as is the consumer evaluation of the two channels' relative value.

(b) The results for the sub-sectors covering Radio Broadcasters and for News Services and Programme Makers were rescaled to take account of the fact that not all of the companies identified by Ofcom were available on the Amadeus dataset. Therefore, the figures that were obtained for the companies whose results were available on Amadeus were extrapolated to produce the results for the sub-sector as a whole. In the case of the Radio Broadcasters sub-sector, we used Ofcom's analysis on the market players' turnover figures to conduct the rescaling.

(c) An adjustment was made for the advertisement sector to take account of the fact that advertising on television has halved since 2000. Only 15 per cent of turnover was attributed to the broadcasting sector. Total turnover in the advertising sector has been calculated from the Advertising Yearbook

6.5 The table below summarises producer surplus by sub-sector for Broadcasting.

Table 6.2: Producer surplus by sector

Sub-sector	Value (£M)	Percentage (%)
Total	**1,690**	**100**
Of which:		
Transmission Companies	103	6
Terrestrial and satellite broadcasters, schedulers and multiplex	232	14
Radio broadcasters	326	19
News Services, Program Makers	416	25
Advertisers	477	28
Equipment manufacturers	136	8

Source: EE

Consumer surplus methodological clarifications

6.6 As with the producer surplus calculations, the methodology adopted was similar to that used in the 2000 and 2002 studies. This multiplies reported consumer surplus figures per subscriber (willingness to pay minus actual price) with the number of subscribers. In the case of broadcasting services, calculations were made on the basis of viewing or listening households rather than individual subscribers.

6.7 Consumer surplus is calculated for the following three sub-sectors

(a) Terrestrial television (analogue and digital);

(b) Satellite television; and

(c) Radio

Details of methodology

6.8 In order to calculate consumer surplus, we relied mainly on WTP (willingness to pay) information provided in the BBC 2004 study, "Measuring the Value of the BBC", and in the BBC 2006 Human Capital research on HD TV. We did not find alternative publicly available WTP data for the UK broadcasting sector and it was not possible, given the terms of reference and budget for this study, to carry out our own independent WTP surveys. The number of subscribing households and the average monthly spend on satellite TV were taken from Ofcom's Communications Market Report 2006 and from Ofcom's Q1 2006 Digital TV Update.

6.9 The BBC 2006 Human Capital research shows willingness to pay (WTP) statistics for the five analogue television channels. These figures are then aggregated across the relevant number of analogue and digital terrestrial TV households.

6.10 We do not have WTP figures for all digital terrestrial channels. Although WTP data was available for BBC digital channels from the BBC's 2004 study, when scaled up according to the BBC's market share in digital TV, these WTP figures generated exceptionally high results (the WTP for the digital terrestrial channels was higher than that for the five main TV channels) which were not credible. Therefore, we instead took the more recent (2006) WTP results for analogue TV and extrapolated from these results based on the market share of the other channels available on digital terrestrial television. These results are then aggregated across the total number of households with digital terrestrial television. In the RA's 2000 study, a deduction had to be made for subscription costs for digital terrestrial television but, since there are now no such subscription costs for the Freeview service (we ignored the relatively small number of subscribers of Top-up TV), there was no similar deduction made in this study.

6.11 For the radio sector, the BBC's 2004 study contains data on willingness to pay for BBC radio channels. This figure is then scaled up to capture all radio broadcasters (covering both analogue and digital radio), taking into account the market share of BBC radio and multiplied across all households. While we have no empirical evidence to suggest that the WTP for analogue and digital radio are the same, we note that Ofcom's Communications Market Report indicates that digital radio is largely substituting for analogue radio listening and therefore one might impute intuitively that the WTP for digital radio services are at least as high as for analogue radio, given the wider variety of services offered and the added value features available.

6.12 According to the BBC, the total revenues from licence fees amount to £3.1 billion. We have to subtract this amount from total consumer surplus in order to calculate the net estimate of consumer surplus. Since licence fees are paid in respect both of television and radio services, we have deducted the amount for licence fees from the total result for both radio and television.

6.13 Since no recent willingness to pay data was available for the satellite sector, we carried out two methodologies:

(a) Simple updating for inflation and accounting for the change in households with satellite services; and alternatively

(b) Using WTP for BBC digital channels (which are also available via satellite) and scaling up for the total satellite television market, subtracting the costs of average household spending on satellite television (subscription costs and pay per view).

