The Physical and Economic Accounts for UK Fisheries

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Acronyms used in the text:

ACFM: Advisory Committee on Fisheries Management
CEFAS: The Centre for the Environment, Fisheries and Aquaculture Science
DEFRA: Department for Environment, Food and Rural Affairs
FH: Fishermen's Handbook
ICES: The International Council for the Exploration of the Sea
ITQ: Individually Transferable Quotas
SEEA: UN Integrated System of Environmental and Economic Accounting
SNA: UN System of National Accounts
STECF: Scientific, Technical and Economic Committee for Fisheries
TAC: Total Allowable Catch

Executive Summary

This report attempts to construct both physical and economic accounts for UK fisheries. The resulting series should be viewed as experimental statistics because of the incomplete coverage of stocks and species within the accounts.

The accounts have been developed within the satellite account framework of the National Accounts, which enables the stock and values of natural assets to be compared with the produced assets covered by the National Accounts, and provides a basis for assessing the sustainability of natural resource extraction. This report attempts to value just some of the wild fish stocks captured by the UK fishing fleet at the present time, by testing out one of a number of methodologies described in the United Nations fisheries accounts handbook. In line with normal National Accounts practice, no attempt has been made to anticipate the impact of future changes in the amount or cost of fishing, even for the limited number of fish stocks covered by the study.

In this report,

- 'UK fisheries' are defined as fish stocks predominantly harvested by the UK fishing fleet and those that are to be found geographically around the UK: the Irish Sea, the North Sea and the English Channel;

- The nine stocks covered in this study (two of cod, two of plaice, two of sole, two of whiting and one haddock) have been chosen on the basis of their commercial and biological importance in addition to the availability of data required to construct both sets of accounts;

- 'Physical accounts' are the opening and closing stocks of the whole stock regardless of which country's fleet is harvesting it, whilst 'economic accounts' are a measure of the net present value of income (rent) that the UK's share of that stock is expected to generate in the future. The latter is based on estimates of costs incurred and revenues generated by the UK fleet in the relevant year and as such assumes (despite evidence of declining yields for some species) that the same total rent can continue to be generated in real terms in perpetuity. To the extent that this assumption is unrealistic, the values will be correspondingly over- or understated. The estimates have been made on the basis of the costs of fishing attributed to individual fish stocks, although as a sensitivity test the effect of using average fishing costs have also been calculated;

- In attempting to estimate levels of rent and hence the 'true value' of each stock (as opposed to private values relating to the fishing industry alone), 'other values' such as subsidies for management costs and fuel duties have been taken into account in the calculations. However, due to a lack of data other benefits of fish stocks relating to biodiversity, 'eco-tourism' and other social and environmental values have not been included in the calculations;

- Asset value is calculated as the economic (resource) rent divided by the social discount rate, which in this study is set at 4 per cent. Where rent is negative, a zero value is assumed for the stock.

The results for each selected stock are summarised below, with all physical accounts dating from 1981 to 2000 and economic accounts dating from 1991 to 2001 and using individually

estimated stock costs. Note that in this summary the direction of and the term of the sign for levels of economic rent are given only, and not absolute values.

- In the North Sea and Eastern English Channel, stocks of cod and whiting in 2000 were only 33 and 44 per cent of the level that they were in 1981, respectively, while haddock stocks in 2000 were two and a half times higher compared to levels in 1981. Levels of rent for cod were similar and positive in 1991 and 2001 despite being negative between 1994 and 1998, whilst haddock experienced a steep decline in value between 1991 and 1998. The value of haddock became positive again in 2000 before dropping once more in 2001. The whiting stock experienced a gradual increase in value between 1991 and 2001, although this value remained negative throughout;

- In the English Channel, the stocks of sole and plaice have both significantly declined from 1981 to 2000, by 44 and 41 per cent, respectively. However, while the values of the sole and plaice stocks have increased from 1991 to 2001, the plaice stock still exhibited a negative value in 2001;

- In the Irish Sea, the stocks of cod, plaice and sole all peaked in the 1980s before declining throughout the 1990s. Between 1981 and 1999, the levels of cod and whiting have fallen by 79 and 84 per cent, respectively, while the levels of plaice and sole have fallen by a much smaller 8 and 19 per cent, respectively. The values of cod, whiting and plaice all increased from 1991 until 2001, although as of 2001 the values of all three stocks were still negative. The value of the sole stock on the other hand declined slightly over this 10 year period, although positive rent values were exhibited throughout this time frame.

In conclusion, these results can be summarised as follows.

- For the nine stocks in this study, only two, both sole stocks, exhibited positive resource rent in each year from 1991 to 2001. Both cod and haddock generated some years of positive rent during this period, although the patterns of change appear to be relatively erratic. The two whiting and two plaice stocks covered in this study generated negative rents for the whole ten year period;

- Using individually calculated stock costs, overall, the aggregated level of rent for all nine stocks was negative between 1991 and 1998, with two years of small positive values in 1999 and 2000, before becoming negative again in 2001. Using average stock costs, the pattern of changes in level of rent is very similar to the pattern seen when using individual costs. However in contrast to the use of individual costs, aggregated rent remains negative for every year between 1991 and 2001 when these average costs are used;

- The economic interpretation of negative rents is that the fishery is being managed in an economically sub-optimal way. Moreover, inputs such as capital and labour are also being used in a sub-optimal activity, implying that there would be an improvement in economic welfare if these resources were employed elsewhere in the economy and subsidies did not have to be paid;

- The economic or resource rents calculated for the stocks covered in this study take account of some social costs of fishing. However, although rents for most of the stocks covered in the study have been shown to be negative, the levels of these rents

are still likely to be overstated because there are a number of other costs for which data were not available such as monitoring costs and biodiversity values of fish stocks;

- Using rent values derived from individual stock costs, the aggregated asset value for all nine stocks fell from £229 million to £165 million between 1991 and 2001, although the change from year to year follows no clear pattern, with the lowest value being recorded in 1996 (at £34 million);

- Using rent values derived from average stock costs on the other hand results in an increase in asset values for all nine stocks from 1991 to 2001, from £65 million to 108 million. However, again it should be noted that the patterns of change in asset value are very erratic, although for both estimations asset value appears to peak in 2000 before declining again;

- An extension of this work should include a calculation of rent based on the markets for fishing licenses in the UK. This is a more accurate method of rent estimation and could be usefully compared to estimates obtained from the current rent approach;

- Analysis with a bio-economic model could show how resource rent might change with the rate of exploitation of the fish stock. A bio-economic model attempts to measure the maximum potential value of a fish stock and is the most accurate method of rent estimation, although it was not possible to develop a model of this type within the context of this study due to the data demands and the nature of shared fisheries in the UK.

1 Introduction

The traditional national accounts are incomplete with regard to natural resources such as fisheries, because the values of natural resource assets are not measured. This affects the analysis of economic performance for these sectors, which in turn affects government policies with regard to the natural resource sectors (Atkinson et al, 1997[1]). Measuring natural resources in the national balance sheet implies that governments can work with a measure of total wealth in examining policies for sustainable development. Hence, the balance of natural versus produced assets in this measure of total wealth then becomes an important indicator as governments consider development options.[2]

In this study, an attempt is made to construct a fisheries account for the UK for a number of selected UK stocks, where the emphasis on these is on balance sheet items, the opening and closing stocks, and the flows that add to and subtract from the balance sheet position. These accounts are in quantities, i.e. the physical accounts, and can also be in values, i.e. the monetary accounts, and may or may not be linked to the UN System of National Accounts (SNA) through the national balance sheet accounts. The first step towards standardising the multitude of accounting approaches is provided by the UN Integrated System of Environmental and Economic Accounting (SEEA) (United Nations, 1993[3]). The SEEA is designed to be a 'satellite' account to the SNA, in that it is an adjunct to, but not a modification of, the core accounts. More specifically, this study attempts to measure the costs of depletion with respect to the formulation of 'Green GDP' via one of a number of methodologies as described in the United Nations fisheries accounts handbook (United Nations, 2002). Within the framework of the National Accounts, an attempt is made to value these selected fish stocks as at the present time and not to anticipate future changes. Furthermore, while this study attempts to construct both the physical and economic accounts for as broad a range of UK fish stocks as is possible, it is recognised that a significant proportion of the UK's fisheries have not been covered and hence the resulting series should be viewed as experimental.

The need for accurate and comprehensive fishery accounts can be seen by the fact that the quantities of mature demersal fish in the sea as assessed by the International Council for the Exploration of the Seas (ICES) have, in many cases, declined significantly over the last 25 years. On average, these quantities were about 90 per cent greater in the early 1970s than in the late 1990s. The general decline in landings is similar. The overall trend is of an increased proportion of the stocks being taken each year (increased fishing mortality rate) which has led to the erosion of the quantities of mature fish. In recent years for many stocks the quantities of mature fish in the sea have been below or very close to the minimum levels required to provide high probability of sustainability (precautionary levels of stock biomass), whereas historically they tended to be above such levels. Similarly, many stocks have been subject to a level of fishing mortality rate in excess of precautionary levels. From a biological point of view, the sustainability of a high number of stocks will be threatened if the current levels of exploitation are maintained although the situation varies from one fishing area to another. Section 2 of this report discusses the stocks to be covered in the accounts and the reasoning behind this selection. Section 3 describes the methodologies to be used in the accounts, and

[1] Atkinson, G., Dubourg, R., Hamilton, K., Munasinghe, M., Pearce, D., and Young, C., (1997). 'Measuring sustainable development: macroeconomics and the environment', Edward Elgar, Cheltenham, UK.

[2] This approach becomes even more powerful if human capital is estimated and brought into the balance sheet.

[3] United Nations (1993). 'Integrated environmental and economic accounting', Series F, No.61, United Nations, New York.

sections 4 and 5 present the results for the physical and economic accounts, respectively. Section 6 concludes.

