CENTRAL STATISTICAL OFFICE

Economic Trends

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Contents

Introduction

Economic Trends brings together all the main economic indicators. It contains three regular sections of tables and charts illustrating trends in the UK economy.

'Latest developments' presents the most up-to-date statistical information available during the month. It is important to note that data included in this section may not be wholly consistent with other sections which have gone to press earlier. All data in this section are seasonally adjusted unless otherwise stated. In most cases estimates are provisional and subject to revision.

The main section is based on information available to the CSO on the date printed at the foot of this page and shows the movements of the key economic indicators. The indicators appear in tabular form on left hand pages with corresponding charts on facing right hand pages. Colour has been used to aid interpretation in some of the charts, for example by creating a background grid on those charts drawn to a logarithmic scale. Index numbers in some tables and charts are given on a common base year for convenience of comparison.

The section on cyclical indicators shows the movements of four composite indices over 20 years against a reference chronology of business cycles. The indices group together indicators which lead, coincide with and lag behind the business cycle, and a short note describes their most recent movements. The March, June, September and December issues carry further graphs showing separately the movements in all of the 27 indicators which make up the composite indices.

In addition, quarterly articles on the national accounts appear in the January, April, July and October issues, and on the balance of payments in the March, June, September and December issues. Occasional articles comment on and analyse economic statistics and introduce new series, new analyses and new methodology.

Economic Trends is prepared monthly by the Central Statistical Office in collaboration with the statistics divisions of Government Departments and the Bank of England.

Notes on the tables

1. Some data, particularly for the latest time period, are provisional and may be subject to revisions in later issues.

2. The statistics relate mainly to the United Kingdom; where figures are for Great Britain only, this is shown on the table.

3. Almost all quarterly data are seasonally adjusted; those not seasonally adjusted are indicated by NSA.

4. Rounding may lead to inconsistencies between the sum of constituent parts and the total in some tables.

5. A line drawn across a column between two consecutive figures indicates that the figures above and below the line have been compiled on different bases and are not strictly comparable. In each case a footnote explains the difference.

6. 'Billion' denotes one thousand million.

7. There may sometimes be an inconsistency between a table and the corresponding chart, because the data may be received too late to update the chart. In such cases it should be assumed that the table is correct.

8. There is no single correct definition of *money*. Consequently, several definitions of money stock are widely used:

M0 the narrowest measure consists of notes and coin in circulation outside the Bank of England and bankers' operational deposits at the Bank.

M2 comprises notes and coin in circulation with the public *plus* sterling retail deposits held by the UK private sector with UK banks and building societies.

M4 comprises notes and coin in circulation with the public, together with all sterling deposits (including *certificates of deposit*) held with UK banks and building societies by the rest of the private sector.

The Bank of England also publish data for liquid assets outside M4.

9. Symbols used:
   .. not available
   - nil or less than half the final digit shown
   + alongside a heading indicates a series for which measures of variability are given in the table on page 79
   † indicates that the data has been revised since the last edition; the period marked is the earliest in the table to have been revised
   * average (or total) of five weeks.

The Editor would welcome readers' suggestions for improvements to *Economic Trends*.

Central Statistical Office, 9 November 1992

CSO Databank

Virtually all the series in *Economic Trends* and the Quarterly Articles may be obtained as part of the CSO Databank Service on tape or disk. The appropriate four digit identifier is included at the top of the column or start of a row of figures. This enables users to obtain (in computer-readable form) a much more comprehensive and up-to-date set of long run macro-economic time series data than can be included in this publication. The tape format, unlabelled EBCDIC, is the same for all datasets. The disks, either $3^1/_2$" or $5^1/_4$" are written in ASCII text which can be loaded as spreadsheets and viewed using standard spreadsheet packages, such as LOTUS or SMART.

Details of the service offered and the schedule of charges may be obtained from the Databank Manager, CSO Information Systems Branch, Room 52/4, Government Offices, Great George Street, London, SW1P 3AQ (telephone 071-270 6386). CSO does not offer direct on-line access for these data but a list of host bureaux offering such a facility is available on request from CSO.

Latest developments in the economy

Data available at 13 November 1992

DATA PUBLISHED BY CSO

Output
In the three months to September, the output of the production industries was 0.6 per cent higher than the previous quarter, but 0.6 per cent lower than the same period a year earlier. The provisional index of production figure for September is 105.8 (1985=100). The index covers the manufacturing and energy industries, and all figures are seasonally adjusted.

Manufacturing output fell by 0.1 per cent in the three months to September compared with the previous three months, and by 0.8 per cent on the same period a year earlier. Within manufacturing, between the latest three month periods, the output of the metals industry fell by 1.9 per cent, chemicals fell by 0.6 per cent, engineering and allied industries rose by 0.1 per cent, "other manufacturing" rose by 0.3 per cent, "other minerals" fell by 0.2 per cent, food, drink and tobacco fell by 0.7 per cent, and textiles and clothing rose by 0.2 per cent.

The output of the oil and gas extraction industries was 6.7 per cent higher than in the preceding three months, but 0.2 per cent lower than in the same period a year earlier. Other energy and water supply industries fell by 1.0 per cent compared with the previous three months, and by 0.3 per cent on the same quarter last year.

By market sector, between the latest three month periods, the output of the investment goods industries rose by 0.8 per cent, the output of the consumer goods industries fell by 0.5 per cent, and the output of the intermediate goods industries rose by 1.1 per cent.

Producer prices
The input price index for materials and fuel purchased by manufacturing industry rose by 2.0 per cent in the twelve months to October, compared with no change in the twelve months to September. Between September and October, the unadjusted index rose by 2.5 per cent, and the seasonally adjusted index rose by 2.0 per cent.

The increase over twelve months in the output price index for home sales of manufactured products was 3.3 per cent in October, compared with 3.4 per cent in the year to September. The index rose by 0.1 per cent between September and October.

Retail prices
The general index of retail prices for 13 October was 139.9 (January 1987=100), 0.4 per cent higher than in September and 3.6 per cent higher than in October 1991.

Between September and October there were price increases for clothing and footwear, as new stocks arrived in the shops, increases in motoring costs and higher prices for some seasonal foods.

The tax and price index for October was 130.8 (January 1987=100), an increase of 2.6 per cent over the previous twelve months.

Retail sales
The provisional, seasonally adjusted estimate of retail sales volume in September was 121.2 (1985=100), little changed from the August figure but above the July level. In the three months July to September, the volume of sales was 0.6 per cent higher than in the previous three months, and 0.8 per cent higher than in the same period a year earlier.

Sales by food retailers fell by 0.5 per cent compared with the previous three months, those by mixed businesses rose by 1.6 per cent, and those of specialist non-food retailers rose by 1.0 per cent.

Based on non-seasonally adjusted data, retail sales value in current prices in September was 3 per cent higher than in September 1991.

Balance of payments
Information on visible trade in September and recent trends in invisibles imply a current account deficit of £1.0 billion, £0.1 billion smaller than in August. In the latest three months the implied deficit was £3.0 billion, £0.2 billion larger than in the previous three months.

The visible deficit in September was £1.1 billion, compared with £1.2 billion in August. In the three months to September the visible deficit was £3.3 billion, £0.2 billion more than the preceding three months.

In September the value of exports was £8.7 billion, 2 per cent lower than in August. In the three months to September, the value of exports was 1.5 per cent lower than in the previous three months and almost the same as a year earlier. On a volume basis, excluding oil and the erratic items, exports in the three months to September were 1 per cent lower than in the previous three months, but 3 per cent higher than a year earlier.

Imports in September were valued at £9.7 billion, 2.5 per cent lower than in August. In the three months to September, the value of imports was 0.5 per cent lower than in the previous three months, but 3 per cent higher than a year earlier. Excluding oil and erratics, import volume in the three months to September was 1.5 per cent higher than in the previous three months, and 8 per cent higher than a year earlier.

Estimates of invisibles are not available monthly. Based on recent trends and limited information on EC transfers, invisibles in September are projected to be in surplus by £0.1 billion. Revisions to these projections can be substantial.

Public sector borrowing requirement
Provisional estimates put the public sector borrowing requirement at £4.0 billion in September, with privatisation proceeds amounting to £1.4 billion from the third call on the sale of the regional electricity companies.

DATA PUBLISHED BY OTHER DEPARTMENTS

Official reserves
The overall level of the UK's official reserves fell by $539 million in October, bringing the end of October reserves to $42,138 million (£26,956 million), compared with $42,677 million (£24,016 million) at the end of September.

The underlying change in the reserves during October was a fall of $3,017 million.

The underlying change excludes a number of factors that are included in the total change. Proceeds from this month's tender of UK ECU Treasury Bills and sales into the secondary market amounted to $846 million and maturing UK ECU Treasury Bills were $1,208 million. The underlying change also excludes repayments of borrowing under the exchange cover scheme of $29 million.

Exchange rate
The sterling exchange rate index (1985=100) was 80.8 in October, compared with 88.2 in September.

Unemployment and vacancies
In October, the seasonally adjusted level of claimant unemployment in the UK increased by 24,200 to 2.868 million, 10.1 per cent of the workforce. Over the past six months, unemployment has risen by 28,700 per month on average.

The stock of unfilled vacancies at jobcentres decreased by 2,500 to a seasonally adjusted 97,600 in the month to October. Over the three months to October, vacancies have decreased on average by 5,000 a month.

Employment
The number of employees in employment in manufacturing industries in Great Britain stood at 4,388,000 in September, a fall of 32,000 since August. Employment has fallen by 257,000 since September 1991, compared with a fall of 376,000 in the previous year.

The UK workforce in employment (employees in employment, the self-employed, HM Forces and participants in work related government training programmes) stood at 25,361,000 in June 1992, a fall of 195,000 in the quarter. Employment over the year to June fell by 658,000.

Earnings
The underlying increase in average weekly earnings in the year to September was about 5.5 per cent, 0.25 per cent below the increase in the year to August. The actual increase in the year to September, at 4.9 per cent, was below the underlying increase.

In the production industries, the underlying increase in average weekly earnings in the year to September was about 6 per cent, 0.25 per cent lower than the increase in the year to August which has been revised down to 6.25 per cent. Within this sector, the underlying increase in manufacturing industries in the year to September was about 6 per cent, the same as the increase in the year to August which has been revised down to 6 per cent. The actual seasonally adjusted increases for production and manufacturing in the year to September were 5.2 per cent and 5.8 per cent respectively.

In the service industries, the underlying increase in average weekly earnings in the year to September was about 5.25 per cent, 0.25 per cent lower than the increase in the year to August. The actual increase in the service industries in September was 4.8 per cent.

Productivity
Manufacturing output per head in the three months to August was 1.3 per cent higher than in the three months ending May, and was 3.9 per cent higher than in the same period a year earlier. Output per head in the whole economy was 0.3 per cent higher, in the second quarter of 1992, than in the previous quarter, and 2.1 per cent higher than in the same quarter a year earlier.

Unit wage and salary costs
In the three months ending August 1992, wages and salaries per unit of output in manufacturing were 2.3 per cent above the corresponding period a year earlier. This increase was below the rise in average earnings in manufacturing as there was a rise of 3.9 per cent in productivity over this period. In the second quarter of 1992, wages and salaries per unit of output in the whole economy were 4.2 per cent above the corresponding period a year earlier. This increase was below the rise in average earnings because of the rise of about 2.1 per cent in productivity over this period.

Monetary aggregates
Provisional information suggests that in the 12 months to September, and before seasonal adjustment, M0 increased by 2.6 per cent, and M4 by 5.0 per cent. In September, again before seasonal adjustment, M0 decreased by 0.3 per cent, and M4 increased by 0.6 per cent. After seasonal adjustment, M0 rose by 0.4 per cent, and M4 was unchanged.

THE PRODUCTION OF FULLY RECONCILED UK NATIONAL AND SECTOR ACCOUNTS FOR 1988-1991

M A Baxter, Central Statistical Office

Introduction

The Central Statistical Office's Agency Framework Document says that 'the Treasury expects the CSO to produce, each year, fully reconciled accounts that remove all inconsistencies in the accounts'. Such accounts were first produced for 1985-87 (CSO 1989). The need for them - recognised in the press notice accompanying the 1988 *Blue Book* - arose due to the very large sector balancing items in the accounts, particularly for 1987.

If all items in the National Accounts were known exactly, the sector balancing items, the items in the last row of Table A (summary analysis by sector) of the *Blue Book*, would be zero. For many purposes, it is useful to adjust the National Accounts to make these items zero while of course retaining the constraints that appropriate rows of this Table should sum to zero. In the adjustment process, the items altered most should be those deemed most uncertain or subject to deficiencies in coverage.

The technique used to make the accounts balance was first described by Stone, Champernowne and Meade (1942); as noted above, it was applied to the 1985-87 National Accounts; results of that exercise are given in the February 1989 *Economic Trends* (CSO 1989). This article reports the refinements made to the model used in 1989, and the results of balancing the 1988-91 National Accounts.

Only current price data were used, as below the line data cannot in general be produced in constant prices. (In National Accounts usage, 'above the line' means current and capital transactions; 'below the line' means financial transactions.) However, some constant price information is implicit in the published value of GDP. Data for financial companies and institutions are split below the line into banks & building societies and OFIs. As this split is not available above the line, it was for simplicity ignored in the balancing model.

The balancing procedure yields a set of accounts which satisfies a set of constraints while minimising the total alteration (measured by a weighted sum of squares of the individual changes) to the published accounts. The main constraints are of course that the columns and most rows sum to zero. Some further constraints are described below. Tables similar to Table A are adjusted so that they satisfy all the constraints. The sum of the sector balancing items equals the difference between GDP estimated by summing the income and summing the expenditure components. Therefore, these two estimates must be equal after adjustment.

If the weights are correct, the balanced accounts are the minimum variance linear unbiased estimate of the "true" accounts (i.e. what the accounts would show if we could eliminate errors). If the errors are normally distributed, they are also the minimum variance unbiased estimate and the maximum likelihood estimate.

This does *not* mean that every item is made closer to its true value by balancing; some items may be moved away. However, there is a reduction in the total error, because we are bringing in the extra information that each item must satisfy one or more constraints.

This exercise should still be regarded as experimental. Its main aims are to identify the likely areas of weakness in the National Accounts, to help in interpreting them and to produce the reconciled accounts required by the Framework Document. However, it is not felt that the results of balancing should supersede the *Blue Book* data; for this reason the results have been constrained to retain the published value of GDP.

Balancing Model

The mathematical details of the model, the method of solution and the diagnostic tests are described in the Annex. This section outlines the inputs to the model, with particular attention to those aspects which have changed since the 1989 article.