Results

6.14 The results of our calculations for consumer surplus for broadcasting are shown below:

Table 6.3: Consumer surplus by sector

Sub-sector	Consumer surplus (£M)
Terrestrial television	8,991
Satellite Method 1	2,617
Satellite Method 2	448
Radio	3,181
Licence fees	- 3,125
Total (1)	**11,664**
Total (2)	**9,495**

6.15 The average of the two results gives a consumer surplus of **£10,579 million**.

6.16 The overall contribution of the broadcasting sector to the UK economy is considerably larger than in 2002. The difference in results is mainly due to a very significant increase in consumer surplus.[19] These results have been driven by the use in this study of recent willingness to pay estimates that show considerably higher levels than those used in the previous studies. We believe that the higher willingness to pay survey results may be explained by the fact that digital services are now much more pervasive but we note that very high WTP results were also returned for the traditional five terrestrial television channels.

6.17 With regards to radio broadcasting, the previous RA studies acknowledged that it was likely that the contribution of this sub-sector had been under-estimated. The results of our study would seem to confirm this opinion and are perhaps particularly emphasised in view of the relatively recent increase in the availability and use of digital radio services.

[19] It should be noted that producer surplus for broadcasting is now estimated approximately at the same level as the 2000 study, the 2002 study recording an industry-wide loss.

7 SATELLITE LINKS

7.1 This sector covers three main types of satellite services:

(a) Permanent earth stations;

(b) Transportable earth stations; and

(c) Networks for very small aperture terminals (VSATs).

7.2 Given that no major changes haven taken place in the satellite links sector since the previous study and that there are no updated willingness to pay estimates, the figure for consumer surplus has been obtained by updating for inflation the results calculated in the 2002 study.

7.3 For the sake of comparison, we also produced estimates for consumer surplus, taking account of the number of licences in issue in 2006 compared with those in issue in 2002 (using information taken from the Radiocommunications Agency and Ofcom annual reports). Using this approach generated an estimate of consumer surplus for 2006 of £2,608M, a reduction compared both to the 2002 calculation and to the alternative estimate for 2006 (this is because the number of satellite link licences has fallen in the period between 2002 and 2006).

7.4 Producer surplus has been obtained using the standard methodology described above in Chapter 4.

7.5 The amount for licence fees in 2002 was subtracted from the 2002 study result to obtain a net estimate of the consumer surplus. This figure was then updated for inflation. Total benefits have then been calculated by adding back the current figure for licence revenues.

7.6 The following table summarizes the results of our calculations.

Table 7.1: Satellite links contribution

	2006 (£M)	2002 (£M)
Total	**2,827**	**2,894**
Producer Surplus	- 5	- 9
Consumer Surplus	2,832	2,903

Note: 2002 results expressed in 2006 prices

Source: EE

7.7 Producer surplus in this sector is recorded as negative, indicating an industry wide loss. This result is not entirely unexpected since, following the limited commercial success of first generation satellite phone services, we understand that satellite companies are now investing in the development of alternative infrastructures to launch more reliable services while continuing to face price competition from public mobile cellular services.

8 FIXED LINKS

8.1 Producer surplus was not calculated for this sector, following the approach adopted in the 2000 and 2002 studies. The reason for this approach is quoted below from the 2000 study:

> "When fixed links are used to help the operator run their business, the benefits are measured by consumer surplus. Similarly, benefits accruing to those customers who lease fixed links, such as a company that uses fixed links to provide communications between its offices and factories, are also measured by consumer surplus. Only the benefits to the company leasing fixed links on a commercial basis to another company would be measured by producer surplus. In practice, this means that the benefits of fixed links accrue in very large measure to consumers."

8.2 Given that no major changes have taken place in the fixed links sector since the previous study and that there are no updated willingness to pay estimates, the figure for consumer surplus has been obtained by updating for inflation the results calculated in the 2002 study. We then adjusted this figure by the rate of increase in the number of fixed links deployed in 2006 compared with 2002, using information taken from the Radiocommunications Agency and Ofcom annual reports. As the number of fixed links has increased slightly in the period between 2002 and 2006, the consumer surplus figure also shows a small increase.

8.3 The amount for licence fees in 2002 was subtracted from the 2002 study result to obtain a net estimate of the consumer surplus. This figure was then updated for inflation. Total benefits have then been calculated by adding back the current figure for licence revenues.

8.4 The following table summarises the results of our calculations.

Table 8.1: Fixed links contribution

	2006 (£M)	2002 (£M)
Total	**3,883**	**3,793**

Note: 2002 results expressed in 2006 prices

Source: EE

9 WIRELESS BROADBAND

9.1 Given the development of new technologies and services for wireless broadband and the potential for future growth in this area, we were asked specifically by Ofcom to provide an estimate of the economic contribution of this sector, although it had not been included in the previous studies by the RA.