2 Stocks covered in the accounts

These are to be the accounts for the UK fishing fleet that catch fish from ICES fishing areas around the UK, regardless of *where* they are landed. These are not strictly 'UK fisheries' in the sense that they are 'owned' by the UK[4] but they are the immediate areas around the UK in a geographic sense and there are a number of stocks that are predominantly fished by the UK fleet and hence of significant economic importance. In order to construct *both*[5] the physical and economic accounts, certain types of data needs to be made available and limitations of this kind will act as a constraint to the stocks that should be selected. In this report, the physical accounts refer to the total stock for each stock under study (and not just on the UK catch alone), and the economic accounts refer to the UK catch only (and not the whole stock).

For management purposes, the populations of each fish species are separated into stocks based on ICES sub-areas and divisions. In this study, stocks to be covered will derive from the following three sea regions around the UK:

- the North Sea and eastern English Channel (IV, VIId, IIIa);
- western English Channel (VIIe);
- Irish sea (VIIa).

Within each region, stocks are selected on the basis of their commercial importance, the availability of stock data and given the mixed catch nature of most fisheries, the structure of the fishery in the region. This is important in the context of estimating stock-specific costs for the economic accounts. Following, are brief descriptions of the structure of the fisheries, which is sourced from the Centre for Environment and Fisheries Science (CEFAS)[6].

2.1 The North Sea and eastern English Channel

The stocks covered here are **cod**, **haddock** and **whiting**. Cod are largely targeted by otter trawl and gill net vessels. Trawlers usually catch cod as part of a mixed fishery in which haddock and whiting form an important component of the catch. Gill-net vessels are better able to target their effort towards cod alone. Cod also form an important by-catch in the beam trawl fisheries targeting plaice and sole, and in the otter trawl fisheries targeting Nephrops (prawns). Cod are caught all over the North Sea, although the main areas where they are taken vary seasonally. ICES has recommended that cod in the fishing areas, IIIa (Kattegat) and VIId require stock recovery plans.

2.2 Western English Channel

The stocks covered here are **sole** and **plaice**. UK landings of sole and plaice from ICES Division VIIe were at a low level until 1977, when they increased rapidly due to the gradual replacement of otter trawlers by beam trawlers. These are still the principal gears used to

[4] It may be more appropriate to suggest that it is the EU that has ultimate 'ownership' of UK fish stocks, except perhaps those stocks that have quotas that are shared between the EU and non-EU nations such as Norway and Russia.

[5] The author acknowledges that for some stocks excluded from this study either the physical or the economic accounts could have been constructed but not both together.

[6] See www.cefas.co.uk

catch flatfish. ICES has recommended that this sole stock is currently being fished outside safe biological limits.

2.3 The Irish Sea

The stocks covered here are **cod**, **whiting**, **sole** and **plaice**. The Irish Sea cod fishery has traditionally been carried out by otter trawlers, although since the early 1980s the activities of these vessels have decreased and there has been a development of semi-pelagic trawling for cod and whiting. Some of these vessels switch between pelagic trawling and twin-trawl fishing for Nephrops (prawn), depending on fishing opportunities and market demands. Cod are caught throughout the year in mixed-species fisheries, over a wide area but especially in the north-west Irish Sea. Plaice are taken mainly by otter trawls, as part of a mixed white-fish fishery, and as a by-catch in the beam-trawl fishery for sole. Effort in the UK beam-trawl fleets increased in the late 1980s, but has since declined. ICES recommends recovery plans for Irish Sea stocks of cod, whiting and haddock.

Table 2.1 illustrates how important the UK is in each of the selected fisheries, and the relative importance of the selected stocks for UK fisheries. In 2001, for the nine stocks under consideration, total UK catch accounted for approximately 28 per cent and 27 per cent of all demersal fish caught by the UK fleet, by volume and value, respectively. However, the total UK catch from these fisheries accounted for only 10% by volume and 13% by value of the UK's catch from all fisheries in 2001.

Table 2.1: UK catches of the selected stocks, 2001

Fishing area	Species	Total catch in 2001 (tonnes)[1]	UK catch in 2001 (tonnes)[2]	UK catch as % of total catch	Total value of UK catch in 2001[2] (£ million)
IV, VIId, IIIa	cod	49,693	19,931	40.1	28.19
IV, IIIa	haddock	167,000	32,544	19.5	26.20
IV, VIId	whiting	46,640	19,168	41.1	8.38
VIIe	sole	965	384	39.8	7.66
	plaice	967	784	81.1	2.66
VIIa	cod	3,875	917	23.7	1.43
	whiting	1,745	531	30.4	0.30
	sole	1,473	618	42.0	0.50
	plaice	1,053	198	18.8	1.17
Total of selected stocks		**271,411**	**75,075**	**27.7**	**76.49**
Total UK catch			**737,802**	**-**	**574.38**

Source: [1]ICES Working Groups**;** [2]UK sea fisheries statistics 2001

The reason for this is that important pelagic species such as herring and mackerel and shellfish such as *Nephrops* were not included either due to data constraints, i.e. either lacking stock and/or cost data, or due to the UK accounting for relatively insignificant proportions of total catch. In many cases, stocks are not being constantly monitored by ICES and hence, stock data is not systematically collected because the condition of these are not considered to be in such a perilous state relative to the ones being considered in this report. For future reference, it is important that this relatively narrow range of stocks covered in this report is expanded to include shellfish amongst others once the data is available to enable the construction of both the physical and economic accounts at the same time.

3 Methodologies for the fish asset accounts

Fish can be divided into produced and non-produced assets, based largely on the degree of control over the production process (UN, 2002). Produced assets include aquaculture and mariculture, while non-produced assets include capture fisheries and ranching. In this study, the focus is on non-produced fish assets, principally, selected wild fish stocks in the North Sea, Irish Sea and English Channel.

3.1 Physical accounts

Fisheries accounts can be constructed in a similar method as with all asset accounts, with opening stocks, changes that occur over the accounting period, and the closing stock. Changes that occur during the accounting period can be divided into those that are due to economic activity such as fish catch and those that are due to natural processes such as growth, recruitment and deaths. Other volume changes can include factors such as the migration of fish stock out of the country's territorial waters, but will also include the, sometimes substantial, reassessments made of stock levels each year by scientists. In addition, where data are available, stock accounts can be disaggregated by age of fish, by geographic region, and accounts can be constructed for important predator or prey species. The treatment of resident and non-resident fishing creates a problem for the fish accounts. Fisheries accounts for a given country require that total catch be reported, resident and non-resident. This representation departs from the SNA, in which the economic activity of non-resident operators is not included in that country's national accounts but in the accounts of the country where the vessel's operator resides.

The physical accounts incorporate data that has been primarily collected by CEFAS. CEFAS scientists contribute to the assessment of North Sea fish stocks through their involvement with ICES working groups and the European Commission's Scientific, Technical and Economic Committee for Fisheries (STECF). These assessments are based on estimates of numbers of fish at each age in international landings, commercial catch rates in relation to fishing effort, and data from trawling surveys. These results are used to provide advice on the level of exploitation of each stock, and on management measures for the coming year. CEFAS staff routinely collect commercial fishery information on catch and effort for UK vessels, which is combined with similar data from other countries' fleets in order to build a time series of international catch and effort data. This data are made available to ICES, whose Working Groups publish the data under the Advisory Committee on Fisheries Management (ACFM). CEFAS data is only available for stocks as a whole. While the UK's proportion of stocks could be calculated on the basis of relative stability shares, which are used to calculate catch quotas for individual countries, this would be subject to a high degree of uncertainty. Furthermore, the attribution of the share of stock for individual countries would make little sense in the calculation of physical accounts because of the biological nature, i.e. interbreeding, of fish populations and the fact that relatively little is still actually known regarding the biology of fish stocks. Therefore, no effort was made in this paper to attribute changes in stock levels to individual countries.

3.2 Economic accounts

The value of fish, like any other asset, is the net present value of the stream of income (rent) it is expected to generate in the future. Constructing monetary accounts consists of defining how rent is to be calculated and making projections about the future rent a fishery is likely to generate. Resource rent is defined as the excess profit owing to the scarcity of a resource; it

is valued as the cost of production minus the marginal exploitation costs. For fisheries, there are two approaches to measuring rent, a market-price approach and the residual value approach. When available, the market price, established by a trading mechanism such as Individually Transferable Quotas (ITQ), is the preferred method of valuation because it is consistent with the definition of value used in the SNA and SEEA, and because it can be observed directly. The residual value approach is also consistent with the SNA and SEEA but cannot be observed directly and its estimation requires a number of assumptions. In practice, however, market-determined rent is rarely observed for most of the world's fisheries, although it should be noted that there is a market for the transfer of fishing licenses between vessels in the UK, the values of which are dependent on the fishery in question. Unfortunately, this information was not made available to the researcher during the research phase.

Consequently, the most commonly used method for measuring rent, not only for fisheries but for most other resources as well, is the residual value approach. This method uses data about revenues and costs to estimate rent as the residual of the two. Data from a range of sources may be used including national accounts, fishing company surveys and other information, but national accounts most often provide the starting point for the calculations. In actual implementation, rent is calculated as the difference between revenue and *average* cost rather than marginal cost because data about marginal cost are generally not available.

Most of the data required for the rent calculation can be obtained directly from the data source, whether that data source is the national accounts or a survey. All cost data are derived from the Sea Fish industry authority (SeaFish), which collects data on the costs and earnings of the UK fishing fleet, the results of which are presented in the Fishermen's Handbook (FH). This is not an annual publication and changes in methodology and data collection from one publication to the next makes the creation of a time series difficult. For example, data for vessels under 10 metres in size are only collected for the latest, 2000-01 survey. Consequently and following the Aggregated Sea Fisheries Account (DEFRA, 2002), the data for 2000-01 has been extrapolated back to 1991 and assumptions have had to be made regarding the behaviour of cost and landings (on a per vessel basis) data. Landings data on a stock by stock basis has been obtained from reports from various ICES Working Groups[7] and price data from UK Sea Fisheries statistics.