Error ranges

To balance the accounts in the way chosen, we need the standard deviations of the errors of all items in Table A for 1988 to 1991. As a proxy for these, confidence intervals were used; the compilers of the series were asked to supply intervals such that they are 90% confident that the "true" values are within these intervals. These are based, inevitably, on compilers' judgements, but they allow for both the sampling error of any surveys used to obtain the figures, and all known sources of non-sampling error. Further details are given in the Annex.

For most items, the errors were thought to be symmetrical about the published value. Where they were not, that item was prior adjusted to set it to the mid-point of its confidence interval. The prior adjustments were all to gross trading profits:

	1988	*1989*	*1990*	*1991*
ICCs	+350	+350	—	—
Financial	+1650	+1650	+1650	+2850

The GDP constraint

To remove all inconsistencies, the sum of the components of GDP (on either the income or expenditure breakdown) must, after balancing, equal published GDP, which is not derived from the balancing process. As noted above, balancing makes the income and expenditure components of GDP sum to the same total. In all the results given below, GDP is constrained to the value published in the 1992 *Blue Book*. To achieve this, GDP was added as an extra variable, with a very small error margin; an extra constraint that the sum of the income components must equal GDP was added.

Published GDP for 1990 and 1991 uses information derived from income, expenditure and output. (For 1988 and 1989, only income and expenditure data were used.) Thus the GDP constraint brings in output data not in Table A. Ways to add this information to the balancing model more directly are being considered.

Two further constraints

In some cases, the sum of a number of items is known more accurately than any of them individually. This can be allowed for in the model by a similar method to the one above: add an extra variable equal to the required sum, with a suitably small error margin, and an extra constraint that the relevant items sum to the new variable. This has been done in two cases: bank profit and Central Government accruals. The latter constraint is used here for the first time.

Bank profit: Gross trading profits for banks appearing in these accounts are on a special definition peculiar to national accounts. The figures supplied by the banks are gross trading profits as given here plus dividend and interest receipts less interest payments. Thus the combination of these three items is known quite accurately. The dividend and interest components have to be estimated separately, so they, hence profits as published, have much bigger error ranges.

Central Government accruals: The sum of a number of items, less the accruals adjustment, equals total cash receipts by Central Government; this is known almost exactly.

Correlations

Another way to represent the fact that the sum of two items is known more accurately than either of them individually is to add a negative covariance between them to the covariance matrix described in the Annex. Again, this was not done in 1989. In the present analysis, for the personal, ICC and PC sectors a covariance representing a correlation of -0.235 is assumed between stock appreciation and value of physical increase in stocks (stock appreciation in other sectors is negligible).

In some cases, the sum of two items is known almost exactly. This occurs if the uncertainty in both of them is mainly due to an item which is added to one and subtracted from the other. In these cases, the two items are given equal error margins and a covariance equivalent to a correlation of -1. The pairs so treated were:

Personal: Other current transfers, receipts and
Overseas: Other current transfers, payments
Personal: Other current transfers, payments and
Overseas: Other current transfers, receipts
Personal/Banks: Deposits with other institutions
Personal/Banks: Other lending
ICC/Overseas: Deposits with other institutions
ICC/Overseas: Other lending

Probably, these correlations should not be exactly -1; however, altering them slightly has little effect.

It is probable that many more correlations exist. Work is continuing to identify them and include them in future balancing exercises.

Financial flows for the Overseas sector

Another constraint not used in 1989 relates financial flows and dividend and interest receipts for the overseas sector. As explained in the Annex, this constraint involves all four years together.

Results

Published data and balanced accounts for 1988 to 1991 are given in tables 1 to 4 and 5 to 8 respectively. These are in the same format as Table A in the *Blue Book* except that figures below the line for Banks and Building Societies and for OFIs are not shown separately.

With only four exceptions for 1988 and one for 1990 (shown below) all balanced data are within the confidence intervals of the unbalanced data. These five items do not necessarily have errors greater than the assumed ranges. They are merely symptoms of the incoherence of the overall accounts, though they probably indicate which sectors contribute most to the incoherence. As the confidence intervals are 90% ones, not 100% ones, it would be surprising if nothing went outside them; indeed, it might be expected that this would happen more often.

Diagnostic tests

A useful test of the error ranges and the coherence of the accounts is to see if the sector balancing items are larger than would be expected from the size of the ranges. This can be tested by using the Mahalanobis distance, which is explained further in the Annex.

Applying this test to the data gives the following diagnostic statistics. As an aid to interpretation, note that with the assumptions given in the Annex the expected value of each diagnostic is 7, and values greater than 18.5 occur by chance with only 1% probability. Thus, values greater than 18.5 imply that there is probably some incoherence in the accounts, and the greater the diagnostic the more the incoherence.

1988: 52.47
1989: 14.27
1990: 17.92
1991: 6.02

Items changed by more than their error ranges

Item	Blue Book	Balanced	Change	Range	Change + range
1988					
ICC: Gross trading profits	76244	73036	-3208	2500	-1.28
Financial: other overseas instruments	-88	-1841	-1753	1456	-1.20
Central Govt: Imputed charge for capital consumption	1303	927	-376	224	-1.68
Central Govt: Consumption	-55610	-55978	-368	224	-1.64
1990					
Central Govt: Consumption	-67052	-66771	281	273	+1.03

The figure for 1988 is very significantly large, and that for 1990 almost significant at 1%. However, the figures for 1989 and 1991 are not significant; indeed, that for 1991 is smaller than its expected value. The sum of the figures for 1989, 1990 and 1991 is 38.21, nearly significant at 1% (the 1% point for 21 degrees of freedom is 38.9). Note that for 1988, the year having by far the largest diagnostic, four balanced items moved outside the error margins. For 1990, with the second largest diagnostic, just one item went outside, and none did so for 1989 or 1991.

Table 14 gives a rough breakdown of these diagnostic statistics by sector. For 1988, financial institutions, CG and ICC are significant at 1%. For 1989, only the financial institution sector has a diagnostic significant at 1% (or even 10%). For 1990, CG is the largest; nothing else is significant at 5%. For 1991, nothing is significant at even 10%; thus, the 1991 data are extremely coherent. (Again, this is only valid given the assumptions in the Annex.)

Conclusions

This paper presents the fully reconciled accounts required by our Framework Document. It also tests the coherence of the published accounts. Clearly, for 1988 the sector balancing items are larger than would be expected from the error ranges, especially for the financial institutions, CG and ICC sectors. This is probably also true for 1990, mainly for CG, and maybe also for 1989, mainly for financial institutions.

References

CSO (1989) An investigation into balancing the UK national and financial accounts, 1985-7. *Economic Trends*, 424, February 1989, p.74-103.

STONE J R N, CHAMPERNOWNE D G and MEADE J E (1942) The precision of National Income accounting estimates. *Rev. Econ. Studies*, 9, p. 111-125.

ANNEX: Methodology

To use the balancing technique of Stone *et al.*, we need a covariance matrix for the errors of all the variables used. Variances were derived from error ranges (see below). Little information is available on correlations between errors of individual items; they are mostly assumed to be zero so the covariance matrix is nearly diagonal. However, the constraints imply correlations; if, for example, the sum of a number of items is assumed to be known almost exactly, this implies negative correlations among the items.

In matrix notation, the method is as follows: let **x** be the vector of published estimates, **V** the covariance matrix of **x** and **A** the matrix of constraints. There are 264 items per year in Table A (with the Bank & building society and OFI columns merged, and excluding items zero by definition, such as earnings from employment outside the personal sector). There are three further items (due to the GDP and two other constraints described above), giving 267 items, and 55 constraints per year.

Then **Ax** is the vector of sector balancing items to be balanced out. We seek a vector $\mathbf{x}^*$ such that the weighted total alteration

$$(\mathbf{x}^*-\mathbf{x})'\mathbf{V}^{-1}(\mathbf{x}^*-\mathbf{x})$$

is minimised subject to the constraint that all balancing items are zero:

$$\mathbf{A}\mathbf{x}^* = \mathbf{0}$$

It may be shown that the solution is

$$\mathbf{x}^* = \mathbf{x} - \mathbf{V}\mathbf{A}'(\mathbf{A}\mathbf{V}\mathbf{A}')^{-1}\mathbf{A}\mathbf{x}$$

Thus the balancing items **Ax** are spread over the whole of **x** in proportions determined by the variances and constraints. If there were just one constraint involving only 1s and -1s, and no correlations, the amount of adjustment received by an item would be proportional to its variance. The actual situation is quite complex, and different constraints may try to move an item in opposite directions, so it is not necessarily true that items with large variances are adjusted by large amounts.

The covariance matrix of $\mathbf{x}^*$ is

$$\mathbf{V}^* = \mathbf{V} - \mathbf{V}\mathbf{A}'(\mathbf{A}\mathbf{V}\mathbf{A}')^{-1}\mathbf{A}\mathbf{V}$$

It follows from this equation that the variance of every item is reduced by balancing, though the reduction may be minimal in many cases. This reduction occurs because we are bringing in the extra information that each item must satisfy one or more constraints.

Error ranges

Compilers were asked to give a 90% confidence interval for each item in the account. Half the width of a confidence interval is called the "error range". If compilers could not supply intervals, the ranges from the 1988 exercise, multiplied by the change in the GDP deflator, were used. If the errors have roughly the same distribution, the error ranges are proportional to the standard deviations of the errors; a constant factor cancels out when the balancing is done, so we need not convert these ranges to standard deviations. If the distributions are normal, the ranges are 1.645 times the standard deviations. The ranges are usually greater for the most recent data, reflecting the uncertainty of early estimates.

Some items are thought to be known almost exactly. Also, GDP is treated as if it were known exactly, to force consistency with published GDP. Putting in a zero error range would make **V**, hence possibly also **AVA'**, singular. These items are given an error range of 0.5, which is the implicit uncertainty due to the figures being rounded to the nearest unit. (Here, as throughout the article, the unit of measurement is £1 million.) It is found that items with this range do not change appreciably on balancing.

For some items in the personal sector column, all that is known is that they satisfy the constraint that the row must sum to zero. For example, payment from the personal sector of community charge is not measured, but is set equal to receipts by local authorities. This also applies to oil and gas royalties paid by ICCs. Similarly, the row totals (where they are not zero) are just found by summing the sector values. In these cases, the relevant items should be given infinite error ranges. In practice, they are set to 1,000,000; increasing this has little effect. (In 1989, a value of 1,000,000 was used for the row totals but not for items in the other columns.)

Financial flows for the Overseas sector

The accounts for the Overseas sector are constructed so that relationships exist between the dividend and interest receipts and payments above the line, the financial flows below the line and assumed rates of return. Balancing each year separately destroys these relationships. Further constraints are therefore needed to restore the relationships so that alterations to the financial flows in any year are matched by corresponding alterations to dividend and interest receipts and payments in the same and following years. (Similar constraints ought to apply to the other sectors, but due to the lower quality of financial balance sheet data for other sectors, it is not thought to be worth applying them.)

If **y** is the vector for all four years and **B** the above relationships, then the constraint is that after the second balance

$$\mathbf{B}\mathbf{y}^{**} = \mathbf{B}\mathbf{y}$$

As the right hand side is not zero, this has a slightly different solution from before, namely

$$\mathbf{y}^{**} = \mathbf{y}^* - \mathbf{V}\mathbf{B}'(\mathbf{B}\mathbf{V}\mathbf{B}')^{-1}\mathbf{B}(\mathbf{y}^*-\mathbf{y})$$

The constraints incorporate the rates of return as coefficients, so they are being treated as if known exactly. To allow for the uncertainty in these rates, dummy "slack" variables are added to **y** with error margins equivalent to a 1% uncertainty in the rates.

Partition and ripple back

The constraints in the previous section use data from all four years. With the computing resources available, it would be very difficult to balance all four years simultaneously. The following procedure was used to get round this problem: first, each year was balanced

separately. Then the nine variables directly involved in the relationships (dividend & interest receipts & payments and changes in holdings of sterling sight, sterling time and foreign currency deposits, bank lending, UK & overseas securities & unit trust units, other domestic instruments, other overseas instruments) were extracted from the $\mathbf{x}^*$ vector for each year, and their variances and covariances were extracted from the $\mathbf{V}^*$ matrix for that year.

These variables plus the two slack variables for each year (a total of 44) were balanced separately with their constraints. (Thus the four year balancing problem is partitioned into four separate annual balances and a relatively small inter-year balance.) For each year, the re-balanced variables were extracted. The change due to this second balance was then rippled back onto the data obtained from the first balance. This means that the changes to the variables not re-balanced consequent on the changes to the re-balanced variables were calculated from the covariances in $\mathbf{V}^*$.

The constraints may be formulated as follows: for 1988, let

I88 = Div & int receipts
c88 = financial flows on items that generate receipts
r88 = interest rate
s88 = slack to allow for uncertainties in interest rates

with a similar notation for other years. Then the following quantities are constrained to have the same value as they did before the individual years were balanced:

I88 - r88.c88/2 - s88
I89 - r89.c88 - r89.c89/2 - s89
I90 - r90.c88 - r90.c89 - r90.c90/2 - s90
I91 - r91.c88 - r91.c89 - r91.c90 - r91.c91/2 - s91

There are similar constraints for payments. In practice, different interest rates are assumed for different items.

Diagnostic tests

If the variances of all the items in the account were known, we could calculate the Mahalanobis distance

$$(\mathbf{Ax})'(\mathbf{AVA}')^{-1}(\mathbf{Ax})$$

This has a χ^2 distribution if we assume that the sector balancing items are purely due to random error of the amount given by the variances and all errors are normally distributed. The number of degrees of freedom equals the number of constraints not initially satisfied automatically by the data which, in this case, is the number of sector balancing items, namely 7. If we add the results for n years, since the results for each year are independent we get a diagnostic with a χ^2 distribution on $7n$ degrees of freedom.

If the errors are normally distributed, the standard deviations are the error ranges divided by 1.645. Thus we can find the Mahalanobis distance by assuming that the error ranges are the standard deviations, then multiplying the result by 1.645^2.

Note that this diagnostic is a measure of the coherence of the published data and can be computed without actually generating the balanced accounts.

If the distance is significantly large, compared to a χ^2 variable with 7 degrees of freedom, this may indicate one or more of the following:

a. Some or all of the error ranges were under-estimated;

b. The distribution of the errors is grossly non-normal;

c. There are unknown biases in the data (including, possibly, gross blunders; the detection of these is a major potential use of balancing methods);

d. There are unknown correlations in the data.

There is no easy way to distinguish between these. As the only unsatisfied constraints are those relating to the sector balances, we can say roughly how much each sector contributes to the total Mahalanobis distance, but not how much each item in the sector contributes.