9.2 However, as with most new developing market segments, there was a limited amount of publicly available data which we could use to derive estimates of the sector's economic contribution. We therefore focused on WiFi as the most visible and most widely used application of wireless broadband technology. Even here, we found no existing publicly available willingness to pay surveys, nor was it feasible (or envisaged) within the scope of this study to conduct or commission such surveys ourselves.

Producer surplus

9.3 The methodology used for producer surplus is consistent with that used for other sectors. We focused on those companies that have a specific focus on Wi-Fi rather than on the wireless broadband sector in a wider sense. A further point to note in this case is that it is likely that many of the suppliers of Wi-Fi technology are involved in other parts of the radio industry for which we have more reliable information and a better knowledge of the shape of the market. Therefore, part of the producer surplus of the Wi-Fi sector is likely already to have been captured in other sectors.

9.4 Our initial expectations on producer surplus in this sector were for a very small or even negative figure. Bearing in mind that we are looking for an economic definition of profits rather than accounting profits and since this sector is young and requires investments in basic infrastructure, we suspected that we might find low or negative producer surpluses for the WiFi sector (as described in section 3 of this report). These expectations were borne out by the results we found.

Consumer surplus

9.5 There are many different types of Wi-Fi users including: households wishing to enjoy an internet connection in different places within the same residence; offices wanting to save cabling expenditure and maintenance; business users logging onto hotspots at airports and other public spaces; and students using university networks.

9.6 It is therefore very difficult to estimate consumer surplus, especially without willingness to pay survey results for the different types of consumer. We therefore decided to focus on those sub-sectors where the availability of data was higher and where the aggregate surplus was likely to be of higher magnitude. In this study, we have calculated consumer surplus for Wi-Fi-using households as well as for airport users of Wi-Fi.

9.7 Consumer surplus for households has been calculated using data on elasticity for broadband[20], as we would expect generally available broadband services and wireless or WiFi enabled broadband to be close substitutes and therefore to have similar elasticities. Data on the number of households with WiFi enabled broadband and data on average broadband prices were obtained from a recent survey[21] and from the Ofcom Communication Market Reports.

9.8 We accept that there may be some over-statement of the consumer surplus arising from household use of WiFi as the prices we used in the calculations covered the total cost of broadband and not solely the WiFi element. It was not possible to calculate a separate WiFi only price (except on a purely arbitrary basis) and, moreover, the only elasticity data to which we had access used the total broadband price (including WiFi).

9.9 Consumer surplus for airport users has been calculated using the data from a recent survey[22]. This provides data on the average cost of hotspots in Western European airports as well as on the number of connections per passenger. We used BAA data on the total number of passengers to obtain an estimate of the number of connections per year in UK airports. As we do not have data on willingness to pay, we assumed that the highest price charged was equal to willingness to pay.

9.10 Table 9.1 reports the results of our calculations

Table 9.1: Wi-Fi contribution

	2006 (£M)
Total	**290.9**
Producer Surplus	- 0.7
Consumer Surplus	291.6
of which:	
Households	291.3
Airport users	0.3

9.11 Although there may be some over-statement of the consumer surplus arising from household use of WiFi (see paragraph 9.8 above), the fact that our estimates do not include wide segments of the Wi-Fi hotspot market (such as hotel and café users) implies that the total contribution of this sector may be underestimated.

[20] See Rappoport, P. Taylor, L. and Kridel, D. Willingness to Pay and the Demand for Broadband Service, 2004
[21] http://www.strategyanalytics.net/default.aspx?mod=PressReleaseViewer&a0=2912
[22] BWCS Airport Hotspot Usage Survey

10 PRIVATE MOBILE RADIO

10.1 Given that no major changes have taken place in the private mobile radio sector since the previous study and that there are no updated willingness to pay estimates, the figure for consumer surplus has been obtained by updating for inflation the results calculated in the 2002 study.

10.2 For the sake of comparison, we also produced estimates for consumer surplus, taking account of the number of licences in issue in 2006 compared with those in issue in 2002 (using information taken from the Radiocommunications Agency and Ofcom annual reports). Using this approach generated an estimate of consumer surplus for 2006 of £1,133M, a reduction compared both to the 2002 calculation and to the alternative estimate for 2006 (this is because the number of PMR licences has fallen in the period between 2002 and 2006).

10.3 The amount for licence fees in 2002 was subtracted from the 2002 study result to obtain a net estimate of the consumer surplus. This figure was then updated for inflation. Total benefits have then been calculated by adding back the current figure for licence revenues.