For each stock, this report measures the present discounted value of economic rent generated by fishing using reported costs and revenues and by making some assumption about future rent based on current experience, i.e. this is a current rent approach. Limited knowledge regarding the biology of the fishery implies with this approach that it would be a reasonable assumption to estimate the value of future rents based on rent derived from current operations, although it should be noted that using current estimates of costs and revenues should be undertaken with a degree of caution given future uncertainty and the likelihood of falling rents for some species, at least in the short term. It follows that the discounted present value of the fish stock, calculated as the current rent (expressed in constant prices) divided by the social discount rate of 4%, will overstate the true value where future rents are lower than the current level as a result of unsustainable fishing levels.

This value is estimated using information about costs and revenues for each stock. Revenues can be calculated from information on landings and prices for each stock. Costs for each stock have been divided between variable (operating costs), fixed (capital costs) and 'other costs',

[7] All of these are available at www.ices.dk . Reports are only available for 2001 and 2002.

such as subsidies to the fishing industry. Variable costs include intermediate consumption and compensation to employees, while fixed costs includes consumption of fixed capital and normal return on capital stock. Additionally, many vessels are operated by their owners and hence the operating surplus includes a payment for the labour of the owner operators as well as the cost of capital. Values for normal profit are based on the rate of return for fixed capital, which the FH gives as anything between -10 and 38 per cent depending on vessel type. Furthermore, it should be noted that many vessel owners are actually receiving less than normal profit.

This report makes an attempt to measure the costs for each stock using data provided by the FH despite the fact that this data is available by vessel and that most vessels fish for more than a single species. The FH data samples variable and fixed cost data taken from all types of vessel that are to be found in the UK fleet. Furthermore, for each vessel type an 'average catch' has been sampled, which can give a cost per tonne of fish caught regardless of the species. Using this and fisheries information from ICES it is possible to get an approximate 'picture' of which type of vessel fishes for which species despite the lack of fleet size data for individual fishing areas and despite the fact that many vessel types fish for a number of species. However while obviously imperfect, the stocks under consideration in this study tend to be the main targeted catches for each vessel type anyway. Hence, for each stock under consideration all vessels that fish for this have been grouped together and the average cost per tonne calculated since the FH gives average catch in tonnes per vessel in addition to average cost per vessel surveyed. For some stocks, e.g. sole and plaice in VIIa, the costs are the same on the assumption that all vessels in the FH that fish for one species also fish for the other at the same time. Therefore, for each area and stock surveyed, individual variable and fixed costs have been calculated, all based on data from the FH and using 2000 as the base year. Furthermore, an average cost per tonne of fish caught was calculated using the cost data from the FH for all vessel types relevant to the stocks under consideration. Following the Aggregate Sea Fisheries Account, three separate prices indices were used to adjust the data[8]. Table 3.1 gives the average costs of fishing for all stocks under consideration. Annex A.1 gives these costs on a per stock basis.

Table 3.1: Average (fixed and variable) costs of fishing, 1991-2001 (£ per tonne, at 2000 prices)

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Average cost (all stocks)	1,059	1,050	1,030	1,003	978	959	969	948	957	977	970

Source: The Fishermen's Handbook, 2000-2001

Other costs that have been factored into the calculation of rent include a fuel duty subsidy the industry receives due to exemption from fuel tax, as well as interest charges. Also, VAT reclaimed is subtracted from this aspect of the cost base. Furthermore, in this study the social costs of fishing are considered in order to narrow the divergence between the private and social value of rent. First, government may cover part of the costs of fishing. In the UK, the government provides some of the fixed capital necessary for resource exploitation at subsidised rates such as port facilities or other infrastructure, water and electricity supply. In the national accounts, these capital costs are reported as part of public sector investment and not associated with fishing. The omission of government investment reduces the private costs of fishing and increases the private value of rent relative to the social value.

[8] These are prices indices from the ONS database using relatively similar inputs to fisheries: the fuel prices index, an index of prices of building and repairing ships and a more general manufacturing index.

Data are available for 'fisheries grants' for England and Wales for the years 1995-99. This has been extrapolated for the UK as a whole and an average taken to be used as a baseline for the missing years, 1991-94 and 2001. These grants, received from both the UK government and the EU, are used as subsidies for port facilities, processing and marketing, decommissioning[9] and regional development funds, i.e. the social costs of fishing. The provision of harbour facilities and subsidies towards the alleviation of social costs as a consequence of the collapse of fish stocks can be considered public goods and hence an average has been calculated for the industry as a whole and not for the fishing of individual stocks. Therefore, for each tonne of fish caught this is a constant cost regardless of the stock under consideration and can be seen for all stocks under consideration from 1991 to 2000 in table 3.2 (see Annex A.2 and A.3 for the break down of these 'other costs' of fishing).

Table 3.2: Average 'other costs', per tonne, 1991-2001 (£, constant 2000 prices)

Year	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Average cost	116	109	114	117	129	117	137	209	145	199	171

Source: Aggregate Sea Fisheries Account (2002), DEFRA; 'Four Year Expenditure on Fisheries Grant Schemes', DEFRA (see Annex A.3)

When no further information is available about likely future levels of catch, fish prices and costs of fishing, it can be assumed that fish stocks will continue to generate the current year's rent in future years. The value is the present discounted value of future rent, and in this study this calculated for the selected stocks using a discount rate of 4 per cent. The most commonly used assumption for asset valuation is stable fish stocks, based on conservative assumptions of a sustainable, but not growing fish stock. This assumption is made even for stocks where there has been a significant decline in population in recent years because of the uncertainty involved in attempting to assess future stock levels. In this case, where fish are harvested at a constant, sustainable rate in perpetuity, the formula for asset value reduces to the economic rent divided by the discount rate. Where rent is negative, a zero value has been assumed for the stock.

9 The EU has an ongoing programme to reduce overcapitalization of the fishing industry through government purchase of excess vessels. This is a special instance of a resource management cost borne by government. While the reduction in fishing capacity would produce no immediate impact on the size of the fish stock(s), it is reasonable to assume that the future resource rent would be higher than the current rent from two effects: first, the reduced fishing capacity can be expected to result in the medium and long term in a higher stock size (depending of course always on the extent of current biological overfishing); second, the lower number of participants in the fishery will almost immediately improve the harvesting performance and thus profits of the remaining fishing vessels. Given adequate data on the population dynamics of the stock(s) and costs and earnings data of the fishing fleet, estimates can be made of these two effects on future rent through bioeconomic analysis.

4 Physical accounts for UK fisheries

The following tables and charts give the physical accounts for selected UK stocks over a 20 year period, from 1981 to 2000. A table showing the opening and closing stocks is shown for cod in areas IV, IVVd and IIIa with a graph illustrating stocks and landing for the same stock. For the remainder of the selected stocks, all the tables are in the annexes, with graphs illustrating stocks and landings remaining in this section.

4.1 The North Sea and eastern English Channel

Table 4.1: Physical account for cod in areas IV, VIId and IIIa, 1981-00 (thousand tonnes)

COD (IV, VIId, IIIa)	1981	1982	1983	1984	1985	1986	1987	1988	1989
Stock estimate 01/01	855	840	649	718	503	683	571	426	416
Total landings	-335	-303	-259	-228	-215	-204	-216	-184	-140
Other volume changes	320	112	328	13	395	92	71	174	52
Stock estimate 31/12	840	649	718	503	683	571	426	416	328

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
328	297	403	338	421	422	376	496	314	256	279
-125	-102	-114	-122	-111	-136	-126	-124	-146	-96	-71
94	209	49	205	112	90	247	-58	88	119	n/a
297	403	338	429	422	376	496	314	256	279	n/a

Source: ACFM
Note: n/a denotes data not available

Figure 4.1: Stocks and landings for cod in IV, VIId and IIIa, 1981-2000 (tonnes)

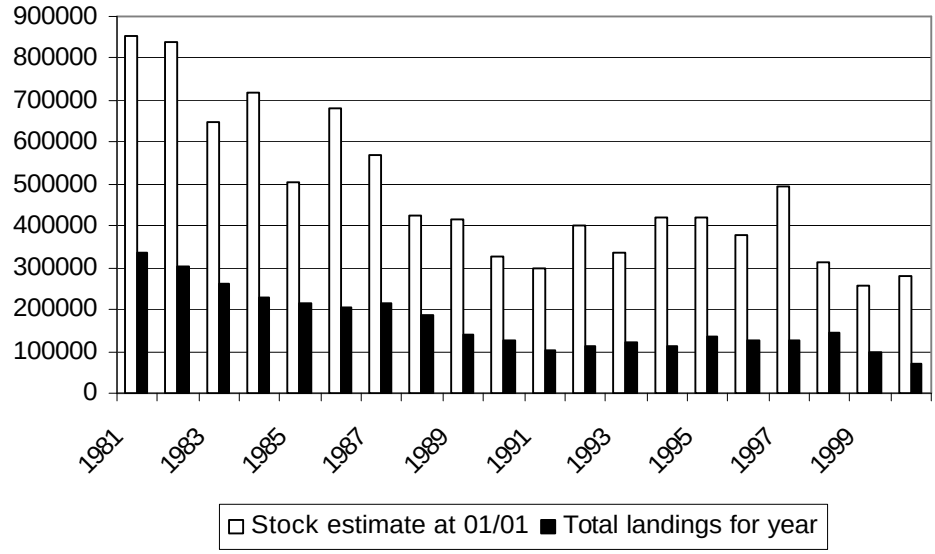


Figure 4.2: Stocks and landings for haddock in IV and IIIa, 1981-2000 (tonnes)