The contribution to this diagnostic from each sector is roughly equal to the square of the ratio of the sector balancing item to its standard deviation; assuming normality, this quantity is distributed as a χ^2 with one degree of freedom. (The sum of the sector diagnostics is not exactly equal to the total diagnostic for the year, due to correlations between the sectors.)

To find out roughly how much each sector contributes, we proceed as follows: split the constraints matrix A into $\mathbf{A}_1$, all constraints except the column ones and $\mathbf{A}_2$, the column constraints. As all the constraints in $\mathbf{A}_1$ are initially satisfied, balancing on these constraints does not change $\mathbf{x}$, though $\mathbf{V}^*$ does not equal $\mathbf{V}$. Then the vector of sector balancing items is $\mathbf{A}_2\mathbf{x}$, with covariance matrix $\mathbf{A}_2\mathbf{V}\mathbf{A}_2'$. The diagonal of this matrix gives the error margins for the balancing items, which are divided by 1.645 to give estimates of the standard deviations. Table 17 gives the resultant diagnostic for each sector for all four years.

List of tables

Table 1
1988 data as published

£ million

	Personal sector	ICCs	Financial sector	Public corps	Central govt	Local auths	Overseas sector	TOTAL
CURRENT TRANSACTIONS								
Factor incomes:								
Income from employment	255625	0	0	0	0	0	0	255625
Income from self-employment	47612	0	0	0	0	0	0	47612
Gross trading profits, etc	0	76244	-12869	7354	-459	427	0	70697
Rent	21773	3776	509	552	152	3142	0	29904
Imputed charge for capital consumption	524	0	0	0	1303	1807	0	3634
less stock appreciation	-759	-5344	0	-242	0	0	0	-6345
Inter-sector transfers:								
Earnings on direct investment overseas	186	12529	1126	10	0	0	-13851	0
Earnings due abroad	-54	-7777	-834	0	0	0	8665	0
Dividends and interest:								
receipts	47238	6880	83782	1015	9170	915	43463	192463
payments	-30745	-29587	-64423	-2785	-17351	-4873	-42699	-192463
Taxes on income	-43820	-15502	-2423	-116	61861	0	0	0
Social security contributions	-32106	0	0	0	32106	0	0	0
Social security benefits	43056	0	0	0	-43517	0	461	0
Community charge	0	0	0	0	0	0	0	0
Other current grants by government:								
receipts	11031	0	0	0	2115	23452	4902	41500
payments	0	0	0	0	-34518	-4867	-2115	-41500
Other current transfers:								
receipts	1915	0	0	0	394	0	1985	4294
payments	-2347	-181	-51	0	0	0	-1715	-4294
Royalties and licence fees on oil and gas production	0	-823	0	0	823	0	0	0
Factor cost adjustment:								
Taxes on expenditure	0	0	0	0	57407	18726	0	76133
Subsidies	0	0	0	0	-4888	-1030	0	-5918
Expenditure:								
Consumption	-302057	0	0	0	-55610	-36119	0	-393786
Exports of goods and services	0	0	0	0	0	0	-107705	-107705
Imports of goods and services	0	0	0	0	0	0	124788	124788
Balance = **Saving**	17072	40215	4817	5788	8988	1580	16179	94639
CAPITAL TRANSACTIONS								
Gross domestic fixed capital format	-28745	-43499	-6488	-4619	-3709	-2797	0	-89857
Value of physical increase in stocks and work in progress	-599	-4489	0	-16	322	0	0	-4782
Taxes on capital	-3268	-626	-141	0	4035	0	0	0
Other capital transfers:								
receipts	2107	1019	0	953	20	1248	0	5347
payments	-85	-271	0	-148	-3993	-850	0	-5347
Balance = **Financial surplus or deficit**	-13518	-7651	-1812	1958	5663	-819	16179	0
FINANCIAL TRANSACTIONS								
Notes and coin	1190	-154	394	-3	-1476	0	49	0
Sterling treasury bills and government securities	-1794	-355	-2468	116	3697	28	776	0
National savings and tax instrument	1437	-324	-686	102	-531	2	0	0
Issue Departments transactions in commercial bills	0	-589	-40	0	435	0	194	0
Other government domestic transaction	-6	-59	-868	629	-768	1072	0	0
Government overseas transactions	0	0	-1771	0	3283	0	-1512	0
Local authority debt	-609	-65	-740	-34	4860	-3404	-8	0
Public corporations debt	-23	0	-540	109	716	47	-309	0
Deposits with banks:								
Sterling sight	8586	1757	-10804	106	358	-108	105	0
Sterling time	8007	3573	-27837	879	94	1748	13536	0
Foreign currency	255	446	-21059	2	-99	8	20447	0
Deposits with building societies	20238	-398	-20395	0	0	0	555	0
Bank lending (excluding public sector)	-13272	-30863	64019	0	0	0	-19884	0
Other lending	-40876	-2975	44082	-8	514	-483	-254	0
Trade and retail credit	-216	307	512	-380	3	0	-226	0
UK and overseas securities and unit trust units	-11569	9958	8947	-87	-6194	113	-1168	0
Other domestic instruments	21257	-9740	-20233	89	-800	-69	9496	0
Other overseas instruments	30	12656	-88	49	-246	0	-12401	0
Accruals adjustments	1809	63	-2570	-122	1049	-229	0	0
Total financial transactions	-5556	-16762	7855	1447	4895	-1275	9396	0
BALANCING ITEM	-7962	9111	-9667	511	768	456	6783	0

Table 2
1989 data as published

£ million

	Personal sector	ICCs	Financial sector	Public corps	Central govt	Local auths	Overseas sector	TOTAL
CURRENT TRANSACTIONS								
Factor incomes:								
Income from employment	282919	0	0	0	0	0	0	282919
Income from self-employment	54093	0	0	0	0	0	0	54093
Gross trading profits, etc	0	80988	-13846	6418	-323	522	0	73759
Rent	24802	4435	640	572	108	3238	0	33795
Imputed charge for capital consumption	557	0	0	0	1484	1964	0	4005
less stock appreciation	-809	-6542	0	-84	0	0	0	-7435
Inter-sector transfers:								
Earnings on direct investment overseas	123	16190	342	1	0	0	-16656	0
Earnings due abroad	-81	-8635	-522	0	0	0	9238	0
Dividends and interest:								
receipts	61281	9990	118428	1449	10036	1435	61256	263875
payments	-44316	-43442	-92376	-3028	-17985	-5394	-57334	-263875
Taxes on income	-48208	-19338	-2734	-120	70400	0	0	0
Social security contributions	-32902	0	0	0	32902	0	0	0
Social security benefits	44958	0	0	0	-45496	0	538	0
Community charge	-586	0	0	0	0	586	0	0
Other current grants by government:								
receipts	11835	0	0	0	2143	24200	5883	44061
payments	0	0	0	0	-36560	-5358	-2143	-44061
Other current transfers:								
receipts	2034	0	0	0	431	0	2050	4515
payments	-2441	-260	-64	0	0	0	-1750	-4515
Royalties and licence fees on oil and gas production	0	-556	0	0	556	0	0	0
Factor cost adjustment:								
Taxes on expenditure	0	0	0	0	60050	19913	0	79963
Subsidies	0	0	0	0	-4774	-1008	0	-5782
Expenditure:								
Consumption	-330532	0	0	0	-60527	-38502	0	-429561
Exports of goods and services	0	0	0	0	0	0	-122049	-122049
Imports of goods and services	0	0	0	0	0	0	142693	142693
Balance = **Saving**	22727	32830	9868	5208	12445	1596	21726	106400
CAPITAL TRANSACTIONS								
Gross domestic fixed capital format	-27993	-52347	-7827	-5513	-4951	-4631	0	-103262
Value of physical increase in stocks and work in progress	-429	-2665	0	-207	163	0	0	-3138
Taxes on capital	-3178	-767	-151	0	4096	0	0	0
Other capital transfers:								
receipts	2509	561	0	1453	24	2387	0	6934
payments	-90	-319	0	-148	-5503	-874	0	-6934
Balance = **Financial surplus or deficit**	-6454	-22707	1890	793	6274	-1522	21726	0
FINANCIAL TRANSACTIONS								
Notes and coin	826	67	320	-27	-1245	0	59	0
Sterling treasury bills and government securities	-2212	-140	-12418	-4	15391	13	-630	0
National savings and tax instrument	-1492	136	37	-78	1397	0	0	0
Issue Departments transactions in commercial bills	0	1996	1230	0	-3598	0	372	0
Other government domestic transactions	-49	-7	-608	6	-345	1003	0	0
Government overseas transactions	0	0	-63	0	-6615	0	6678	0
Local authority debt	60	29	-1186	-44	2589	-1385	-63	0
Public corporations debt	23	0	-209	607	1798	-84	-2135	0
Deposits with banks:								
Sterling sight	10981	2061	-15356	2	179	16	2117	0
Sterling time	10154	5280	-25441	-215	107	-169	10284	0
Foreign currency	365	3110	-35790	-42	-2	21	32338	0
Deposits with building societies	17580	1044	-20378	0	0	0	1754	0
Bank lending (excluding public sector)	-13475	-35946	78405	0	0	0	-28984	0
Other lending	-35352	-5697	40065	259	1081	-292	-64	0
Trade and retail credit	-47	-878	352	582	-8	0	-1	0
UK and overseas securities and unit trust units	-19776	10536	35651	-9	-4657	149	-21894	0
Other domestic instruments	27198	-12741	-44546	152	-289	-119	30345	0
Other overseas instruments	32	9936	914	62	-27	0	-10917	0
Accruals adjustments	3239	-394	-2974	6	217	-94	0	0
Total financial transactions	-1945	-21608	-1995	1257	5973	-941	19259	0
BALANCING ITEM	-4509	-1099	3885	-464	301	-581	2467	0

Table 3
1990 data as published

£ million

	Personal sector	ICCs	Financial sector	Public corps	Central govt	Local auths	Overseas sector	TOTAL
CURRENT TRANSACTIONS								
Factor incomes:								
Income from employment	311745	0	0	0	0	0	0	311745
Income from self-employment	59971	0	0	0	0	0	0	59971
Gross trading profits, etc	0	83095	-17507	4342	-545	557	0	69942
Rent	29586	4953	715	584	142	3383	0	39363
Imputed charge for capital consumption	585	0	0	0	1623	2183	0	4391
less stock appreciation	-683	-5498	0	-107	0	0	0	-6288
Inter-sector transfers:								
Earnings on direct investment overseas	159	15863	-124	1	0	0	-15899	0
Earnings due abroad	-109	-7637	736	0	0	0	7010	0
Dividends and interest:								
receipts	70642	12551	136108	1260	9699	1309	70231	301800
payments	-53197	-49412	-109949	-2375	-17877	-5552	-63438	-301800
Taxes on income	-55524	-19027	-2294	-176	77021	0	0	0
Social security contributions	-34651	0	0	0	34651	0	0	0
Social security benefits	48895	0	0	0	-49500	0	605	0
Community charge	-8629	0	0	0	0	8629	0	0
Other current grants by government:								
receipts	13107	0	0	0	2231	38333	6223	59894
payments	0	0	0	0	-51666	-5997	-2231	-59894
Other current transfers:								
receipts	2099	0	0	0	504	0	2100	4703
payments	-2569	-265	-69	0	0	0	-1800	-4703
Royalties and licence fees on oil and gas production	0	-654	0	0	654	0	0	0
Factor cost adjustment:								
Taxes on expenditure	0	0	0	0	71838	5129	0	76967
Subsidies	0	0	0	0	-5404	-665	0	-6069
Expenditure:								
Consumption	-350411	0	0	0	-67052	-42826	0	-460289
Exports of goods and services	0	0	0	0	0	0	-133500	-133500
Imports of goods and services	0	0	0	0	0	0	147728	147728
Balance = **Saving**	31016	33969	7616	3529	6319	4483	17029	103961
CAPITAL TRANSACTIONS								
Gross domestic fixed capital formation	-26758	-54863	-6763	-4985	-6415	-6244	0	-106028
Value of physical increase in stocks and work in progress	-84	1438	0	264	-156	0	0	1462
Taxes on capital	-3207	-673	-100	0	3980	0	0	0
Other capital transfers:								
receipts	3124	513	0	5952	0	2039	0	11628
payments	-92	-319	0	-134	-10219	-864	0	-11628
Balance = **Financial surplus or deficit**	3999	-19935	753	4626	-6491	-586	17029	-605
FINANCIAL TRANSACTIONS								
Notes and coin	-148	39	-21	229	-77	0	-22	0
Sterling treasury bills and government securities	-1023	866	-1371	-29	5181	-17	-3607	0
National savings and tax instrument	814	288	72	-79	-1096	1	0	0
Issue Departments transactions in commercial bills	0	-312	-199	0	705	0	-194	0
Other government domestic transactions	30	67	1567	211	-525	-1350	0	0
Government overseas transactions	0	0	130	0	20	0	-150	0
Local authority debt	-118	116	370	80	742	-1127	-63	0
Public corporations debt	-52	0	118	4419	-4304	-73	-108	0
Deposits with banks:								
Sterling sight	8540	1484	-12398	129	378	209	1658	0
Sterling time	7981	-520	-16856	-82	65	-1550	10962	0
Foreign currency	674	3986	-39712	33	24	3	34992	0
Deposits with building societies	17959	1880	-21146	0	0	0	1307	0
Bank lending (excluding public sector)	-8479	-19599	69124	0	0	0	-41046	0
Other lending	-33089	-3668	37218	-328	473	-252	-354	0
Trade and retail credit	-97	579	413	-264	-2	0	-629	0
UK and overseas securities and unit trust units	-8416	-5012	21291	-79	-4462	81	-3403	0
Other domestic instruments	25198	-11544	-27921	-4	125	-10	14156	0
Other overseas instruments	32	3675	-851	51	-499	0	-2408	0
Accruals adjustments	2724	-255	-2827	116	-2712	2954	0	0
Total financial transactions	12530	-27930	7001	4403	-5964	-1131	11091	0
BALANCING ITEM	-8531	7995	-6248	223	-527	545	5938	-605