10.4 Producer surplus was calculated in 2002 but not in the 2000 study. The figure was negative and it only included surplus from equipment manufacturers. The companies that produce this kind of equipment are very often involved in the radio industry in other ways and it is likely that part of the producer surplus of this sector is captured in other sectors. We therefore did not calculate producer surplus for PMR.

10.5 The following table summarizes the results of our calculations for consumer surplus.

Table 10.1: PMR contribution

	2006 (£M)	2002 (£M)
Total	**1,223**	***1,086**

**Difference is accounted for by a negative producer surplus in 2002*

Note: 2002 results expressed in 2006 prices

Source: EE

11 NON-COMMERCIAL AVIATION, AMATEUR RADIO, CITIZENS' BAND AND OTHER

11.1 For each of these sectors no significant new information was available and therefore we decided to treat them together as a single group, following the approach of the 2002 study.

11.2 We have updated for inflation the figures contained in the 2002 study.

11.3 Table 11.1 summarizes the results

Table 11.1: Other sectors' contribution

	2006 (£M)	2002 (£M)
Total	**124**	**127**
Producer Surplus	114	116
Consumer surplus	10	10

Note: 2002 results expressed in 2006 prices

Source: EE

11.4 We have also explored the possibility of calculating an estimate for the commercial aviation sector as it is a sector where the spectrum is clearly of primary importance. However, we found that any estimate of the impact of radio spectrum in this sector would be highly dependent on a wide range of assumptions, including assumptions on the definition of customers and the share of revenues to be attributed to radio spectrum.

11.5 We could not identify any previous attempts to quantify the impact of spectrum in this sector in the UK or in other countries that could represent a basis for our analysis. The Cave Report[23] suggests a methodology based on cost savings but we found that this would be extremely difficult to develop in a short time span and within the resources for this study, and therefore did not pursue our attempts to produce results for the commercial aviation sector. A more in-depth specific analysis of this sector would be necessary to obtain a meaningful estimate.

[23] Review of Radio Spectrum Management, Professor Martin Cave, March 2002

12 GDP EFFECTS

12.1 In this section, we calculate the contributions to GDP and employment made by firms that are direct users of spectrum. This is an alternative way, as distinct from the consumer and producer surplus calculations that we have described earlier, to indicate the economic importance of radio spectrum. This method shows how much of the UK's GDP and employment are created in radio spectrum using firms.

12.2 We use company turnover data to compute direct effects, and then use the ONS Input-Output tables to calculate multiplier effects. An alternative methodology could have been to calculate the value added by these firms, rather than use their turnover figures. However, we give preference to turnover, as it is better suited to computing multiplier effects and is consistent with the previous (1995) study which estimated the GDP effect of radio spectrum use.

Direct Effects

12.3 To compute direct GDP and employment effects, we identify firms for whom radio spectrum contributes substantially to turnover, i.e. firms that are small scale users of spectrum are not included. The reason for this is that it is very difficult to break down, for each firm, how much of the turnover and employment arises due to the use of radio spectrum compared with other inputs. Therefore, we include all of the turnover and employment generated by major radio spectrum users, but none of that generated by firms that are light users. Table 12.1 summarises the results for direct contribution to GDP and employment made by major radio spectrum using firms. As a reference point, the total turnover in the Telecommunications sector in 2004 was £53,270M.[24]

[24] This is the last year from which data is available with the Annual Business Inquiry.

Table 12.1: Direct GDP and employment effects

Sectors	Turnover 2006 prices (£M)	Employment
Broadcasting	7,520.1	21,654
Public Mobile	1,452.1	1,886
Cellular	37,528.2	79,575
Satellite Links	0.3	479
Wireless broadband	0.7	33
Total Direct contribution	**to GDP**	**to employment**
	46,501.4	**103,627**

Indirect Effects

12.4 Two types of GDP and employment effects arise from direct employment and turnover: linkage effects and induced effects. Linkage effects refer to the jobs created in the supply or distribution chain. An example would be jobs in a mobile handset manufacturing firm which provides the physical equipment to cellular phone providers. The jobs of those employed in the manufacturing firm will be directly affected if there is a change in demand from the cellular phone provider.

12.5 The second effect is the induced employment or the income multiplier effect that arises due to expenditure of the incomes that employees in the radio spectrum using sector earn. This additional expenditure creates further jobs as the money is spent on goods and services – a ripple effect.