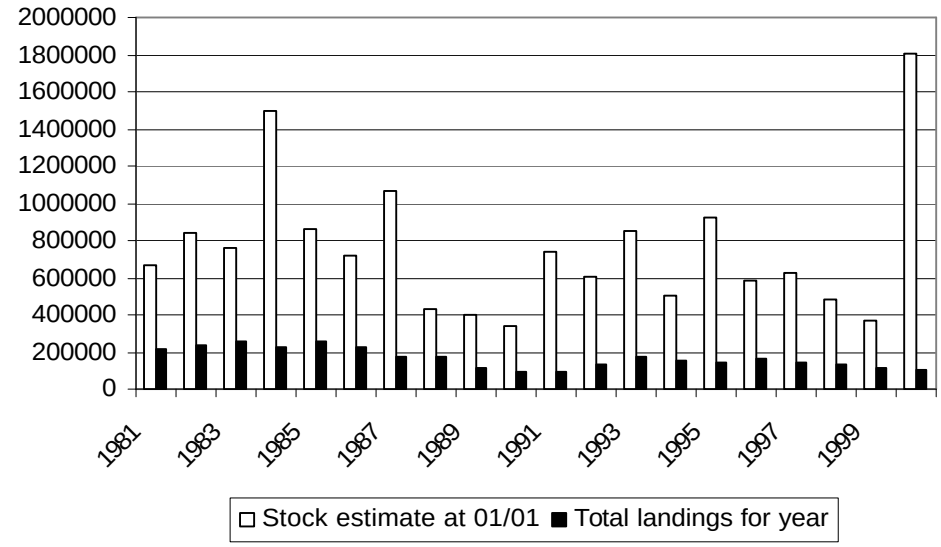
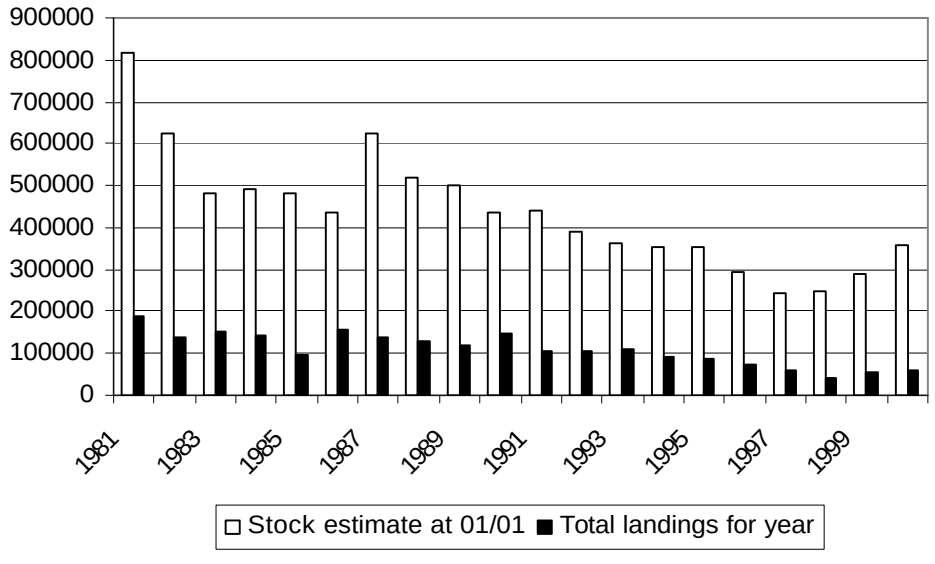


Figure 4.3: Stocks and landings for whiting in IV and VIId, 1981-2000 (tonnes)



In 2000, stocks of cod and whiting were 33 and 44 per cent of the level that they were in 1981, respectively. While, these stocks showed clear patterns of decline over this 20 year period, haddock stocks in the North Sea displayed more erratic patterns of growth and decline. In 2000, the level of haddock was two and a half times higher than it was in 1981, although by 2001, this level had fallen to 890,000 tonnes (not included in table 4.2). This estimated level of stock is still significantly higher than it was in 1981.

4.2 Western English Channel

Figure 4.4: Stocks and landings for sole in VIIe, 1981-2000 (tonnes)

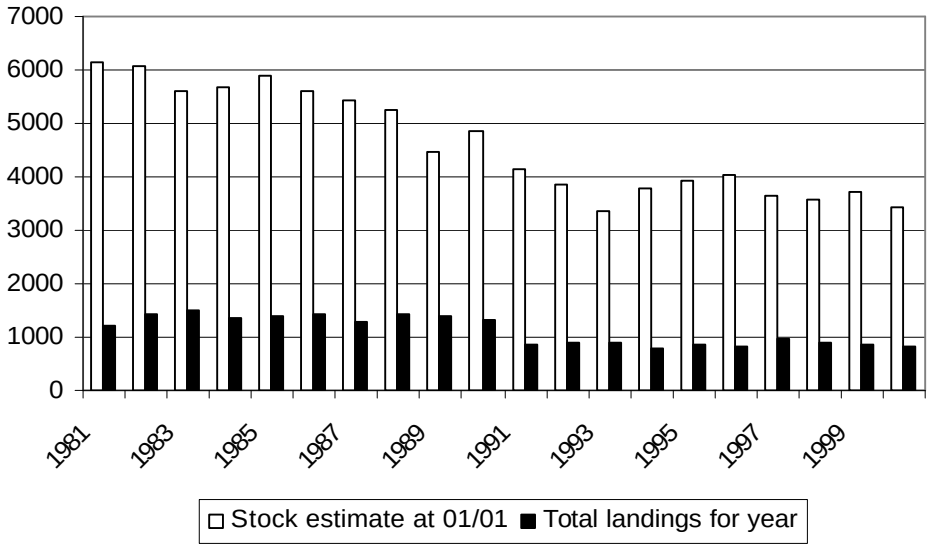
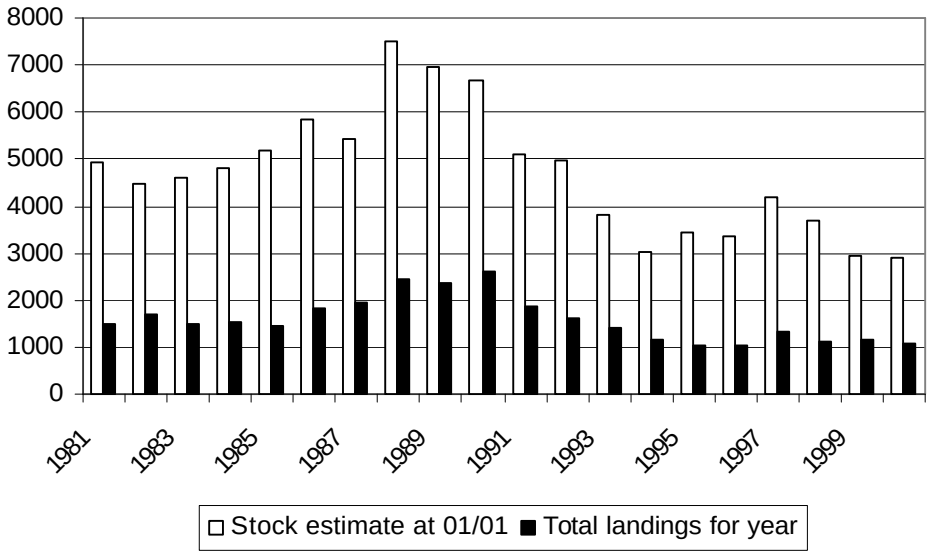


Figure 4.5: Stocks and landings for plaice in VIIe, 1981-2000 (tonnes)



In the English Channel, the sole stock has gradually declined, by a total of 44 per cent from 1981 to 2000. Stocks of plaice on the other hand peaked in 1989 before falling to a level in 2000 that was 41 per cent lower than it was in 1981.

4.3 The Irish Sea

Figure 4.6: Stocks and landings for cod in VIIa, 1981-2000 (tonnes)

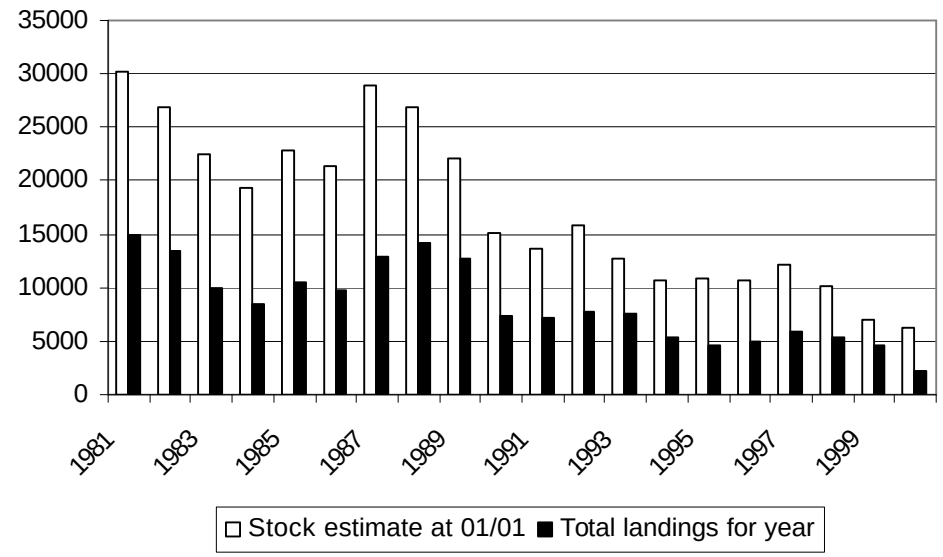


Figure 4.7: Stocks and landings for whiting in VIIa, 1981-2000 (tonnes)

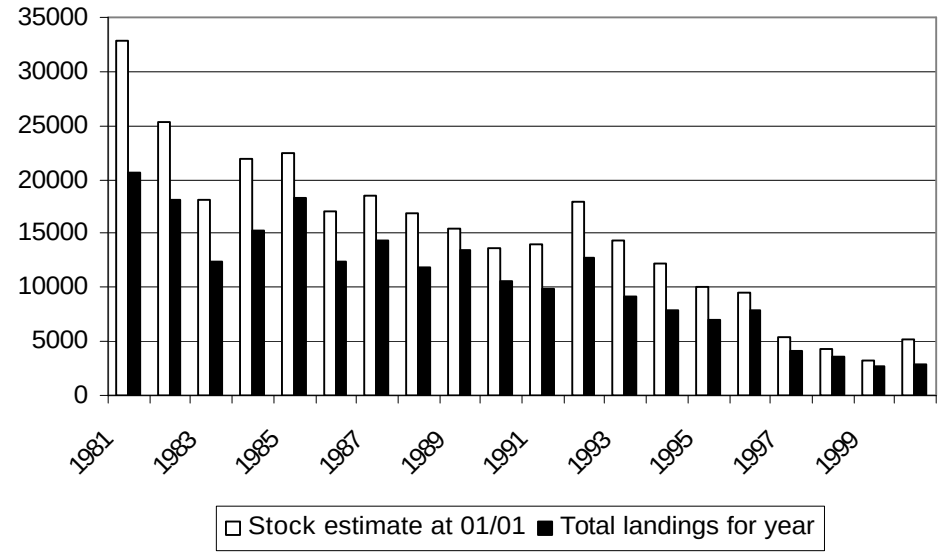


Figure 4.8: Stocks and landings for plaice in VIIa, 1981-2000 (tonnes)