Table 4
1991 data as published

£ million

	Personal sector	ICCs	Financial sector	Public corps	Central govt	Local auths	Overseas sector	TOTAL
CURRENT TRANSACTIONS								
Factor incomes:								
Income from employment	329808	0	0	0	0	0	0	329808
Income from self-employment	57507	0	0	0	0	0	0	57507
Gross trading profits, etc	0	80144	-19470	3119	-457	576	0	63912
Rent	34134	4919	711	607	122	3599	0	44092
Imputed charge for capital consumption	600	0	0	0	1650	2240	0	4490
less stock appreciation	-371	-2374	0	-80	0	0	0	-2825
Inter-sector transfers:								
Earnings on direct investment overseas	160	13623	-316	0	0	0	-13467	0
Earnings due abroad	-128	-6764	1043	0	0	0	5849	0
Dividends and interest:								
receipts	67526	11654	133147	865	9665	962	71491	295310
payments	-51197	-50465	-105976	-1722	-16340	-5409	-64201	-295310
Taxes on income	-57370	-15707	-1556	-472	75105	0	0	0
Social security contributions	-36643	0	0	0	36643	0	0	0
Social security benefits	57578	0	0	0	-58291	0	713	0
Community charge	-8162	0	0	0	0	8162	0	0
Other current grants by government:								
receipts	14189	0	0	0	4894	47730	5230	72043
payments	0	0	0	0	-59348	-7801	-4894	-72043
Other current transfers:								
receipts	2188	0	0	0	370	0	2200	4758
payments	-2544	-258	-56	0	0	0	-1900	-4758
Royalties and licence fees on oil and gas production	0	-581	0	0	581	0	0	0
Factor cost adjustment:								
Taxes on expenditure	0	0	0	0	82905	118	0	83023
Subsidies	0	0	0	0	-5298	-580	0	-5878
Expenditure:								
Consumption	-367853	0	0	0	-74442	-47457	0	-489752
Exports of goods and services	0	0	0	0	0	0	-135115	-135115
Imports of goods and services	0	0	0	0	0	0	140415	140415
Balance = **Saving**	39422	34191	7527	2317	-2241	2140	6321	89677
CAPITAL TRANSACTIONS								
Gross domestic fixed capital formation	-23479	-49683	-6179	-3928	-7042	-5131	0	-95442
Value of physical increase in stocks and work in progress	293	5169	0	-8	-151	0	0	5303
Taxes on capital	-2622	-574	-100	0	3296	0	0	0
Other capital transfers:								
receipts	3966	447	0	2528	0	2667	0	9608
payments	-16	-265	0	-137	-8106	-1084	0	-9608
Balance = **Financial surplus or deficit**	17564	-10715	1248	772	-14244	-1408	6321	-462
FINANCIAL TRANSACTIONS								
Notes and coin	420	37	-162	-111	-219	0	35	0
Sterling treasury bills and government securities	568	475	2017	-81	-7507	-6	4534	0
National savings and tax instrument	2160	-70	45	67	-2202	0	0	0
Issue Departments transactions in commercial bills	0	-950	-596	0	1774	0	-228	0
Other government domestic transactions	-33	15	-1122	192	-42	990	0	0
Government overseas transactions	0	0	-453	0	1032	0	-579	0
Local authority debt	103	-60	-204	-1	1069	-848	-59	0
Public corporations debt	-110	0	159	114	-115	1	-49	0
Deposits with banks:								
Sterling sight	5501	898	-5592	19	-427	-347	-52	0
Sterling time	581	4127	5502	657	-15	-1682	-9170	0
Foreign currency	6	-1217	16006	-75	65	17	-14802	0
Deposits with building societies	17345	1707	-20820	0	0	0	1768	0
Bank lending (excluding public sector)	-1961	1921	-32419	0	0	0	32459	0
Other lending	-26272	-773	27375	6	95	-228	-203	0
Trade and retail credit	-66	-160	-79	181	0	0	124	0
UK and overseas securities and unit trust units	-3651	-10897	46713	-18	-9019	-9	-23119	0
Other domestic instruments	26174	-10439	-40795	1	313	-1	24747	0
Other overseas instruments	32	2483	6968	42	632	0	-10157	0
Accruals adjustments	2410	-1295	-1608	-478	710	261	0	0
Total financial transactions	23207	-14198	935	515	-13856	-1852	5249	0
BALANCING ITEM	-5643	3483	313	257	-388	444	1072	-462

Table 5

Balanced 1988 accounts

£ million

	Personal sector	ICCs	Financial sector	Public corps	Central govt	Local auths	Overseas sector	TOTAL
CURRENT TRANSACTIONS								
Factor incomes:								
Income from employment	257324	0	0	0	0	0	0	257324
Income from self-employment	48113	0	0	0	0	0	0	48113
Gross trading profits, etc	0	73036	-11371	7354	-459	427	0	68987
Rent	21909	3716	512	552	152	3142	0	29983
Imputed charge for capital consumption	529	0	0	0	927	1713	0	3169
less stock appreciation	-752	-5432	0	-264	0	0	0	-6449
Inter-sector transfers:								
Earnings on direct investment overseas	188	12519	1226	10	0	0	-13943	-0
Earnings due abroad	-51	-7801	-746	0	0	0	8598	-0
Dividends and interest:								
receipts	48355	6780	83914	1008	9170	915	43608	193750
payments	-30661	-31012	-64395	-2785	-17351	-4873	-42673	-193750
Taxes on income	-43811	-15641	-2293	-116	61861	0	0	0
Social security contributions	-32103	0	0	0	32103	0	0	0
Social security benefits	43056	0	0	0	-43517	0	461	-0
Community charge	0	0	0	0	0	-0	0	0
Other current grants by government:								
receipts	11031	0	0	0	2115	23452	4902	41500
payments	0	0	0	0	-34518	-4867	-2115	-41500
Other current transfers:								
receipts	2042	0	0	0	394	0	1884	4320
payments	-2238	-181	-51	0	0	0	-1850	-4320
Royalties and licence fees on oil and gas production	0	-823	0	-0	823	0	0	0
Factor cost adjustment:								
Taxes on expenditure	0	0	0	0	57407	18726	0	76133
Subsidies	0	0	0	0	-4888	-1030	0	-5918
Expenditure:								
Consumption	-300406	0	0	0	-55978	-36208	0	-392592
Exports of goods and services	0	0	0	0	0	0	-108131	-108131
Imports of goods and services	0	0	0	0	0	0	124362	124362
Balance = **Saving**	22523	35161	6796	5759	8241	1396	15104	94981
CAPITAL TRANSACTIONS								
Gross domestic fixed capital formation	-28695	-43899	-6399	-4619	-3709	-2797	0	-90118
Value of physical increase in stocks and work in progress	-566	-4585	2	-36	322	0	0	-4863
Taxes on capital	-3268	-626	-141	-0	4035	0	0	0
Other capital transfers:								
receipts	2107	1019	0	953	20	1248	0	5347
payments	-85	-271	0	-148	-3993	-850	0	-5347
Balance = **Financial surplus or deficit**	-7983	-13201	259	1909	4916	-1003	15104	-0
FINANCIAL TRANSACTIONS								
Notes and coin	1184	-154	394	-3	-1476	0	55	-0
Sterling treasury bills and government securities	-1796	-71	-2764	116	3697	28	790	-0
National savings and tax instrument	1437	-324	-686	102	-531	2	0	0
Issue Departments transactions in commercial bills	0	-589	-40	0	435	0	194	0
Other government domestic transactions	-6	-59	-891	629	-768	1072	23	-0
Government overseas transactions	0	0	-1774	0	3283	0	-1509	0
Local authority debt	-609	-65	-740	-34	4860	-3404	-8	0
Public corporations debt	-23	0	-540	109	716	47	-309	0
Deposits with banks:								
Sterling sight	8569	1923	-11053	120	382	-102	161	0
Sterling time	7961	3573	-27837	879	94	1748	13582	0
Foreign currency	255	564	-21279	2	-99	8	20549	-0
Deposits with building societies	20244	-398	-20401	0	0	0	555	0
Bank lending (excluding public sector)	-13272	-30371	63031	0	0	0	-19388	0
Other lending	-40783	-2975	43989	-8	514	-483	-254	0
Trade and retail credit	-1904	1312	512	-278	3	194	162	0
UK and overseas securities and unit trust units	-13213	10182	7892	-87	-6194	113	1307	-0
Other domestic instruments	22395	-9727	-22904	89	-800	-69	11016	-0
Other overseas instruments	-84	13921	-1841	49	-246	0	-11799	-0
Accruals adjustments	1662	57	-2810	223	1046	-156	-22	0
Total financial transactions	-7983	-13201	259	1909	4916	-1003	15104	0
BALANCING ITEM	0	0	-0	-0	-0	0	-0	-0

Table 6

Balanced 1989 accounts

£ million

	Personal sector	ICCs	Financial sector	Public corps	Central govt	Local auths	Overseas sector	TOTAL
CURRENT TRANSACTIONS								
Factor incomes:								
Income from employment	282410	0	0	0	0	0	0	282410
Income from self-employment	53943	0	0	0	0	0	0	53943
Gross trading profits, etc	0	80227	-12296	6418	-323	522	0	74548
Rent	24761	4423	637	572	108	3238	0	33739
Imputed charge for capital consumption	555	0	0	0	1334	2058	0	3947
less stock appreciation	-815	-6570	0	-66	0	0	0	-7451
Inter-sector transfers:								
Earnings on direct investment overseas	124	16201	304	1	0	0	-16631	-0
Earnings due abroad	-79	-8616	-557	0	0	0	9252	-0
Dividends and interest:								
receipts	61162	9974	118504	1455	10036	1435	61487	264053
payments	-44325	-43664	-92360	-3028	-17985	-5394	-57297	-264053
Taxes on income	-48172	-19295	-2813	-120	70400	0	0	-0
Social security contributions	-32903	0	0	0	32903	0	0	0
Social security benefits	44958	0	0	0	-45496	0	538	-0
Community charge	-586	0	0	0	0	586	0	0
Other current grants by government:								
receipts	11835	0	0	0	2143	24200	5883	44061
payments	0	0	0	0	-36560	-5358	-2143	-44061
Other current transfers:								
receipts	2135	0	0	0	431	0	1967	4533
payments	-2348	-260	-64	0	0	0	-1861	-4533
Royalties and licence fees on oil and gas production	0	-556	0	0	556	0	0	0
Factor cost adjustment:								
Taxes on expenditure	0	0	0	0	60050	19913	0	79963
Subsidies	0	0	0	0	-4774	-1008	0	-5782
Expenditure:								
Consumption	-329892	0	0	0	-60670	-38388	0	-428949
Exports of goods and services	0	0	0	0	0	0	-122419	-122419
Imports of goods and services	0	0	0	0	0	0	142343	142343
Balance = **Saving**	22764	31865	11355	5232	12153	1804	21119	106292
CAPITAL TRANSACTIONS								
Gross domestic fixed capital formation	-27978	-52265	-7883	-5513	-4951	-4631	0	-103221
Value of physical increase in stocks and work in progress	-417	-2631	-2	-187	165	0	0	-3071
Taxes on capital	-3178	-767	-151	0	4096	0	0	0
Other capital transfers:								
receipts	2509	561	0	1453	24	2387	0	6934
payments	-90	-319	0	-148	-5503	-874	0	-6934
Balance = **Financial surplus or deficit**	-6390	-23555	3320	837	5984	-1314	21119	-0
FINANCIAL TRANSACTIONS								
Notes and coin	823	67	320	-27	-1245	0	62	-0
Sterling treasury bills and government securities	-2219	-286	-12263	-4	15391	13	-632	0
National savings and tax instrument	-1492	136	37	-78	1397	-0	0	-0
Issue Departments transactions in commercial bills	0	1996	1230	0	-3598	0	372	0
Other government domestic transactions	-49	-7	-599	6	-345	1003	-9	0
Government overseas transactions	0	0	-62	0	-6615	0	6677	0
Local authority debt	60	29	-1186	-44	2589	-1385	-63	-0
Public corporations debt	23	0	-209	607	1798	-84	-2135	-0
Deposits with banks:								
Sterling sight	10928	1990	-15205	-12	187	9	2102	0
Sterling time	10134	5280	-25441	-215	107	-169	10304	-0
Foreign currency	365	3045	-35680	-42	-2	21	32292	0
Deposits with building societies	17573	1044	-20371	0	0	0	1754	0
Bank lending (excluding public sector)	-13547	-36203	78911	0	0	0	-29160	0
Other lending	-35472	-5697	40185	259	1081	-292	-64	-0
Trade and retail credit	-585	-1354	352	477	-8	-277	1396	-0
UK and overseas securities and unit trust units	-21496	10496	36501	-9	-4657	149	-20983	-0
Other domestic instruments	25270	-12746	-42151	152	-289	-119	29883	0
Other overseas instruments	-37	9023	1713	62	-27	0	-10734	0
Accruals adjustments	3332	-369	-2761	-295	220	-183	56	-0
Total financial transactions	-6390	-23555	3320	837	5984	-1314	21119	0
BALANCING ITEM	-0	0	-0	-0	-0	-0	0	-0