12.6 The method that we consider to be the most suitable for assessing sector level change is to use multipliers derived from Input-Output tables. Input-Output tables provide a complete picture of the flows of products and services within an economy for *all* sectors in an economy. Specifically, the tables detail the flows between various industries and also between industries and the final demand sector. Such linkages can then be used to estimate the extent to which any given industry contributes to the various final demand sectors.

12.7 The main concept behind the multiplier is the recognition that the various sectors that make up an economy are interdependent. One can manipulate the Input-Output table to estimate different types of multipliers depending on whether there is an interest in output, employment or income effects. The constituent component of the multipliers is the Leontief Inverse matrix. This is derived from the symmetric industry-by-industry use matrix and shows how much of each industry's output is required, in terms of direct and indirect requirements, to produce one unit of a given industry's output. We derive output

effects from the Leontief inverse tables, and then use industry level output-employment ratios to determine employment effects.

12.8 The estimates of employment and income thus derived are for gross employment rather than net new employment, i.e. the figures are over-estimated as they do not adjust for factors of production which might have been displaced from other productive uses. There is a range of beliefs regarding displacement effects, with a Treasury view that there are no net effects in the economy of the employment and output of a single firm or project. This view stems from the idea that, if a particular firm did not exist, others would have arisen in its place in the long run.

12.9 Still, other studies have attempted to measure specific short-run displacement effects and these can be used to provide benchmark figures. The last data we have available to us to adjust for the displacement effects is a set of four case-studies conducted by the DfEE (now known as the DfES)[25]. This study estimated over four UK case studies how many employees were re-absorbed into the economy 23 months after plant closures. An average re-absorption rate of 52% was found, but with some geographical variation. In the absence of better data, we use the figure of 52% displacement as a benchmark, and present both gross and net estimates. Since displacement in output is likely to be proportional to that in employment, we use the same figures for output as well.

12.10 It is important to understand that these figures are based on economy-wide averages and therefore are useful as ballpark figures, rather than of exact precision. With reference to displacement effects in particular, the figure can change over time as the state of the economy and markets change. In addition, national displacement effects are likely to be much higher than local displacement effects. Therefore we would suggest using caution in interpreting the results, and would emphasize that these are to be viewed as a rough guide to the contribution that radio spectrum using sectors have on the economy.

12.11 We used the most disaggregated version of the Input-Output tables available, which provides us with analysis based on 138 different sectors within the economy. The direct GDP contribution shown in Table 12.1 was entered in the Telecommunications sub-sector of the Input-Output tables to calculate the linkage effects shown below in Table 12.2[26]. Note that linkage effects are generated not only within the Telecommunications sub-sector but also across many of the other economic sub-sectors (these are grouped together in Table 12.2 as “All other sectors”).

---

[25] Moore, Barry and David O’Neill (1996) *The Impact of redundancies on local labour markets and the post redundancy experience* Research Studies RS23, Department for Education and Employment

[26] We could have chosen to enter the direct contribution from broadcasting into the “Recreational Services” sub-sector of the Input-Output tables but decided not to since the Recreational Services sub-sector includes a large proportion of services, such as parks, which are likely to have linkage effects which are significantly dissimilar to those we are interested in.

Table 12.2: Linkage effects – Input-Output tables

	Output (£M)	Employment
Telecommunications	48,712	195,041
All other sectors	21,053	260,026
Total	**69,766**	**455,067**

12.12 To this, we can add the income multiplier effects, based on a standard national income multiplier of 1.1. Table 12.3 summarises the gross estimates arising from both linkage and income multiplier effects.

Table 12.3: Gross linkage and income multiplier effects

	Output (£M)	Employment
Telecommunications	53,583	214,545
Other sectors	23,159	286,029
Total	**76,742**	**500,574**

12.13 If we assume, as described above, that 52% of the output and employment is effectively displaced from other uses, we are left with the following net effects:

Table 12.4: Net linkage and income multiplier effects

	Output (£M)	Employment
Telecommunications	25,720	102,982
Other sectors	11,116	137,294
Total	**36,836**	**240,275**

12.14 In summary, we find that the direct contribution made by radio spectrum using firms in the economy is approximately £46.5 billion, and the direct contribution to employment is approximately 103,600. Adding gross linkage and income multiplier effects, these figures rise to £76.7 billion and 500,600 respectively. Adjusting roughly for possible displacement effects, the net contributions are estimated to be in the range of £37 billion in contribution to GDP and 240,000 in contribution to employment. This represents 3 per cent of total UK GDP and 0.8 per cent of total workforce jobs.[27]

[27] Based on Annual Business Inquiry: GDP in 2004 of £1,224,461M (at current prices) and total workforce jobs in 2006 of 31.1.M.