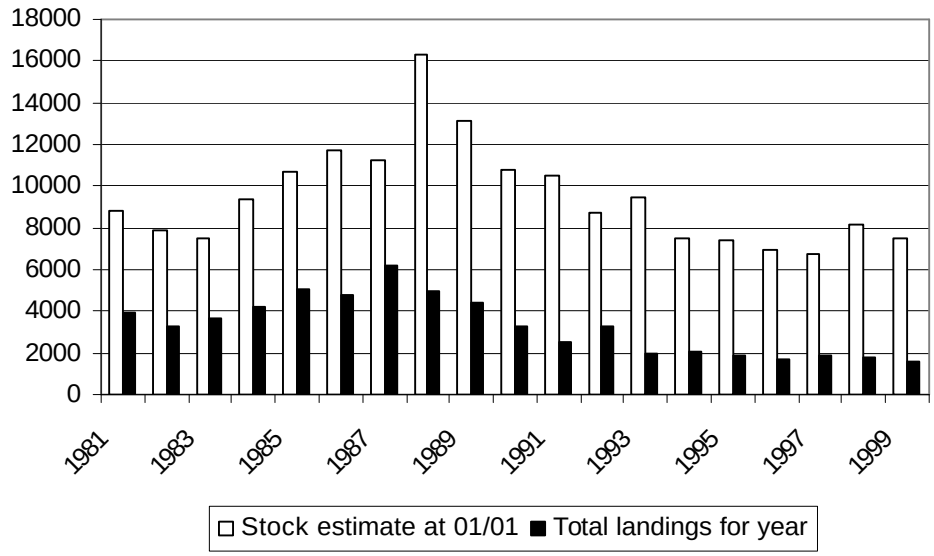
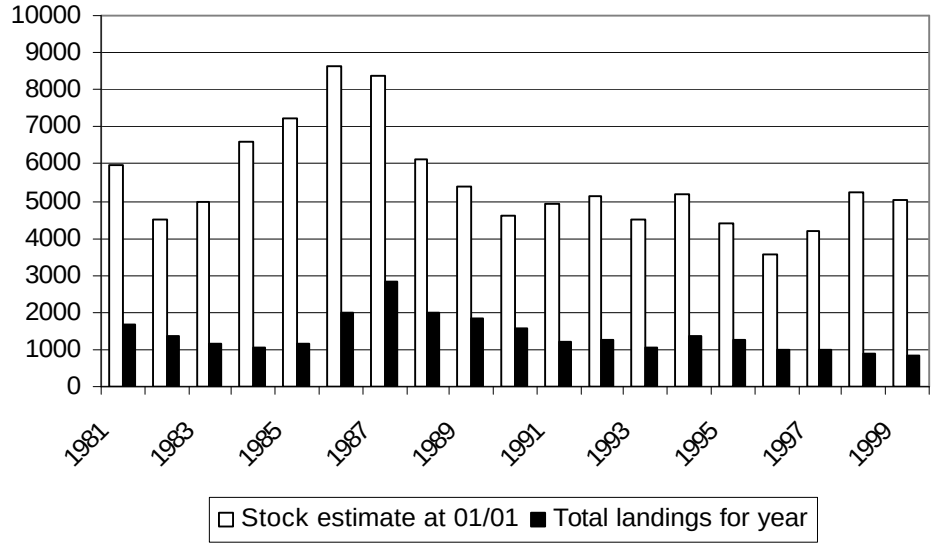


Figure 4.9: Stocks and landings for sole in VIIa, 1981-2000 (tonnes)



In the Irish Sea, stocks of cod, plaice and sole all peaked in the late 1980s before declining throughout the 1990s. The decline in the level of cod has been particularly acute; falling by a total of 79 per cent from 1981 to 2000. The whiting stock exhibited a constant pattern of decline from 1981 to 2000, and also saw an acute fall in stock level by a total of 84 per cent over this 20 year period. Stocks of plaice and sole in 2000 were respectively, 92 and 84 per cent of their levels in 1981.

5 Economic accounts for UK fisheries

The following table gives resource rent for all selected UK stocks for a 10 year period from 1991 to 2000. Table 5.1 uses individual cost data for each stock, as described in table 3.1, and figures 5.1 to 5.3 illustrate patterns of change in resource rent for each fishing region. Annex A.12 details resource rent for each stock individually.

Table 5.1: Total resource rent for selected stocks of selected commercial species in the UK using INDIVIDUAL STOCK COSTS, 1991-2001 (£ million, 2000 prices)

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
TOTAL	-15.3	-11.9	-32.1	-26.9	-25.5	-31.2	-27.6	-29.5	6.3	6.5	-2.1

Note: Rent was calculated as revenue minus costs (including normal profit) from FH data

Figure 5.1: Resource rent for selected stocks in the North Sea, 1991-2001

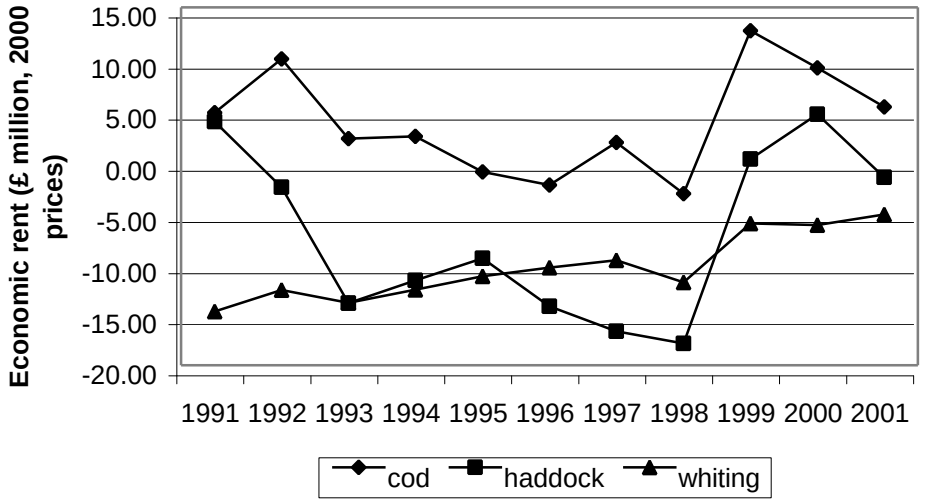


Figure 5.2: Resource rent for selected stocks in the English Channel, 1991-2001

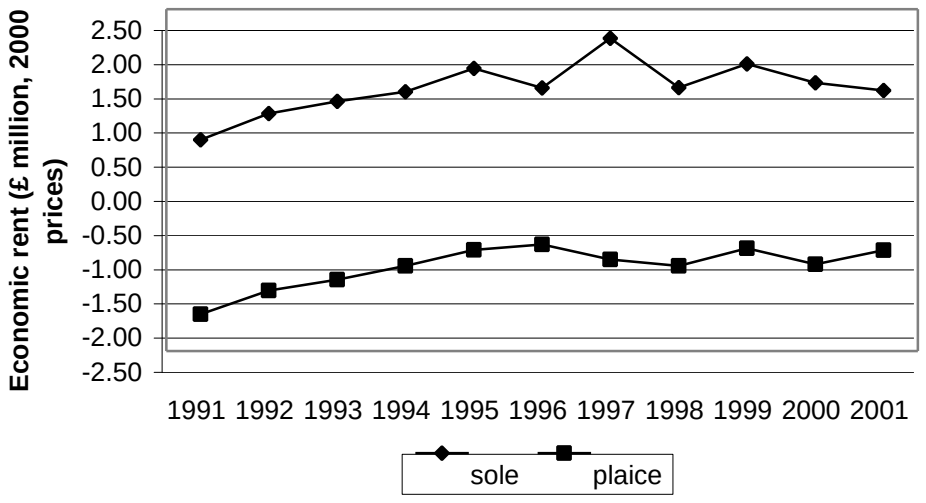
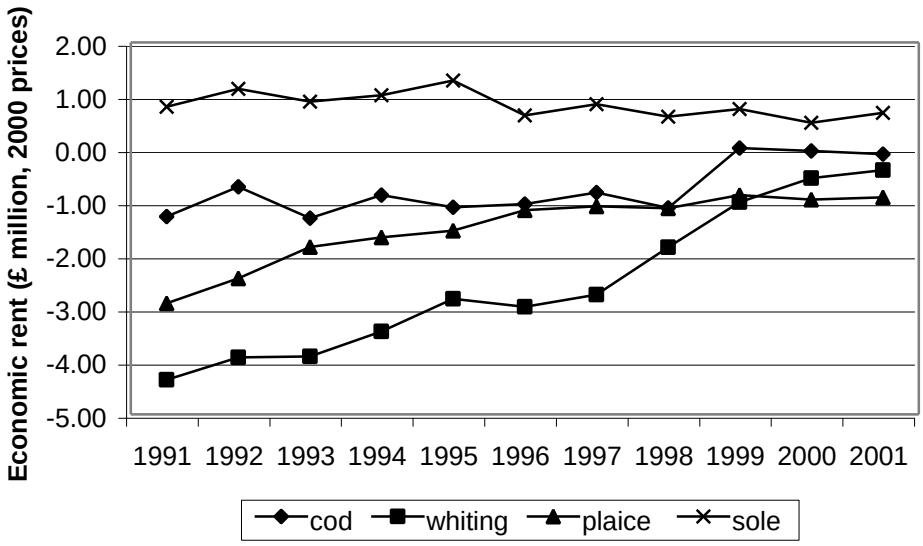


Figure 5.3: Resource rent for selected stocks in the Irish Sea, 1991-2001



For the nine stocks in this study, only two, both sole stocks, exhibited constant positive resource rent from 1991 to 2001. Both cod and haddock generated some years of positive rent during this period, although the patterns of change appear to be relatively erratic. The two whiting stocks in this study generated negative rents for the whole ten year period. The economic interpretation of negative rents is that the fishery is being managed in an economically sub-optimal way. Moreover, inputs such as capital and labour are also being used in a sub-optimal activity, implying that there would be an improvement in economic welfare if these resources were employed elsewhere in the economy and subsidies did not have to be paid.