Table 7

Balanced 1990 accounts

£ million

	Personal sector	ICCs	Financial sector	Public corps	Central govt	Local auths	Overseas sector	TOTAL
CURRENT TRANSACTIONS								
Factor incomes:								
Income from employment	313353	0	0	0	0	0	0	313353
Income from self-employment	60736	0	0	0	0	0	0	60736
Gross trading profits, etc	0	78686	-15689	4330	-545	557	0	67339
Rent	29793	4921	717	584	142	3383	0	39540
Imputed charge for capital consumption	589	0	0	0	1855	2086	0	4530
less stock appreciation	-671	-5538	0	-116	0	0	0	-6324
Inter-sector transfers:								
Earnings on direct investment overseas	160	15860	-75	1	0	0	-15947	0
Earnings due abroad	-106	-7646	779	0	0	0	6973	-0
Dividends and interest:								
receipts	71197	12493	136017	1257	9699	1309	70576	302548
payments	-53162	-50236	-109969	-2375	-17877	-5552	-63377	-302548
Taxes on income	-55509	-19084	-2250	-176	77020	0	0	0
Social security contributions	-34649	0	0	0	34649	0	0	0
Social security benefits	48895	0	0	0	-49500	0	605	-0
Community charge	-8629	0	0	0	0	8629	0	0
Other current grants by government:								
receipts	13107	0	0	0	2231	38333	6223	59894
payments	0	0	0	0	-51666	-5997	-2231	-59894
Other current transfers:								
receipts	2193	0	0	0	504	0	2024	4721
payments	-2485	-265	-69	0	0	0	-1902	-4721
Royalties and licence fees on oil and gas production	0	-654	0	-0	654	0	0	0
Factor cost adjustment:								
Taxes on expenditure	0	0	0	0	71838	5129	0	76967
Subsidies	0	0	0	0	-5404	-665	0	-6069
Expenditure:								
Consumption	-349051	0	0	0	-66771	-42930	0	-458752
Exports of goods and services	0	0	0	0	0	0	-133846	-133846
Imports of goods and services	0	0	0	0	0	0	147396	147396
Balance = **Saving**	35762	28538	9461	3505	6828	4282	16495	104870
CAPITAL TRANSACTIONS								
Gross domestic fixed capital formation	-26709	-55216	-6683	-4985	-6415	-6244	0	-106252
Value of physical increase in stocks and work in progress	-64	1346	1	255	-156	0	0	1382
Taxes on capital	-3207	-673	-100	-0	3980	0	0	0
Other capital transfers:								
receipts	3124	513	0	5952	0	2039	0	11628
payments	-92	-319	0	-134	-10219	-864	0	-11628
Balance = **Financial surplus or deficit**	8814	-25810	2678	4593	-5983	-787	16495	-0
FINANCIAL TRANSACTIONS								
Notes and coin	-152	39	-21	229	-77	0	-18	-0
Sterling treasury bills and government securities	-1040	1024	-1525	-29	5181	-17	-3594	-0
National savings and tax instrument	814	288	72	-79	-1096	1	0	-0
Issue Departments transactions in commercial bills	0	-312	-199	0	705	0	-194	-0
Other government domestic transactions	30	67	1556	211	-525	-1350	11	0
Government overseas transactions	0	0	119	0	20	0	-139	-0
Local authority debt	-118	116	370	80	742	-1127	-63	-0
Public corporations debt	-52	0	118	4419	-4304	-73	-108	-0
Deposits with banks:								
Sterling sight	8511	1724	-12640	139	364	217	1686	-0
Sterling time	7955	-520	-16856	-82	65	-1550	10988	0
Foreign currency	674	4036	-39817	33	24	3	35046	0
Deposits with building societies	17961	1880	-21148	0	0	0	1307	0
Bank lending (excluding public sector)	-8492	-19381	68654	0	0	0	-40781	0
Other lending	-33078	-3668	37209	-328	473	-252	-355	0
Trade and retail credit	-1375	1107	413	-221	-2	227	-148	0
UK and overseas securities and unit trust units	-10858	-4652	20568	-79	-4462	81	-598	-0
Other domestic instruments	25434	-11527	-29317	-4	125	-10	15299	-0
Other overseas instruments	-39	4227	-1934	51	-499	0	-1806	0
Accruals adjustments	2640	-259	-2943	253	-2716	3063	-38	0
Total financial transactions	8814	-25810	2678	4593	-5983	-787	16495	-0
BALANCING ITEM	-0	0	0	0	0	-0	-0	-0

Table 8

Balanced 1991 accounts

£ million

	Personal sector	ICCs	Financial sector	Public corps	Central govt	Local auths	Overseas sector	TOTAL
CURRENT TRANSACTIONS								
Factor incomes:								
Income from employment	329917	0	0	0	0	0	0	329917
Income from self-employment	57557	0	0	0	0	0	0	57557
Gross trading profits, etc	0	77061	-16661	3054	-457	576	0	63573
Rent	34146	4872	709	607	122	3592	0	44048
Imputed charge for capital consumption	600	0	0	0	1764	2167	0	4532
less stock appreciation	-374	-2441	0	-98	0	0	0	-2913
Inter-sector transfers:								
Earnings on direct investment overseas	161	13640	-330	-0	0	0	-13471	-0
Earnings due abroad	-125	-6754	1029	0	0	0	5849	-0
Dividends and interest:								
receipts	67575	11623	133119	862	9665	962	71926	295732
payments	-51190	-50958	-105981	-1722	-16340	-5409	-64132	-295732
Taxes on income	-57336	-15707	-1586	-472	75101	0	0	-0
Social security contributions	-36638	0	0	0	36638	0	0	0
Social security benefits	57578	0	0	0	-58291	0	713	-0
Community charge	-8162	0	0	0	0	8162	0	0
Other current grants by government:								
receipts	14189	0	0	0	4894	47730	5230	72043
payments	0	0	0	0	-59348	-7801	-4894	-72043
Other current transfers:								
receipts	2224	0	0	0	370	0	2171	4765
payments	-2512	-258	-56	0	0	0	-1939	-4765
Royalties and licence fees on oil and gas production	0	-581	0	-0	581	0	0	0
Factor cost adjustment:								
Taxes on expenditure	0	0	0	0	82902	118	0	83020
Subsidies	0	0	0	0	-5299	-583	0	-5882
Expenditure:								
Consumption	-366921	0	0	0	-74176	-47529	0	-488626
Exports of goods and services	0	0	0	0	0	0	-135249	-135249
Imports of goods and services	0	0	0	0	0	0	140285	140285
Balance = **Saving**	40689	30497	10243	2231	-1874	1985	6490	90262
CAPITAL TRANSACTIONS								
Gross domestic fixed capital formation	-23420	-49739	-6255	-3930	-7042	-5174	0	-95560
Value of physical increase in stocks and work in progress	314	5163	-1	-24	-154	0	0	5298
Taxes on capital	-2621	-575	-100	-0	3296	0	0	0
Other capital transfers:								
receipts	3966	447	0	2528	0	2667	0	9608
payments	-16	-265	0	-137	-8106	-1084	0	-9608
Balance = **Financial surplus or deficit**	18912	-14472	3887	668	-13880	-1606	6490	-0
FINANCIAL TRANSACTIONS								
Notes and coin	415	40	-162	-111	-219	0	37	-0
Sterling treasury bills and government securities	538	443	2081	-81	-7507	-6	4532	-0
National savings and tax instrument	2160	-70	45	67	-2202	0	0	-0
Issue Departments transactions in commercial bills	0	-950	-596	0	1774	0	-228	-0
Other government domestic transactions	-33	15	-1119	192	-42	990	-3	0
Government overseas transactions	0	0	-446	0	1032	0	-586	0
Local authority debt	103	-60	-204	-1	1069	-848	-59	-0
Public corporations debt	-110	0	159	114	-115	1	-49	-0
Deposits with banks:								
Sterling sight	5420	869	-5495	34	-435	-337	-57	-0
Sterling time	569	4127	5502	657	-15	-1682	-9158	-0
Foreign currency	6	-1238	16067	-75	65	17	-14842	0
Deposits with building societies	17332	1707	-20807	0	0	0	1768	0
Bank lending (excluding public sector)	-2013	1847	-32239	0	0	0	32406	-0
Other lending	-26351	-773	27454	6	95	-228	-203	0
Trade and retail credit	-674	-99	-79	218	-0	168	467	-0
UK and overseas securities and unit trust units	-6082	-10756	47564	-18	-9019	-9	-21680	0
Other domestic instruments	25298	-10444	-39606	1	313	-1	24440	0
Other overseas instruments	-10	2177	7392	42	632	0	-10233	0
Accruals adjustments	2344	-1306	-1623	-377	694	330	-62	-0
Total financial transactions	18912	-14472	3887	668	-13880	-1606	6490	0
BALANCING ITEM	0	-0	-0	-0	-0	-0	-0	-0

Table 9

Error ranges for 1988

£ million

	Personal sector	ICCs	Financial sector	Public corps	Central govt	Local auths	Overseas sector	TOTAL
CURRENT TRANSACTIONS								
Factor incomes:								
Income from employment	3093	0	0	0	0	0	0	1000000
Income from self-employment	1680	0	0	0	0	0	0	1000000
Gross trading profits, etc	0	note 1	note 2	0.5	0.5	0.5	0	1000000
Rent	874	370	67	0.5	0.5	0.5	0	1000000
Imputed charge for capital consumption	168	0	0	0	224	280	0	1000000
less stock appreciation	280	504	0	112	0	0	0	1000000
Inter-sector transfers:								
Earnings on direct investment overseas	60	224	336	0.5	0	0	1800	-
Earnings due abroad	90	280	336	0	0	0	700	-
Dividends and interest:								
receipts	2240	504	2240	56	0.5	0.5	1344	-
payments	616	1904	1030	0.5	0.5	0.5	4000	-
Taxes on income	392	500	500	0.5	0.5	0	0	-
Social security contributions	1000000	0	0	0	90	0	0	-
Social security benefits	1000000	0	0	0	0.5	0	0.5	-
Community charge	1000000	0	0	0	0	0.5	0	-
Other current grants by government:								
receipts	1000000	0	0	0	0.5	0.5	0.5	-
payments	0	0	0	0	0.5	0.5	0.5	-
Other current transfers:								
receipts	550	0	0	0	0.5	0	475	-
payments	475	0.5	0.5	0	0	0	550	-
Royalties and licence fees on oil and gas production	0	1000000	0	0.5	0.5	0	0	-
Factor cost adjustment:								
Taxes on expenditure	0	0	0	0	0.5	0.5	0	1000000
Subsidies	0	0	0	0	0.5	0.5	0	1000000
Expenditure:								
Consumption	2250	0	0	0	224	291	0	1000000
Exports of goods and services	0	0	0	0	0	0	1850	1000000
Imports of goods and services	0	0	0	0	0	0	1850	1000000
Balance = **Saving**	-	-	-	-	-	-	-	-
CAPITAL TRANSACTIONS								
Gross domestic fixed capital formation	392	1176	336	0.5	0.5	0.5	0	1000000
Value of physical increase in stocks and work in progress	336	672	56	112	112	0	0	1000000
Taxes on capital	1000000	0.5	0.5	0.5	0.5	0	0	-
Other capital transfers:								
receipts	112	0.5	0	0.5	0.5	0.5	0	-
payments	0.5	20	0	0.5	0.5	0.5	0	-
Balance = **Financial surplus or deficit**	-	-	-	-	-	-	-	-
FINANCIAL TRANSACTIONS								
Notes and coin	1000000	0.5	0.5	0.5	0.5	0	112	-
Sterling treasury bills and government securities	157	739	728	0.5	0.5	0.5	200	-
National savings and tax instrument	0.5	0.5	0.5	0.5	0.5	0.5	0	-
Issue Departments transactions in commercial bills	0	0.5	0.5	0	0.5	0	0.5	-
Other government domestic transactions	0.5	0.5	224	0.5	0.5	0.5	224	-
Government overseas transactions	0	0	56	0	0.5	0	170	-
Local authority debt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-
Public corporations debt	0.5	0	0.5	0.5	0.5	0.5	0.5	-
Deposits with banks:								
Sterling sight	448	560	672	78	56	67	450	-
Sterling time	500	0.5	0.5	0.5	0.5	0.5	500	-
Foreign currency	0.5	560	560	0.5	0.5	0.5	900	-
Deposits with building societies	112	56	112	0	0	0	56	-
Bank lending (excluding public sector)	448	896	1456	0	0	0	1120	-
Other lending	448	22	448	0.5	0.5	0.5	22	-
Trade and retail credit	2016	2240	0.5	224	0.5	448	3360	-
UK and overseas securities and unit trust units	3696	672	1344	0.5	0.5	0.5	3000	-
Other domestic instruments	2240	123	3360	0.5	0.5	0.5	1600	-
Other overseas instruments	560	2240	1456	0.5	0.5	0	3100	-
Accruals adjustments	448	224	448	448	90	336	280	-
Total financial transactions	-	-	-	-	-	-	-	-
BALANCING ITEM	-	-	-	-	-	-	-	-

1 -2500 to 3200; average 2850; prior adjustment +350

2 -1200 to 4500; average 2850; prior adjustment +1650

Table 10

Error ranges for 1989

£ million

	Personal sector	ICCs	Financial sector	Public corps	Central govt	Local auths	Overseas sector	TOTAL
CURRENT TRANSACTIONS								
Factor incomes:								
Income from employment	3314	0	0	0	0	0	0	1000000
Income from self-employment	1800	0	0	0	0	0	0	1000000
Gross trading profits, etc	0	note 1	note 2	0.5	0.5	0.5	0	1000000
Rent	936	396	72	0.5	0.5	0.5	0	1000000
Imputed charge for capital consumption	180	0	0	0	240	300	0	1000000
less stock appreciation	300	540	0	120	0	0	0	1000000
Inter-sector transfers:								
Earnings on direct investment overseas	60	240	360	0.5	0	0	1900	-
Earnings due abroad	100	300	360	0	0	0	750	-
Dividends and interest:								
receipts	2400	540	2400	60	0.5	0.5	1440	-
payments	660	2040	1104	0.5	0.5	0.5	4200	-
Taxes on income	420	500	500	0.5	0.5	0	0	-
Social security contributions	1000000	0	0	0	96	0	0	-
Social security benefits	1000000	0	0	0	0.5	0	0.5	-
Community charge	1000000	0	0	0	0	0.5	0	-
Other current grants by government:								
receipts	1000000	0	0	0	0.5	0.5	0.5	-
payments	0	0	0	0	0.5	0.5	0.5	-
Other current transfers:								
receipts	550	0	0	0	0.5	0	475	-
payments	475	0.5	0.5	0	0	0	550	-
Royalties and licence fees on oil and gas production	0	1000000	0	0.5	0.5	0	0	-
Factor cost adjustment:								
Taxes on expenditure	0	0	0	0	0.5	0.5	0	1000000
Subsidies	0	0	0	0	0.5	0.5	0	1000000
Expenditure:								
Consumption	2750	0	0	0	240	312	0	1000000
Exports of goods and services	0	0	0	0	0	0	1900	1000000
Imports of goods and services	0	0	0	0	0	0	1900	1000000
Balance = **Saving**	-	-	-	-	-	-	-	-
CAPITAL TRANSACTIONS								
Gross domestic fixed capital formation	420	1260	360	0.5	0.5	0.5	0	1000000
Value of physical increase in stocks and work in progress	360	720	60	120	120	0	0	1000000
Taxes on capital	1000000	0.5	0.5	0.5	0.5	0	0	-
Other capital transfers:								
receipts	120	0.5	0	0.5	0.5	0.5	0	-
payments	0.5	20	0	0.5	0.5	0.5	0	-
Balance = **Financial surplus or deficit**	-	-	-	-	-	-	-	-
FINANCIAL TRANSACTIONS								
Notes and coin	1000000	0.5	0.5	0.5	0.5	0	120	-
Sterling treasury bills and government securities	168	792	780	0.5	0.5	0.5	220	-
National savings and tax instrument	0.5	0.5	0.5	0.5	0.5	0.5	0	-
Issue Departments transactions in commercial bills	0	0.5	0.5	0	0.5	0	0.5	-
Other government domestic transactions	0.5	0.5	240	0.5	0.5	0.5	240	-
Government overseas transactions	0	0	60	0	0.5	0	180	-
Local authority debt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-
Public corporations debt	0.5	0	0.5	0.5	0.5	0.5	0.5	-
Deposits with banks:								
Sterling sight	480	600	720	84	60	72	480	-
Sterling time	500	0.5	0.5	0.5	0.5	0.5	500	-
Foreign currency	0.5	600	600	0.5	0.5	0.5	960	-
Deposits with building societies	120	60	120	0	0	0	60	-
Bank lending (excluding public sector)	480	960	1560	0	0	0	1200	-
Other lending	480	24	480	0.5	0.5	0.5	24	-
Trade and retail credit	2160	2400	0.5	240	0.5	480	3600	-
UK and overseas securities and unit trust units	3960	720	1440	0.5	0.5	0.5	3500	-
Other domestic instruments	2400	132	3600	0.5	0.5	0.5	1700	-
Other overseas instruments	600	2400	1560	0.5	0.5	0	3300	-
Accruals adjustments	480	240	480	480	96	360	300	-
Total financial transactions	-	-	-	-	-	-	-	-
BALANCING ITEM	-	-	-	-	-	-	-	-