Table 5.2 gives resource rent for all nine stocks again for the period, 1991-2001, but this time using the average cost data for all UK stocks instead of individually calculated cost data for each stock. This is to permit a comparison of total resource rent for all nine stocks, between use of average and individual cost data, which can be seen in figure 5.4. Annex A.13 gives resource rent for each stock individually.

Table 5.2: Total resource rent for selected stocks of selected commercial species in the UK using AVERAGE STOCK COSTS, 1991-2001 (£ million, 2000 prices)

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
TOTAL	-37.6	-30.2	-47.7	-46.3	-44.5	-45.3	-37.6	-45.3	-15.7	-15.4	-14.6

Note: Rent was calculated as revenue minus costs (including normal profit) from FH data

Figure 5.4: A comparison of resource rent for all selected stocks using individual stock costs and average cost, 1991-2001

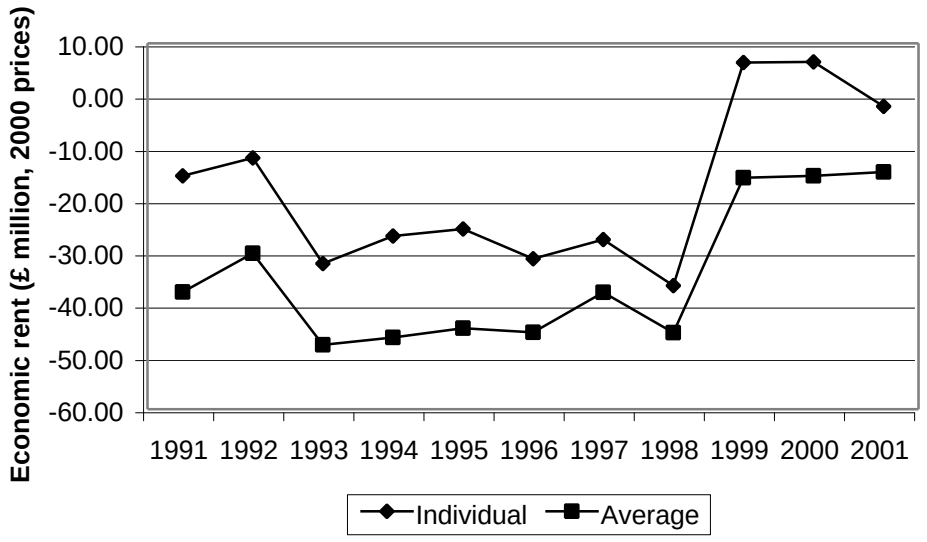


Figure 5.4 illustrates a surprisingly similar pattern for total resource rent derived from different cost assumptions, although use of individual cost data for each stock has resulted in a consistently higher total rent than use of the average for each year under consideration. Unfortunately, the total rent for all nine stocks was negative for all years except in 1999 and 2000.

The following tables give the present discounted values of future rent for selected UK stocks using a discount rate of 4 per cent. Table 5.3 illustrates this value using the rents calculated in table 5.1, i.e. using individual stock costs, while table 5.4 uses rent values calculated in table 5.2, i.e. using average costs for all UK stocks. Annexes A.14 and A.15 detail asset value on a per stock basis. Figure 5.5 compares total asset value for all nine stocks using individual and average stock costs.

Table 5.3: Total asset value for selected stocks of selected commercial species in the UK using INDIVIDUAL STOCK COSTS, 1991-2001 (£ million, constant 2000 prices)

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
TOTAL	228.6	274.2	83.9	93.0	42.2	34.3	97.1	34.5	365.5	376.4	165.1

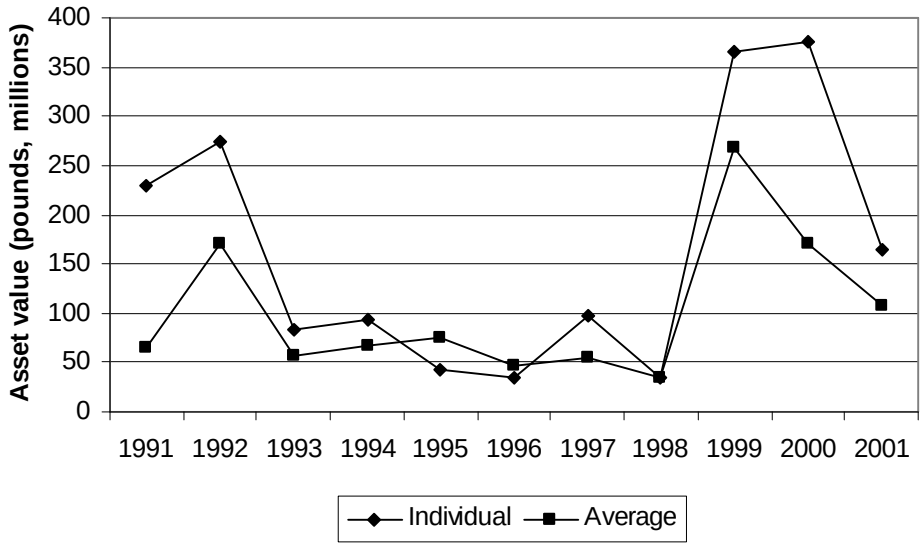
Note: When rent is negative the stock is assigned an asset value of zero.

Table 5.4: Total asset value for selected stocks of selected commercial species in the UK using AVERAGE STOCK COSTS, 1991-2001 (£ million, constant 2000 prices)

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
TOTAL	64.5	170.4	56.6	66.5	75.0	46.7	54.3	35.2	268.4	171.2	107.8

Note: When rent is negative the stock is assigned an asset value of zero.

Figure 5.5: A comparison of asset value for all selected stocks using individual stock costs and average cost, 1991-2000



Again, the patterns of change in asset value are similar using different assumptions of cost, although use of individual stock costs in calculating resource rent tends to result in higher overall asset value. For all nine stocks, asset value appeared to peak in 2000.

6 Conclusions

This study of the physical and economic accounts for a limited number of fish stocks indicates how overfishing has negatively impacted on these stocks. Overall, the stocks have declined over the most recent 20 year period and levels of economic rent tend to be negative. However, when rent is found to be negative and the value of fish stocks are zero, this does not mean that it is unimportant to construct fisheries resource accounts. The physical accounts are still useful for management, and it is important for policy-makers to know that a resource is not being managed efficiently from an economic perspective. In addition, when the value of an important resource, like a fish stock, has an economic value of zero, it is important for fisheries managers to ask what the value of the stock would be under optimal management.

Analysis with a bio-economic model could show how resource rent might change with the rate of exploitation of the fish stock. A bio-economic model attempts to measure the maximum potential value of a fish stock, although it was not possible to develop a model of this type within the context of this study. However for future reference, the optimal fisheries management in a catch quota system is based on a rule for deciding the catch quota in each period. The adoption of a simple catch rule allows for simplicity, which is an advantage when communicating the rule to the fishermen. Secondly, it is very difficult to model the various adjustment costs, which justify smooth catch rules. Thirdly, the economic objective functions tend to be fairly flat around the optimum. Simple rules that may not be perfectly optimal in some mathematical model will, therefore, only lead to small economic losses.

Unlike other valuation methods, bio-economic models use stock related data, principally data to estimate the size of the stock. Forecasting of future stock sizes can be achieved using a logistic growth function with data for the intrinsic growth rate carrying capacity. In addition, estimations of catch and cost functions are required, which tend to show that the catch, which can be taken by some given volume of capital and labour, depends on the size of the stock. The elasticity of the catch per unit effort with respect to the size of the stock needs to be assumed, and this together with the growth function (the recruitment function in the cohort model) tends to be the source of the largest errors in this type of model. Given a suitable price function, e.g. where the future price of fish from the stock changes with changes in the supply, an optimal catch rule, the growth function of the biomass and the cost function it is possible to estimate future profits. The value of the stock at each time can then be calculated as the present value of the estimated future profits from this fishery. While a bio-economic model generates a value for a specified fish stock, the objective of this study was to estimate resource rent for the UK on the basis of UK fleet survey data, and not for other countries that share in the Total Allowable Catch (TAC). Therefore, to estimate the resource rent for the whole stock would require cost data for all the countries that share in fishing for a particular stock along with other easily comparable data such as that for 'fishing effort'.

Resource rent calculated for the stocks in this study include some social costs of fishing and although rents have been shown to be negative, these figures still likely to be underestimates because there are a number of other costs for which data were not available. First, there may be extensive resource management costs borne by the government such as research to assess the state of a fishery each year and to establish the total allowable catch. In addition, government must undertake extensive monitoring, control and surveillance activities to enforce its policies and to prevent illegal fishing. Second, another source of divergence between the private and social costs occurs when there is substantial environmental damage from resource extraction, such as air and water pollution, and the disruption of natural habitat. Finally, most asset valuation has focused on the dominant commercial use of a fishery. Some fisheries may have multiple values, providing tangible and intangible economic benefits related to the stock being part of an eco-system and the stock being important for some people purely because of its existence or for aesthetic or ethical reasons. When all these costs are taken into consideration, it seems likely that the social costs of fishing far outweigh the benefits, and hence, the indications of negative rent found in this study should be considered conservative estimates.

In estimating the potential, optimal value of fish stocks, however, the optimal value of fisheries should not be mistaken for the 'true' value of fisheries and substituted for the actual value of fisheries in the accounts. The SNA and the SEEA are measures of economic activity not economic welfare. Consequently, the accounting practices of the SNA and the SEEA require asset valuation based on current value, not potential value. Furthermore for increased validation of this work, different methods of valuation should be undertaken where data for the transfer of licences between vessels for markets in 'fishing rights' in individual fisheries should be made available. This could be used to calculate levels of rent for comparison with the current rent approach and would be an improvement on using a single approach alone.

Office for National Statistics
March 2003

Annexes

Table A.1: Fixed and variable costs of fishing by stock, 1991-2001 (£ per tonne, at 2000 prices)

Fishing area	Species	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
IV, VIId, IIIa	cod	916	909	891	868	846	830	838	820	828	845	839
IV, IIIa	haddock	764	758	743	724	706	692	699	684	691	705	700
IV, VIId	whiting	798	791	777	756	737	723	730	715	722	736	731
VIIe	sole	2659	2637	2588	2519	2456	2409	2433	2381	2404	2453	2435
	plaice	2469	2449	2403	2340	2281	2237	2259	2211	2233	2278	2262
VIIa	cod	1325	1314	1289	1255	1223	1200	1212	1186	1198	1222	1213
	whiting	1325	1314	1289	1255	1223	1200	1212	1186	1198	1222	1213
	sole	2659	2637	2588	2519	2456	2409	2433	2381	2404	2453	2435
	plaice	2659	2637	2588	2519	2456	2409	2433	2381	2404	2453	2435
Average (all UK stocks)		**1059**	**1050**	**1030**	**1003**	**978**	**959**	**969**	**948**	**957**	**977**	**970**

Source: The Fishermen's Handbook, 2000-2001

Table A.2: Average 'other costs', 1991-2001 (£ per tonne, at 2000 prices)

Type of cost	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Fuel duty subsidy[1]	23	31	32	41	47	58	63	68	80	66	23
VAT Reclaimed[1]	35	33	31	29	28	28	27	28	29	28	35
Interest charges[1]	20	16	16	17	18	22	31	26	33	34	20
UK Fisheries grants[2]	100	100	100	100	80	85	142	79	115	100	100
Total	**116**	**109**	**114**	**117**	**129**	**117**	**137**	**209**	**145**	**199**	**171**

Sources: [1]Aggregate Sea Fisheries Account (2002), DEFRA; [2] 'Four Year Expenditure on Fisheries Grant Schemes', DEFRA

Table A.3: Expenditure on Fisheries Grant Schemes 1995/96 to 1998/99 (£ thousand, current prices)

Scheme	95/96		96/97		97/98		98/99	
	EC Aid	UK Aid	EC Aid	UK Aid	EC Aid	UK Aid	EC Aid	UK Aid
Processing & Marketing	2,858	372	2,267	329	3,916	787	4,094	862
Port Facilities	806	107	240	61	589	119	534	162
Promotion	900	441	42	7	117	3	226	-
Search for new markets	143	-	1,433	245	1,479	507	1,971	344
PO formation grants	-	152	-	77	-	38	-	18
National Harbour Grants	-	3,995	-	3,475	-	5,677	-	3,081
EC Vessel Safety	564	792	1,120	1,029	1,318	449	1,656	438
Decommissioning	5,265	4,382	5,756	4,569	5,774	8,116	-	-
PESCA[1] (FIFG)	-	-	-	-	1,169	1,016	1,289	733
TOTAL	**10,536**	**10,241**	**10,859**	**9,791**	**14,363**	**16,713**	**9,770**	**5,638**

Source: DEFRA
Note: [1]Funds for fishing dependent areas via Regional Development Funds

Table A.4: Physical account for haddock in areas IV and IIIa, 1981-2000 (thousand tonnes)

HADDOCK (IV, IIIa)	1981	1982	1983	1984	1985	1986	1987	1988	1989
Stock estimate 01/01	671	840	759	1,493	860	715	1,068	428	396
Total landings	-217	-238	-254	-223	-258	-226	-177	-176	-109
Other volume changes	386	157	988	-410	113	579	-463	144	56
Stock estimate 31/12	840	759	1,493	860	715	1,068	428	396	343

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
343	740	602	853	501	926	583	627	484	371	1,802
-93	-97	-138	-174	-154	-145	-160	-142	-132	-112	-105
490	-41	389	-178	579	-198	204	-1	19	1,543	-807
740	602	853	501	926	583	627	484	371	1,802	890

Source: ACFM

Table A.5: Physical account for whiting in areas IV and VIId, 1981-2000 (thousand tonnes)

WHITING (IV, VIId)	1981	1982	1983	1984	1985	1986	1987	1988	1989
Stock estimate 01/01	819	625	481	491	484	435	626	519	499
Total landings	-186	-137	-152	-142	-98	-158	-138	-128	-122
Other volume changes	-8	-7	162	135	93	289	51	118	65
Stock estimate 31/12	625	481	491	484	435	626	519	499	436

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
436	442	390	364	354	353	292	242	250	287	360
-149	-107	-106	-109	-90	-88	-72	-59	-43	-57	-61
128	97	81	96	108	29	38	80	96	116	20
442	390	364	354	353	292	242	250	287	360	323

Source: ACFM

Table A.6: Physical account for sole in area VIIe, 1981-2000 (tonnes)

SOLE (Div VIIe)	1981	1982	1983	1984	1985	1986	1987	1988	1989
Stock estimate 01/01	6,157	6,066	5,611	5,669	5,895	5,623	5,426	5,256	4,478
Total landings	-1,215	-1,446	-1,498	-1,370	-1,409	-1,419	-1,280	-1,444	-1,390
Other volume changes	1,124	991	1,556	1,596	1,137	1,222	1,110	666	1,772
Stock estimate 31/12	6,066	5,611	5,669	5,895	5,623	5,426	5,256	4,478	4,860

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
4,860	4,150	3,865	3,346	3,776	3,929	4,041	3,632	3,556	3,726	3,445
-1,315	-852	-895	-904	-800	-856	-833	-949	-880	-868	-824
605	567	376	1,334	953	968	424	873	1,050	587	207
4,150	3,865	3,346	3,776	3,929	4,041	3,632	3,556	3,726	3,445	2,828

Source: ACFM

Table A.7: Physical account for plaice in area VIIe, 1981-2000 (tonnes)

PLAICE (Div VIIe)	1981	1982	1983	1984	1985	1986	1987	1988	1989
Stock estimate 01/01	4,934	4,480	4,612	4,816	5,172	5,842	5,435	7,495	6,962
Total landings	-1,501	-1,688	-1,495	-1,547	-1,441	-1,810	-1,958	-2,458	-2,358
Other volume changes	1,047	1,820	1,699	1,903	2,111	1,403	4,018	1,925	2,081
Stock estimate 31/12	4,480	4,612	4,816	5,172	5,842	5,435	7,495	6,962	6,685

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
6685	5,089	4,967	3,815	3,040	3,430	3,354	4,186	3,685	2,923	2,889
-2,593	-1,848	-1,624	-1,417	-1,156	-1,031	-1,044	-1,323	-1,131	-1,154	-1,084
997	1,726	472	642	1,546	955	1,876	822	369	1,120	1,123
5,089	4,967	3,815	3,040	3,430	3,354	4,186	3,685	2,923	2,889	2,928

Source: ACFM

Table A.8: Physical account for cod in sub-area VIIa, 1981-2000 (tonnes)

COD (Div VIIa)	1981	1982	1983	1984	1985	1986	1987	1988	1989
Stock estimate 01/01	30,163	26,976	22,493	19,286	22,785	21,333	29,013	26,980	22,113
Total landings	-14,907	-13,381	-10,015	-8,383	-10,483	-9,852	-12,894	-14,168	-12,751
Other volume changes	11,720	8,898	6,808	11,882	9,031	17,532	10,861	9,301	5,781
Stock estimate 31/12	26,976	22,493	19,286	22,785	21,333	29,013	26,980	22,113	15,143

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
15,143	13,651	15,836	12,768	10,714	10,814	10,597	12,114	10,197	6,922	6,268
-7,379	-7,095	-7,735	-7,555	-5,402	-4,587	-4,964	-5,859	-5,310	-4,694	-2,179
5,887	9,280	4,667	5,501	5,502	4,370	6,481	3,942	2,035	4,040	4,583
13,651	15,836	12,768	10,714	10,814	10,597	12,114	10,197	6,922	6,268	8,672

Source: ACFM

Table A.9: Physical account for whiting in sub-area VIIa, 1981-2000 (tonnes)

WHITING (Div VIIa)	1981	1982	1983	1984	1985	1986	1987	1988	1989
Stock estimate 01/01	32,859	25,291	18,153	21,939	22,480	17,013	18,481	16,810	15,512
Total landings	-20,606	-18,112	-12,345	-15,235	-18,236	-12,415	-14,418	-11,856	-13,408
Other volume changes	13,038	10,974	16,131	15,776	12,769	13,883	12,747	10,558	11,450
Stock estimate 31/12	25,291	18,153	21,939	22,480	17,013	18,481	16,810	15,512	13,554

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
13,554	13,936	17,982	14,399	12,117	10,072	9,475	5,411	4,368	3,228	5,259
-10,656	-9,946	-12,791	-9,230	-7,936	-7,044	-7,966	-4,205	-3,533	-2,762	-2,880
11,038	13,992	9,208	6,948	5,891	6,447	3,902	3,162	2,393	4,793	4,512
13,936	17,982	14,399	12,117	10,072	9,475	5,411	4,368	3,228	5,259	6,891

Source: ACFM

Table A.10: Physical account for plaice in sub-area VIIa, 1981-2000 (tonnes)

PLAICE (Div VIIa)	1981	1982	1983	1984	1985	1986	1987	1988	1989
Stock estimate 01/01	8,766	7,844	7,498	9,412	10,726	11,754	11,254	16,274	13,100
Total landings	-3,906	-3,237	-3,639	-4,241	-5,075	-4,806	-6,220	-5,005	-4,372
Other volume changes	2,984	2,891	5,553	5,555	6,103	4,306	11,240	1,831	2,070
Stock estimate 31/12	7,844	7,498	9,412	10,726	11,754	11,254	16,274	13,100	10,798