1 -3400 to 4100; average 3750; prior adjustment +350

2 -1200 to 4500; average 2850; prior adjustment +1650

Table 11

Error ranges for 1990

£ million

	Personal sector	ICCs	Financial sector	Public corps	Central govt	Local auths	Overseas sector	TOTAL
CURRENT TRANSACTIONS								
Factor incomes:								
Income from employment	3596	0	0	0	0	0	0	1000000
Income from self-employment	2480	0	0	0	0	0	0	1000000
Gross trading profits, etc	0	5400	note 1	124	0.5	0.5	0	1000000
Rent	1290	459	87	0.5	0.5	0.5	0	1000000
Imputed charge for capital consumption	186	0	0	0	248	310	0	1000000
less stock appreciation	372	620	0	124	0	0	0	1000000
Inter-sector transfers:								
Earnings on direct investment overseas	70	248	372	0.5	0	0	2000	-
Earnings due abroad	130	310	372	0	0	0	800	-
Dividends and interest:								
receipts	2480	558	2604	62	0.5	0.5	1736	-
payments	620	2108	1228	0.5	0.5	0.5	4200	-
Taxes on income	558	500	500	0.5	100	0	0	-
Social security contributions	1000000	0	0	0	124	0	0	-
Social security benefits	1000000	0	0	0	0.5	0	0.5	-
Community charge	1000000	0	0	0	0	0.5	0	-
Other current grants by government:								
receipts	1000000	0	0	0	0.5	0.5	0.5	-
payments	0	0	0	0	0.5	0.5	0.5	-
Other current transfers:								
receipts	550	0	0	0	0.5	0	475	-
payments	475	0.5	0.5	0	0	0	550	-
Royalties and licence fees on oil and gas production	0	1000000	0	0.5	0.5	0	0	-
Factor cost adjustment:								
Taxes on expenditure	0	0	0	0	100	0.5	0	1000000
Subsidies	0	0	0	0	50	0.5	0	1000000
Expenditure:								
Consumption	3250	0	0	0	273	322	0	1000000
Exports of goods and services	0	0	0	0	0	0	1950	1000000
Imports of goods and services	0	0	0	0	0	0	1950	1000000
Balance = **Saving**	-	-	-	-	-	-	-	-
CAPITAL TRANSACTIONS								
Gross domestic fixed capital formation	620	1550	558	0.5	0.5	0.5	0	1000000
Value of physical increase in stocks and work in progress	434	868	62	124	124	0	0	1000000
Taxes on capital	1000000	0.5	0.5	0.5	0.5	0	0	-
Other capital transfers:								
receipts	124	0.5	0	0.5	0.5	0.5	0	-
payments	0.5	20	0	0.5	0.5	0.5	0	-
Balance = **Financial surplus or deficit**	-	-	-	-	-	-	-	-
FINANCIAL TRANSACTIONS								
Notes and coin	1000000	0.5	0.5	0.5	0.5	0	124	-
Sterling treasury bills and government securities	471	893	868	0.5	0.5	0.5	280	-
National savings and tax instrument	0.5	0.5	0.5	0.5	0.5	0.5	0	-
Issue Departments transactions in commercial bills	0	0.5	0.5	0	0.5	0	0.5	-
Other government domestic transactions	0.5	0.5	248	0.5	0.5	0.5	248	-
Government overseas transactions	0	0	248	0	0.5	0	250	-
Local authority debt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-
Public corporations debt	0.5	0	0.5	0.5	0.5	0.5	0.5	-
Deposits with banks:								
Sterling sight	496	1240	992	112	62	87	560	-
Sterling time	500	0.5	0.5	0.5	0.5	0.5	500	-
Foreign currency	0.5	620	620	0.5	0.5	0.5	920	-
Deposits with building societies	124	62	124	0	0	0	62	-
Bank lending (excluding public sector)	496	992	1612	0	0	0	1240	-
Other lending	558	50	496	0.5	0.5	0.5	50	-
Trade and retail credit	2480	2790	0.5	248	0.5	496	3720	-
UK and overseas securities and unit trust units	5456	1364	1860	0.5	0.5	0.5	4500	-
Other domestic instruments	2480	236	3968	0.5	0.5	0.5	2100	-
Other overseas instruments	620	2480	1860	0.5	0.5	0	3500	-
Accruals adjustments	496	248	496	496	150	372	620	-
Total financial transactions	-	-	-	-	-	-	-	-
BALANCING ITEM	-	-	-	-	-	-	-	-

1 -1200 to 4500; average 2850; prior adjustment +1650

Table 12

Error ranges for 1991

£ million

	Personal sector	ICCs	Financial sector	Public corps	Central govt	Local auths	Overseas sector	TOTAL
CURRENT TRANSACTIONS								
Factor incomes:								
Income from employment	4588	0	0	0	0	0	0	1000000
Income from self-employment	3100	0	0	0	0	0	0	1000000
Gross trading profits, etc	0	6100	note 1	310	0.5	0.5	0	1000000
Rent	1550	756	99	0.5	0.5	99	0	1000000
Imputed charge for capital consumption	186	0	0	0	248	310	0	1000000
less stock appreciation	434	930	0	186	0	0	0	1000000
Inter-sector transfers:								
Earnings on direct investment overseas	70	992	372	0.5	0	0	2100	-
Earnings due abroad	180	713	372	0	0	0	850	-
Dividends and interest:								
receipts	2480	620	3472	62	0.5	0.5	1860	-
payments	942	2480	1488	0.5	0.5	0.5	4200	-
Taxes on income	620	500	500	0.5	248	0	0	-
Social security contributions	1000000	0	0	0	186	0	0	-
Social security benefits	1000000	0	0	0	0.5	0	0.5	-
Community charge	1000000	0	0	0	0	0.5	0	-
Other current grants by government:								
receipts	1000000	0	0	0	0.5	0.5	0.5	-
payments	0	0	0	0	0.5	0.5	0.5	-
Other current transfers:								
receipts	550	0	0	0	0.5	0	475	-
payments	475	0.5	0.5	0	0	0	550	-
Royalties and licence fees on oil and gas production	0	1000000	0	0.5	0.5	0	0	-
Factor cost adjustment:								
Taxes on expenditure	0	0	0	0	186	0.5	0	1000000
Subsidies	0	0	0	0	100	62	0	1000000
Expenditure:								
Consumption	3700	0	0	0	372	322	0	1000000
Exports of goods and services	0	0	0	0	0	0	2000	1000000
Imports of goods and services	0	0	0	0	0	0	2000	1000000
Balance = **Saving**	-	-	-	-	-	-	-	-
CAPITAL TRANSACTIONS								
Gross domestic fixed capital formation	930	1674	744	62	0.5	248	0	1000000
Value of physical increase in stocks and work in progress	558	1178	62	186	186	0	0	1000000
Taxes on capital	1000000	100	0.5	0.5	0.5	0	0	-
Other capital transfers:								
receipts	124	0.5	0	0.5	0.5	0.5	0	-
payments	0.5	20	0	0.5	0.5	0.5	0	-
Balance = **Financial surplus or deficit**	-	-	-	-	-	-	-	-
FINANCIAL TRANSACTIONS								
Notes and coin	1000000	198	0.5	0.5	0.5	0	124	-
Sterling treasury bills and government securities	496	980	868	0.5	0.5	0.5	350	-
National savings and tax instrument	0.5	0.5	0.5	0.5	0.5	0.5	0	-
Issue Departments transactions in commercial bills	0	0.5	0.5	0	0.5	0	0.5	-
Other government domestic transactions	0.5	0.5	248	0.5	0.5	0.5	248	-
Government overseas transactions	0	0	496	0	0.5	0	300	-
Local authority debt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-
Public corporations debt	0.5	0	0.5	0.5	0.5	0.5	0.5	-
Deposits with banks:								
Sterling sight	868	1240	992	161	62	124	650	-
Sterling time	500	0.5	0.5	0.5	0.5	0.5	500	-
Foreign currency	0.5	620	992	0.5	0.5	0.5	920	-
Deposits with building societies	248	62	248	0	0	0	62	-
Bank lending (excluding public sector)	620	1240	1612	0	0	0	1240	-
Other lending	620	81	620	0.5	0.5	0.5	62	-
Trade and retail credit	2728	3100	0.5	248	0.5	496	3720	-
UK and overseas securities and unit trust units	6820	1984	2356	0.5	0.5	0.5	5500	-
Other domestic instruments	2480	310	4340	0.5	0.5	0.5	2700	-
Other overseas instruments	620	3720	2108	0.5	0.5	0	3700	-
Accruals adjustments	496	248	496	496	375	372	620	-
Total financial transactions	-	-	-	-	-	-	-	-
BALANCING ITEM	-	-	-	-	-	-	-	-

1 0 to 5700; average 2850; prior adjustment +2850

Table 13
Main changes due to balancing

	Change on balance				Error ranges				Change/error range			
	88	89	90	91	88	89	90	91	88	89	90	91
PERSONAL SECTOR												
Income from employment	1699	-509	1608	109	3093	3314	3596	4588	0.55	-0.15	0.45	0.02
Consumption	1651	640	1360	932	2250	2750	3250	3700	0.73	0.23	0.42	0.25
Trade and retail credit	-1688	-538	-1278	-608	2016	2160	2480	2728	-0.84	-0.25	-0.52	-0.22
Other domestic instruments	1138	-1928	236	-876	2240	2400	2480	2480	0.51	-0.80	0.10	-0.35
INDUSTRIAL AND COMMERCIAL COMPANIES												
Gross trading profits, etc	-3208	-761	-4409	-3083	2500	3400	5400	6100	-1.28	-0.22	-0.82	-0.51
Dividend & interest payments	-1425	-222	-824	-493	1904	2040	2108	2480	-0.75	-0.11	-0.39	-0.20
Bank lending (excl public sector)	492	-257	218	-74	896	960	992	1240	0.55	-0.27	0.22	-0.06
Other overseas instruments	1265	-913	552	-306	2240	2400	2480	3720	0.56	-0.38	0.22	-0.08
FINANCIAL SECTOR												
Bank lending (excl public sector)	-988	506	-470	180	1456	1560	1612	1612	-0.68	0.32	-0.29	0.11
UK & overseas securities & unit trust units	-1055	850	-723	851	1344	1440	1860	2356	-0.78	0.59	-0.39	0.36
Other domestic instruments	-2671	2395	-1396	1189	3360	3600	3968	4340	-0.80	0.67	-0.35	0.27
Other overseas instruments	-1753	799	-1083	424	1456	1560	1860	2108	-1.20	0.51	-0.58	0.20
Accruals adjustments	-240	213	-116	-15	448	480	496	496	-0.54	0.44	-0.23	-0.03
PUBLIC CORPORATIONS												
Accruals adjustments	345	-301	137	101	448	480	496	496	0.77	-0.63	0.28	0.20
CENTRAL GOVERNMENT												
Imputed charge for capital consumption	-376	-150	232	114	224	240	248	248	-1.68	-0.63	0.93	0.46
Consumption	-368	-143	281	266	224	240	273	372	-1.64	-0.59	1.03	0.72
LOCAL AUTHORITIES												
Trade and retail credit	194	-277	227	168	448	480	496	496	0.43	-0.58	0.46	0.34
OVERSEAS SECTOR												
UK & overseas securities & unit trust units	2475	911	2805	1439	3000	3500	4500	5500	0.82	0.26	0.62	0.26
Other domestic instruments	1520	-462	1143	-307	1600	1700	2100	2700	0.95	-0.27	0.54	-0.11

This table lists every item for which the change on balancing exceeds 0.5 of the error range in at least one of the four years 1988-1991

Table 14
Breakdown of diagnostics by sector

Sector	Balancing item	margin	ratio	SD	chisq	% significance
1988						
Personal	-7962	6161	-1.29	3746	4.52	3.4
ICC	9461	4808	1.97	2923	10.48	0.1
Financial	-8017	3295	-2.43	2003	16.02	0.01
PC	511	481	1.06	293	3.05	8.1
CG	768	322	2.39	196	15.42	0.01
LA	456	681	0.67	414	1.21	27.1
Overseas	6783	5837	1.16	3548	3.65	5.6
				Total:	54.35	
1989						
Personal	-4509	6763	-0.67	4111	1.20	27.3
ICC	-749	5588	-0.13	3397	0.05	82.5
Financial	5535	3526	1.57	2144	6.67	1.0
PC	-464	516	-0.90	314	2.19	13.9
CG	301	345	0.87	210	2.06	15.1
LA	-581	730	-0.80	444	1.71	19.1
Overseas	2467	6232	0.40	3788	0.42	51.5
				Total:	14.31	
1990						
Personal	-8531	7921	-1.08	4815	3.14	7.6
ICC	7995	7171	1.11	4359	3.36	6.7
Financial	-4598	4065	-1.13	2471	3.46	6.3
PC	223	563	0.40	342	0.42	51.5
CG	-527	374	-1.41	227	5.37	2.0
LA	545	758	0.72	461	1.40	23.7
Overseas	5938	6980	0.85	4243	1.96	16.2
				Total:	19.12	
1991						
Personal	-5643	9440	-0.60	5739	0.97	32.5
ICC	3483	8398	0.41	5105	0.47	49.5
Financial	3163	4719	0.67	2869	1.22	27.0
PC	257	668	0.38	406	0.40	52.7
CG	-388	451	-0.86	274	2.00	15.7
LA	444	812	0.55	493	0.81	36.8
Overseas	1072	7957	0.13	4837	0.05	82.5
				Total:	5.91	

ENVIRONMENTAL ISSUES AND THE NATIONAL ACCOUNTS

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Summary

Concern for the environment is increasing on a global scale. Environmental issues are being considered in many diverse areas of interest. This article reviews some of the discussion which has taken place about environmental accounting and the issues involved in drawing up such accounts. It reviews the nature of physical environmental accounts and the advantages and difficulties involved in placing monetary values on environmental concerns. The article also examines some of the environmental data already available in the United Kingdom that can be used in environmental accounts. Finally, it shows the construction of some simplified and experimental environmental accounts for the United Kingdom.