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
10,798	10,468	8,702	9,476	7,466	7,453	6,979	6,754	8,150	7,496	8,064
-3,275	-2,554	-3,267	-1,996	-2,066	-1,874	-1,707	-1,871	-1,765	-1,600	-1,371
2,945	788	4,041	-14	2,053	1,400	1,482	3,267	1,111	2,168	1,379
10,468	8,702	9,476	7,466	7,453	6,979	6,754	8,150	7,496	8,064	8,072

Source: ACFM

Table A.11: Physical account for sole in sub-area VIIa, 1981-2000 (tonnes)

SOLE (Div VIIa)	1981	1982	1983	1984	1985	1986	1987	1988	1989
Stock estimate 01/01	5,954	4,527	4,967	6,590	7,216	8,656	8,361	6,128	5,370
Total landings	-1,667	-1,338	-1,169	-1,058	-1,146	-1,995	-2,808	-1,999	-1,833
Other volume changes	240	1,778	2,792	1,684	2,586	1,700	575	1,241	1,082
Stock estimate 31/12	4,527	4,967	6,590	7,216	8,656	8,361	6,128	5,370	4,619

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
4,619	4,898	5,110	4,528	5,180	4,393	3,579	4,178	5,245	5,002	4,799
-1,583	-1,212	-1,259	-1,023	-1,374	-1,266	-1,002	-1,003	-911	-863	-818
1,862	1,424	677	1,675	587	452	1,601	2,070	668	660	n/a
4,898	5,110	4,528	5,180	4,393	3,579	4,178	5,245	5,002	4,799	n/a

Source: ACFM
Note: n/a denotes data not available

Table A.12: Resource rent for selected stocks of selected commercial species in the UK using INDIVIDUAL STOCK COSTS, 1991-2001 (£ million, 2000 prices)

Fishing area	Species	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
IV, VIId, IIIa	cod	4.69	9.95	2.17	2.39	-1.08	-2.37	1.78	-3.21	12.73	9.08	5.27
IV, IIIa	haddock	3.83	-2.60	-13.93	-11.71	-9.55	-14.23	-16.69	-17.87	0.15	4.53	-1.61
IV, VIId	whiting	-14.73	-12.65	-13.90	-12.60	-11.29	-10.46	-9.74	-11.90	-6.15	-6.29	-5.27
subtotal		**-6.21**	**-5.30**	**-25.66**	**-21.92**	**-21.92**	**-27.06**	**-24.65**	**-26.56**	**6.73**	**7.32**	**-1.61**
VIIe	sole	0.59	0.97	1.15	1.29	1.63	1.35	2.07	1.36	1.70	1.43	1.31
	plaice	-1.96	-1.61	-1.46	-1.25	-1.02	-0.94	-1.16	-1.25	-1.00	-1.23	-1.02
subtotal		**-1.37**	**-0.64**	**-0.31**	**0.04**	**0.61**	**0.41**	**0.91**	**0.11**	**0.70**	**0.20**	**0.29**
VIIa	cod	-1.28	-0.72	-1.31	-0.87	-1.10	-1.04	-0.83	-1.11	0.01	-0.04	-0.10
	whiting	-4.35	-3.93	-3.91	-3.44	-2.82	-2.98	-2.75	-1.86	-1.01	-0.55	-0.40
	plaice	-2.91	-2.44	-1.85	-1.67	-1.54	-1.16	-1.08	-1.12	-0.88	-0.96	-0.91
	sole	0.79	1.12	0.89	1.01	1.28	0.63	0.84	0.60	0.75	0.49	0.67
subtotal		**-7.75**	**-5.97**	**-6.18**	**-4.97**	**-4.18**	**-4.55**	**-3.82**	**-3.49**	**-1.13**	**-1.06**	**-0.74**
TOTAL		**-15.33**	**-11.91**	**-32.14**	**-26.85**	**-25.49**	**-31.20**	**-27.56**	**-29.49**	**6.30**	**6.46**	**-2.06**

Note: Rent was calculated as revenue minus costs (including normal profit) from FH data

Table A.13: Resource rent for selected stocks of selected commercial species in the UK using AVERAGE STOCK COSTS, 1991-2001 (£ million)

Fishing area	Species	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
IV, VIId, IIIa	cod	-1.54	3.78	-3.90	-3.44	-7.83	-9.05	-4.28	-10.12	8.36	5.40	2.66
IV, IIIa	haddock	-11.42	-12.55	-20.40	-21.76	-18.26	-17.89	-17.39	-16.80	-14.95	-10.79	-8.79
IV, VIId	whiting	-23.66	-21.50	-22.48	-21.10	-19.00	-17.69	-15.93	-17.72	-10.81	-11.01	-9.85
subtotal		**-36.62**	**-30.27**	**-46.78**	**-46.30**	**-45.09**	**-44.63**	**-37.60**	**-44.64**	**-17.40**	**-16.40**	**-15.98**
VIIe	sole	0.76	0.73	0.75	0.83	0.84	0.63	0.73	0.56	0.57	0.61	0.56
	plaice	-0.10	-0.07	0.03	0.08	0.10	0.15	0.17	-0.13	0.21	-0.02	-0.01
subtotal		**0.66**	**0.66**	**0.78**	**0.91**	**0.94**	**0.78**	**0.90**	**0.43**	**0.78**	**0.59**	**0.55**
VIIa	cod	-0.15	0.35	-0.34	-0.21	-0.42	-0.44	-0.23	-0.49	0.43	0.16	0.12
	whiting	-3.14	-2.77	-2.82	-2.44	-2.00	-2.10	-1.97	-1.39	-0.70	-0.39	-0.27
	plaice	-0.13	-0.10	0.03	0.09	0.13	0.16	0.14	-0.10	0.16	-0.02	-0.01
	sole	1.82	1.96	1.46	1.66	1.94	0.92	1.13	0.85	1.00	0.70	0.96
subtotal		**-1.60**	**-0.56**	**-1.67**	**-0.90**	**-0.35**	**-1.46**	**-0.93**	**-1.13**	**0.89**	**0.45**	**0.80**
TOTAL		**-37.56**	**-30.17**	**-47.67**	**-46.29**	**-44.50**	**-45.31**	**-37.63**	**-45.34**	**-15.73**	**-15.36**	**-14.63**

Note: Rent was calculated as revenue minus costs (including normal profit) from FH data

Table A.14: Asset value for selected stocks of selected commercial species in the UK using INDIVIDUAL STOCK COSTS, 1991-2001 (£ million, 2000 prices)

Fishing area	Species	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
IV, VIId, IIIa	cod	117.21	248.78	54.20	59.67	0	0	44.40	0	318.20	226.95	131.75
IV, IIIa	haddock	95.85	0	0	0	0	0	0	0	3.79	113.31	0
IV, VIId	whiting	0	0	0	0	0	0	0	0	0	0	0
subtotal		**213.06**	**248.78**	**54.20**	**59.67**	**0**	**0**	**44.40**	**0**	**321.99**	**340.26**	**131.75**
VIIe	sole	14.74	24.32	28.81	32.29	40.87	33.68	51.83	33.88	42.44	35.63	32.71
	plaice	0	0	0	0	0	0	0	0	0	0	0
subtotal		**14.74**	**24.32**	**28.81**	**32.29**	**40.87**	**33.68**	**51.83**	**33.88**	**42.44**	**35.63**	**32.71**
VIIa	cod	0	0	0	0	0	0	0	0	0.31	0	0
	whiting	0	0	0	0	0	0	0	0	0	0	0
	plaice	0	0	0	0	0	0	0	0	0	0	0
	sole	0.79	1.12	0.89	1.01	1.28	0.63	0.84	0.60	0.75	0.49	0.67
subtotal		**0.79**	**1.12**	**0.89**	**1.01**	**1.28**	**0.63**	**0.84**	**0.60**	**1.06**	**0.49**	**0.67**
TOTAL		**228.59**	**274.22**	**83.90**	**92.97**	**42.15**	**34.31**	**97.07**	**34.48**	**365.49**	**376.38**	**165.13**

Note: When rent is negative the stock is assigned an asset value of zero.

Table A.15: Asset value for selected stocks of selected commercial species in the UK using AVERAGE STOCK COSTS, 1991-2001 (£ million, constant 2000 prices)

Fishing area	Species	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
IV, VIId, IIIa	cod	0	94.41	0	0	0	0	0	0	209.05	134.94	66.58
IV, IIIa	haddock	0	0	0	0	0	0	0	0	0	0	0
IV, VIId	whiting	0	0	0	0	0	0	0	0	0	0	0
subtotal		**0**	**94.41**	**0**	**0**	**0**	**0**	**0**	**0**	**209.05**	**134.94**	**66.58**
VIIe	sole	19.08	18.13	18.69	20.77	20.88	15.84	18.15	13.94	14.32	15.24	14.07
	plaice	0	0	0.63	1.97	2.43	3.81	4.30	0	5.27	0	0
subtotal		**19.08**	**18.13**	**19.32**	**22.74**	**23.31**	**19.65**	**22.45**	**13.94**	**19.59**	**15.24**	**14.07**
VIIa	cod	0	8.77	0	0	0	0	0	0	10.84	4.04	3.06
	whiting	0	0	0	0	0	0	0	0	0	0	0
	plaice	0	0	0.70	2.28	3.20	4.06	3.47	0	3.98	0	0
	sole	45.45	49.04	36.61	41.44	48.52	23.00	28.36	21.27	24.94	17.49	24.12
subtotal		**45.45**	**57.81**	**37.31**	**43.72**	**51.72**	**27.06**	**31.83**	**21.27**	**39.76**	**21.53**	**27.18**
TOTAL		**64.53**	**170.35**	**56.63**	**66.46**	**75.03**	**46.71**	**54.28**	**35.21**	**268.40**	**171.17**	**107.83**

Note: When rent is negative the stock is assigned an asset value of zero.