Introduction

Environmental issues have received increased attention during the last decade. In 1987 the United Nations' "Brundtland Commission" published "Our Common Future*" and introduced the concept of sustainable development as the basis for an integrated approach to economic and environmental policies. In 1989 the "Pearce Report*" prepared for the Department of Environment (DoE), examined the practicability of the concept of sustainable development. In 1990 DoE issued the White Paper "This Common Inheritance*". This was Britain's first comprehensive examination of all aspects of environmental concern on a global scale. It set out the Government's plans and commitments to preserving Britain's heritage. Two anniversary reports have subsequently been issued by DoE reporting on action to date and setting out new commitments for action. The United Nations is establishing a Sustainable Development Commission to monitor progress in following up the agreements reached at the Rio Earth Summit. The UK Government intends to submit a report to the Commission by the end of 1993.

Concern about the environment continues and some environmentalists have suggested that the national accounts should take into account interactions between the economy and the environment. They believe that the accounts should reflect increasing scarcity of natural resources and the degradation of environmental quality and its consequences on health and welfare. The present national accounts measure economic activity in a clearly defined manner for specific purposes. Any proposed changes would have to be carefully considered before they were implemented. However, the Statistical Office of the United Nations is drawing up a handbook on integrated environment and economic accounts to examine the effects of introducing environmental concerns into the national accounts. Earlier this year, the United Nations Conference on Environment and Development proposed that satellite accounting systems integrating environmental and economic concerns should be established in all its member states at the earliest date. Satellite accounts are accounts constructed in parallel with existing accounts. They provide a framework which allows the existing accounts to be extended to cover new ideas without disrupting the original accounts. They also allow a relaxation of accounting procedures. For example, production boundaries and asset definitions could be varied. Satellite accounts are a powerful analytical tool as they tend to be specific to a field, linked to the field's information system and facilitate macroeconomic analysis of the field in question. Separate satellite accounts might, for instance, be used to analyse various issues such as education, health or tourism. This article will concentrate solely on integrated environmental and economic accounts in a satellite format.

* *See references on page 122*

The national accounts and environmental changes

This section examines the national accounts and areas where integrated accounts may change the existing accounting framework. The national accounts provide a comprehensive accounting framework for describing the economic development of the nation. They describe the nation's output of goods and services; the incomes that are thereby generated; their redistribution; the expenditures made out of these incomes on the goods and services produced; borrowing and lending during the period; and levels of assets and liabilities acquired. The use of an integrated set of accounts to do this ensures logical consistency and gives a basis for macroeconomic analysis and forecasting.

The national accounts measure activity involving economic exchanges. They do not measure, nor claim to measure, sustainable development or welfare. The UK national accounts follow a well established and internationally agreed system of national accounting standards. This allows comparisons to be made over time and between countries. National accounts are used extensively by many users, particularly economists, and any changes to incorporate environmental issues would impact upon their work. The concepts of environmental accounting need to be examined closely before they can be integrated into national accounts. At the same time it is possible to introduce integrated accounts in a satellite accounting framework without disrupting the work of other national accounts users.

Environmentalists have criticised national accounts, in particular because the scope of goods and services covered by the system is largely confined to those which are exchanged for money. A household's production of services for its own consumption, for example, is excluded. Thus cleaning the home is outside the scope of the national accounts if undertaken by the householder but inside if the householder hires a cleaner to do the work. It is the same for other DIY activities such as car maintenance. These activities are not included, because values would have to be imputed on an arbitrary basis and because their inclusion is unlikely to assist the main users of the accounts- the macroeconomists who advise Government and others on economic and financial issues.

The restriction of the national accounts, predominantly, to market transactions has also led to the treatment of environmental assets - air, water, soil and sub-soil assets - as "free" goods. Their depletion and degradation does not enter into the national accounting framework, even though expenditure on pollution abatement is included. However, it has been suggested (Bartelmus et al*) that the exploi-

tation of nature has reached a degree where man is "disturbing" his own living conditions and that, to an increasing extent, economic use of the natural environment has been revealed as abuse. Such "abuse" is not identified in the current measurement of major macro-economic activities.

Environmental accounts

The following section examines the basic ideas of environmental accounting; the next two sections take a more detailed approach. As with all accounting systems, the objectives of environmental accounting are to:

(i) prepare a "balance sheet" giving a profile of what stocks of resources are available at a given point in time,

(ii) prepare "flow accounts" showing what uses are made of these stocks, what sources they are derived from and how they are added to or transformed over time, and,

(iii) ensure that the stock accounts and the flow accounts are consistent, so that the balance sheet at the end of any year can be related to the balance sheet at the end of the previous year and the flow accounts of that year.

Although we naturally think of "accounts" in money terms, there is no reason why such accounts should not be presented in physical units, as long as they present the stocks and flows in a clearly identifiable way and as long as they achieve the reconciliation between the sets of stock and flow accounts as described above. This article looks at environmental accounts in both physical and monetary units. The next section, "Physical Accounts" examines some of the possibilities for developing physical accounts for the United Kingdom. Following that, the section, "Monetary Accounts" examines the theory and problems associated with monetary accounts particularly placing a value on the environment.

As mentioned, the Brundtland Commission embraced the idea of a "sustainable domestic product" and this has led to proposals to measure the interaction between the economy and the environment in monetary terms. These proposals centre on the treatment in the national accounts of the following three issues:

* depletion of natural resources extracted for sale
* defensive expenditures to prevent or correct environmental damage; and
* degradation of the quality of the environment as a result of economic activity.

Let us look at these three issues more closely, firstly the depletion of natural resources. If the objective is to obtain a measure of sustainable income, it is necessary to allow for any depletion of the capital stock of the country - either natural or man made. At present, if a natural resource, such as oil, is extracted from the ground, national income rises as a result of the extraction activities. This, it is argued, is a misrepresentation of the sustainable income level because it fails to allow for the decline in finite oil reserves. This economic activity can only continue whilst there are sufficient reserves.

The second issue concerns defensive expenditures which prevent or correct damage to the environment. If an increase in traffic noise leads a householder to double-glaze his house this is shown as an increase in GDP: yet it only restores the householder's "welfare" to the level enjoyed prior to the traffic noise increase. Another example is non-recyclable waste disposal activities - the more non-recyclable waste produced the more the Government spends on waste disposal and the more GDP is increased. Whilst this activity undoubtedly creates employment incomes, other forms of analysis require the nature of these increases to be categorised to defensive, rather than creative, activities.

The third issue, environmental degradation, is essentially concerned with degradation as a byproduct of economic activity; degradation of the air, soil and water etc. Proposals for measuring the economic cost of environmental degradation generally focus on the cost of preventing deterioration or of restoring the quality of the environment to a specified standard. These issues are explained in more detail later in this article. First, we look at some of the environmental accounting systems which have been developed in non-monetary terms.

THE FRENCH NATURAL RESOURCE ACCOUNTS

The French began work in 1978 to develop a complete system of natural resource accounts. At this time they had no means to assess the long term effects of their economic development on the environment. Natural resource accounts were chosen as the best way to provide such an assessment. This system of accounts became known as "patrimony accounts" because they would provide information on the state of the environment to be inherited by future generations. The intention was to combine this system of ecological accounting with other information such as welfare and environmental indicators.

The patrimony accounts fit into a hierarchy of environmental information. The lowest level is the basic data, such as energy extraction and use; the highest level is the integrated environmental and economic accounts with welfare indicators and a modified GDP. The patrimony accounts are a natural progression from the basic data.

The patrimony accounts are made up of three types of accounts:
i. **Element accounts** - These record changes in stocks of resources. There are three categories; non-renewables (fuel, ores) physical (soil, water) and living (animals, plants).
ii. **Ecosystem accounts** - These record changes occurring in the state of the environment and use of resources. They show the interaction between species and man. These could be prepared for water, forests, and land ecosystems. An example would be population densities of certain species.
iii. **Transactor accounts**- These relate to the sectors of the national accounts such as business, household and government. They show flows between resources and economic activity and include physical accounts of pollutant emissions and waste produced as well as monetary accounts showing environmental expenditure.
The three types of accounts are linked together by matrices which trace the distribution of stocks and flows of resources and might show for example, the use of river and ground water by different actors. The patrimony accounts would be linked with the economy through the transactor accounts. Economic activity would be shown alongside changes in stocks and flows of natural resources.
Such accounts would be used for planning in economic, ecological and social areas. They would be in physical units except for expenditure, depletion of resources and assessment of damage, which would be in monetary terms. The accounts would eventually give a basis for forecasts, models and eventually an adjusted GDP, but are not yet fully developed.

Physical Accounts

Physical accounts usually express environmental activities in the most relevant units. Consequently, such accounts avoid the difficult process of evaluating environmental activities in monetary terms. There will rarely be consensus over monetary evaluation and a description of the environment in physical terms is a useful starting point for examining relationships between the economy and the environment.

The "physical" approach was pioneered by the Norwegian Government which set up, in 1974, a Department of Natural Resources to develop and introduce a system of natural resource accounting and budgeting. In 1978, the French Government decided to introduce, in a phased way, a system of natural resource accounts and set up a special Commission to do this. More recently the Canadian government has begun to develop a similar system of accounts.

THE NORWEGIAN NATURAL RESOURCE ACCOUNTS

The Central Bureau of Statistics has developed two basic types of resource accounts. These are the "material accounts," covering energy, mineral, fish and forests and the "environmental accounts", which cover air, water and land.

Material Accounts

The "material accounts" have been constructed annually in recent years. The energy accounts show the energy reserves - the part of the resource that can be extracted economically at current prices and using current technology. The estimated reserves will vary over time as prices and technology change. The "material accounts" also show the extraction and use of energy in the economy. The mineral accounts (sand, gravel,zinc etc) only show reserve estimates since these minerals are of minor economic importance.

The fish and forestry accounts concentrate on reserves and extraction rather than their uses in the economy. This is because they are renewable resources and it is the sustainable extraction rate which is important in stock management.

Environmental Accounts

The "environmental accounts" aim to monitor the state of the environment. Measuring the current state of an environmental resource is difficult and accounts are compiled for land use and air pollution only. The land use accounts provide data on land availability for different uses and have a local dimension which allows potential shortages of suitable land to be identified. This is essential if one aims to assess potential shortages of suitable land but does raise the question of what, if anything, could be done about this problem if it arose.

The air accounts consist of reports on deduced emission levels and crude quality indicators. The accounts are broken down by pollutant (SO_2,CO,NO_x,Pb etc.) and by source (Industry,domestic etc). The concentrations of pollutants are measured at thirty monitoring stations in order to calculate the quality indicators. The type of information covered in the accounts is similar to that collected by the Department of the Environment.

After assessing the possibilities of constructing and using a comprehensive set of water accounts, it was decided to postpone work on compiling water accounts.

[1] An index measures the relative changes in a variable over time. It is a convenient way of showing the percentage change between two periods.

* *See references on page 122*

Emissions of pollutants can be considered as flows of "bads" alongside goods from the production process. It is not feasible to estimate the stock of pollutants (in the air, water and soil) in the same way as for the stock of capital or other goods. This is because the pollutants are transformed physically and chemically within the natural environment and so stocks change. Estimates may, however, be made of the quality of the air, water and soil during successive periods in the form of an index[1], for example. However, even then there are two main limitations. First, it is difficult to choose the most relevant constituents of quality. Second, to aggregate indices of the constituents to yield an overall index of, for example, air quality is subjective and it is not clear what the index would actually show.

At this stage it is feasible only to measure the emission of certain residuals and a limited range of quality indicators relating to the various environmental media -air, water and soil. This type of information is published for the United Kingdom by DoE in the "Digest of Environmental Protection and Water Statistics*". Some key statistics from this publication are reproduced, in the tables A.0 to A.9, alongside UK national accounts of economic activity.

Annex 1 examines, in detail, the information that is currently available on the UK environment. The information has been taken from a variety of sources including the department of the Environment, the Department of Trade and Industry, the Ministry of Agriculture, Fisheries and Food and the Forestry Commission. It has been examined for the following four headings, non-renewable subsoil assets, forests, air and water

Data are available in a suitable form for some non-renewable subsoil assets. Estimates of economically recoverable reserves of oil and natural gas are available. However, coal reserves are only available for technically extractable coal. There is a limited amount of data available on the UK's forests. Estimates of stocks of forest are collected but the quality of forests is not measured. Data are available on emissions into the atmosphere of pollutants. However, such pollutants disperse in time and estimates of air quality are not easily made. Chart 1 illustrates one of the problems associated with data on air pollutants. The chart shows the concentration of SO_2 in rural and urban areas. Attempts to represent such data in an accounting format would involve regional accounts and even then would be unsatisfactory. There is a substantial amount of data available on water quality and uses, both for freshwater and coastal water. There are also figures showing the pollutants deposited into water.

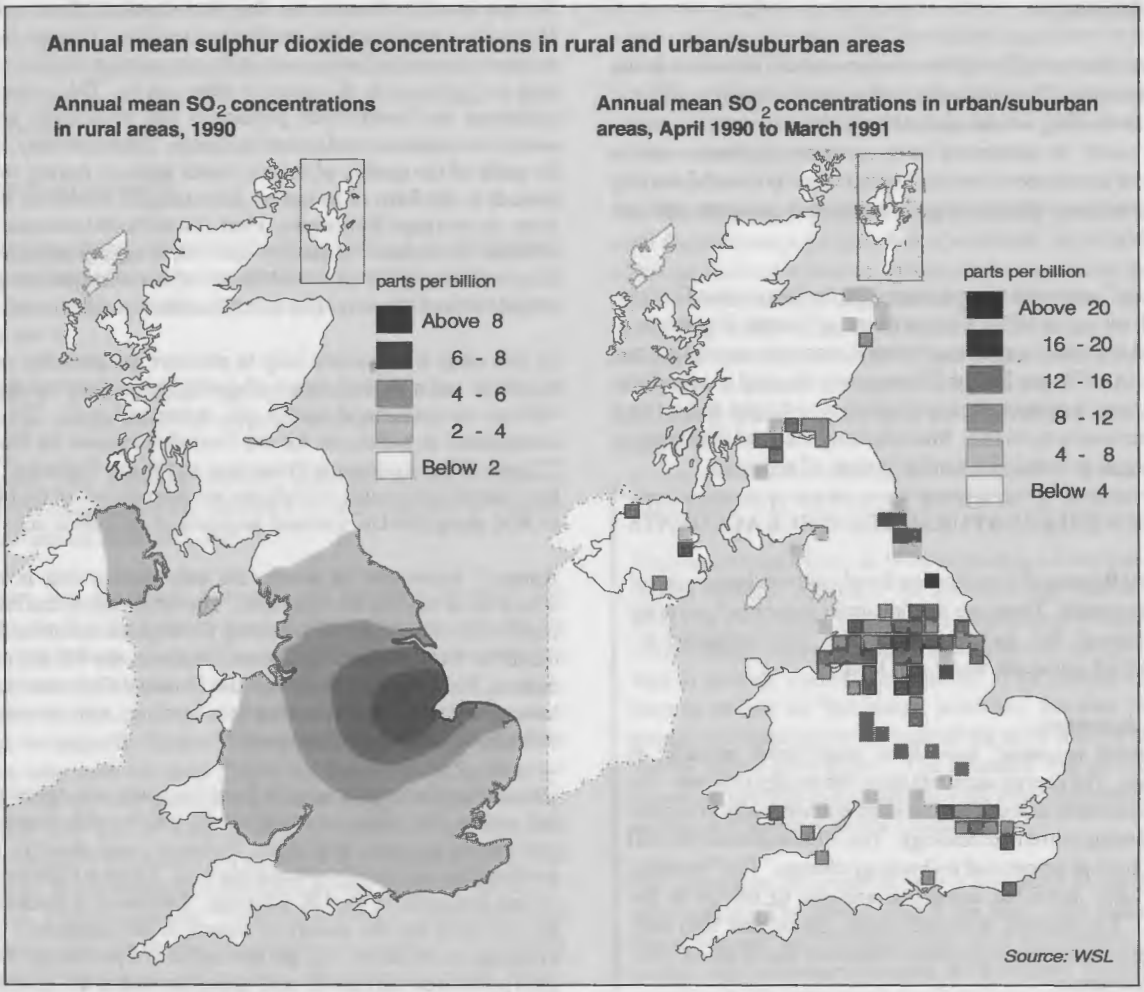
The appendix tables (A.0 to A.9) attempt to show the stocks and flows for the major natural resources using statistics which are available already. In addition, a basic account for the United Kingdom in physical terms is given in the section titled " A simple aggregated account."

We have examined the basic ideas of environmental accounts and have assessed in detail the data currently available for physical accounts. Before environmental accounts can be integrated with the national accounts in the form of satellite accounts, they must however be expressed in common units - monetary terms.

Monetary Accounts

Information on the environment in physical terms uses a variety of different units. These units vary from resource to resource and in most cases, they are actual quantities measured. The national accounts, on the other hand, are in monetary terms. The UN draft handbook on Integrated Environmental and Economic Accounting[2] discusses guidelines for drawing up environmental accounts, both in physical and monetary terms. The World Research Institute has

[2] This follows, as far as possible, the principles and rules followed in the UN system of national accounts, in which products are valued at market prices (that is including the excess of indirect taxes over subsidies). Some taxes can be highly distortionary. CSO consider that products should be measured at prices which reflect their value to society in terms of the resources used in their production, and their prices excluding net taxes are probably a better measure of this value. Factor cost estimates have been used in this article. UK estimates of GDP are produced on both bases.



Note: *WSL is the Warren Spring Laboratory*

recently used this framework to draw up some integrated environmental and economic accounts for the Mexican economy. As already discussed, a simple experimental account for the United Kingdom is shown in the section titled "A simple aggregate account - Physical terms". This example is followed by a similar account in monetary terms which uses figures already published on the UK economy and environment. First we consider the classification of assets involved, sustainability and the major problems of valuation.

Classification of Assets

Environmental accounts cover both produced assets (that is, assets produced by economic activity previous periods and not yet exhausted) and non-produced assets. The latter are sub-divided into non-produced economic assets and environmental assets. The non-produced economic assets are natural assets which have been taken into the economic system for use as part of the economic system's productive capacity or which are managed as an economic resource. Environmental assets are non-produced assets which are not part of the production process but which are affected by it. Examples are given in figure 1.

Sustainability

Sir John Hicks, the famous economist, defined income as the maximum value which a person can consume during a period and still be as well off at the end of the period as at the beginning (the Hicksian concept of income). Extended to the nation, this means that national income is the maximum that a nation can consume during a period whilst keeping intact the stock of capital at the beginning of the period. From an environmental perspective, keeping the stock of capital intact could mean the stock of natural resources or - if substitution of man-made capital for natural capital is permitted - the combined stock of natural resources and man-made capital. The Brundtland Commission defined sustainable development as development which meets present needs without compromising the ability of future generations to meet their own needs.

Figure 1 Classification of Assets

Produced assets	Non-produced assets	
	Economic Assets	Environmental Assets
Buildings. Plant & machinery. Vehicles, ships & aircraft. Stocks. Work in progress.	"Proven" reserves of oil, gas, coal etc. Cultivated land. Commercial forests. Water in reservoirs. Managed fish stocks. Game reserves.	"Unproven" reserves of oil, gas, coal etc. Uncultivated land. Natural woodland. Rivers, lakes and coastal waters. Groundwater. Air. Eco-systems.

Table 1

Alternative estimates of UK oil and natural gas reserve depletion

£ Million

YEAR	Depletion estimates			GDP for mineral extraction	GDP at current factor cost
	User Cost	Reserve Depreciation	Excess Profits		
1980	2,600	7,600	6,600	8,700	201,017
1981	4,200	10,500	9,400	11,800	218,755
1982	5,300	12,200	10,700	13,800	238,231
1983	5,200	14,400	12,400	16,200	261,038
1984	7,700	17,500	15,400	19,600	280,052
1985	7,900	16,700	14,200	19,100	306,716
1986	2,800	6,500	4,500	9,000	326,182
1987	3,400	7,700	5,100	10,100	358,297
1988	2,000	5,100	2,000	7,500	397,292
1989	1,700	4,900	1,800	7,300	436,180
1990	1,600	5,100	2,200	7,700	477,747

Source: CSO estimates

There has been a great deal of research into methods of adjusting national accounts to take account of resource depletion and environmental degradation. Pearce (A Blueprint for a Green Economy*) defines sustainable development as the gross domestic product less consumption of man-made capital (ie present definition of net domestic product) less net depletion of non-produced assets less defensive expenditures (those incorporated in final expenditure[3]) less environmental degradation. This is merely a definition and some may feel it does not measure sustainability. Many other authors have advocated their own methods of adjusting national accounts. As yet, there is no definitive approach. We will look at the approaches of Repetto and El Serafy in the section on depletion of natural resources. They simply estimate the value of depletion of natural resources and deduct these from GDP. The following paragraphs examine the issues of valuation which such calculations could involve.

Methods of Evaluation

Evaluating physical accounts in monetary terms is a difficult and sometimes subjective process; evaluations are not usually unique. However, until accounts can be expressed in monetary terms, they cannot be integrated fully with the national accounts. The following paragraphs examine the different problems involved in evaluating physical accounts in monetary terms. We will look at each aspect of environmental accounting in turn, examining problems and making some monetary estimates.

(i) Depletion of natural resources

In natural resource terms, sustainable development could be defined in two ways:

(i) maintaining the stock of natural resources or

(ii) maintaining the stock of natural and reproducible capital;

the latter approach permits the depletion of non-renewable resources if they are replaced with man-made capital. There are two main approaches to the valuation of the depletion of non-renewable natural resources: depreciation and user cost. The "reserve depreciation" approach involves estimating the present value of reserves of natural resources. This approach has been used by Repetto in estimates of the value of depletion of Indonesian oil reserves*. In this approach the value of depletion of reserves is calculated as the excess of gross trading profits over a "normal" return to capital. Repetto values the natural capital as the product of the gross trading profit per unit of output and the total units of reserves less the value of man made capital. The gross trading profits of the extracting companies are then allocated between natural and man made capital in proportion to their respective values. The value of the depletion of the reserves is then taken as the component of gross trading profits appropriate to natural capital. A variation on this method (the "excess profits" method) is to calculate a normal return for the man-made capital by extrapolation of the average return on man-made capital, and then to attribute the "excess" profits to the natural resource. This approach avoids evaluation of the reserves.

The other main approach is the "user cost" method which has been advocated by El Serafy*. Starting from the Hicksian concept of income, he argues that an income proportion should be identified within the annual earnings from sales of a resource; the remainder, a capital element or "user cost", should be set aside year after year and invested to create a perpetual stream of income that would provide the same level of true income, both during the life of the resource and after the resource has been exhausted. The ratio of true income to total receipts is:

$$\frac{X}{R} = 1 - \frac{1}{(1+r)^{n+1}}$$

Where X is true income, R is total receipts (net of extraction cost), r the rate of discount and n the further number of years for which current extraction rates could be sustained. Hence the proportion of net receipts which is the "user cost" can be given as:

$$1 - \frac{X}{R} = \frac{1}{(1+r)^{n+1}}$$

Annex 2 shows how this formula is derived.

Estimates of the value of depletion of UK oil reserves have been made using Repetto's depreciation method, the suggested variation of this method, and El Serafy's user cost[4] approach. These estimates are shown in Table 1 with output from mineral extraction for comparison. In all cases the estimated value of depletion falls sharply between 1985 and 1986 reflecting the decline in oil prices between those two years; Brent crude averaged £159 per tonne in 1985 and £73 per tonne in 1986. The user cost estimates are substantially lower in all years than the depreciation based estimates. This is because the user cost approach counts part of the "surplus[5]" as income whereas the depreciation approach treats all the "surplus" as depreciation of capital and does not recognise the existence of an income component above the "normal" return from man-made capital. Chart 2 shows the national accounts estimates of the net output from mineral oil and natural gas extraction and estimates of depletion of oil and natural gas reserves between 1980 and 1990. The three alternatives are quite different and this highlights the difficulties of making appropriate estimates of depletion.

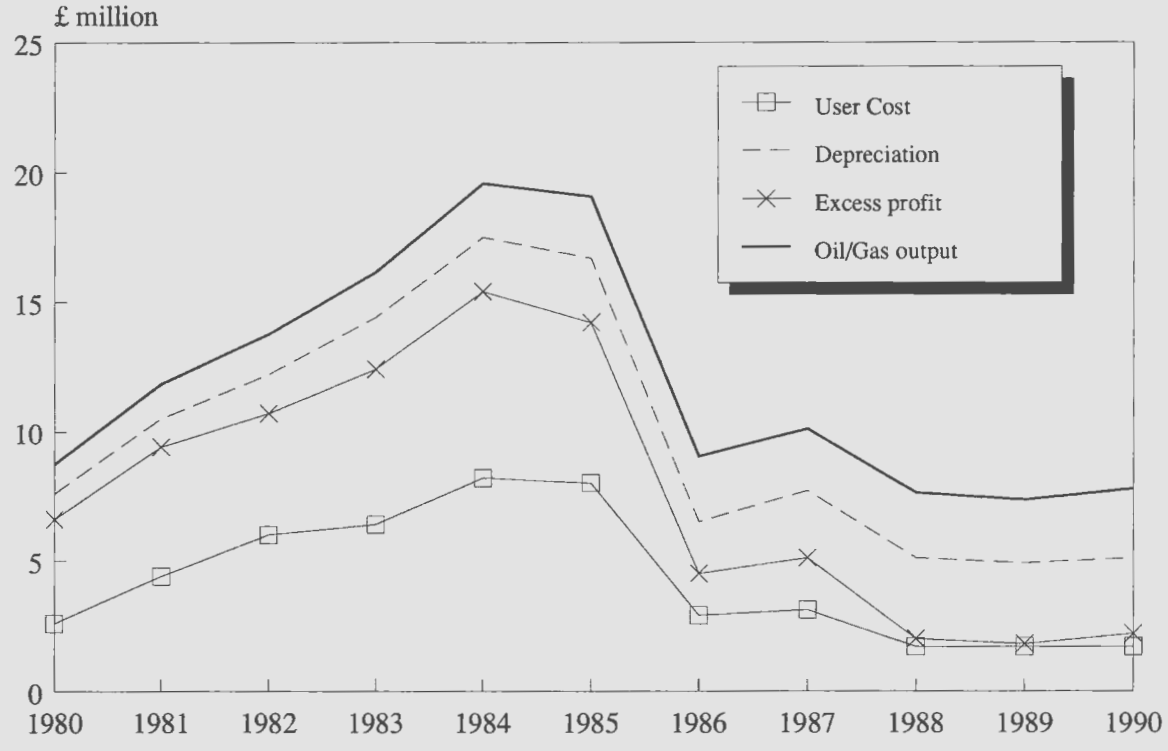
[3] Final expenditures are those expenditure associated with consumption and capital formation rather than intermediate products which are used in production processes.

[4] The "user cost" method is also known as the "permanent income" method.

[5] The "surplus" can be defined as the surplus of the value of oil extracted over the cost of extraction and a "normal" return to man made capital.

* *See references on page 122*

Evaluation of Reserve Depletion compared with output from oil and gas extraction



Source: CSO estimates

The user cost estimates of depletion are dependent on the choice of values of r (the rate of discount) and n (the number of years during which the resource will be extracted). These critically affect the proportion of net receipts from extraction that may be treated as income. In the example in table 1, the life expectancy of the resource has been taken as the remaining number of years over which "proven" and "probable" reserves will be completely used up at the rate of extraction in the year for which depletion value is being estimated. An alternative could have been to include the lower bound estimates of "possible" reserves and "potential additional" reserves in the estimates of life expectancy.

The choice of rate of discount is more difficult and, at least to some extent, arbitrary. El Serafy suggests 5 % as approximating what the classical economists used to call a natural rate of time preference. Alternatives might include the rates of interest on long term indexed government bonds (typically 4-5 % in recent years) and the average rate of return on capital employed by non-North Sea industrial and commercial companies (which varied between 7 % and 1 % between 1985 and 1990).

It is worth noting that taking the Hicksian concept of income (as the amount that can be consumed, whilst remaining as well off at the end of the period as the beginning) raises the question whether new discoveries during a period should be treated as part of income during that period. In his estimates of the net domestic product of Indonesia, Repetto treats all changes in reserves (discoveries and depletions) as part of income. Since the size of discoveries varies substantially from one year to another, this leads to wide fluctuations in the estimated net domestic product. Others however, have taken the discovery of assets to be no more than a reallocation between known and unknown resources.

Estimates in this paper have only been made for oil and natural gas depletion. Another of the United Kingdom's major natural resources is coal. Since, at present, figures reflecting the amount of coal that can be extracted economically are not available, it seems inappropriate to use the figures of technically extractable coal in such calculations. It would however be essential to consider the evaluation of the depletion of coal reserves in full environmental accounts.

The value of depletion of sand, gravel, gypsum, ball and china clay, limestone, granite, slate and salt has not been estimated. The extraction of these resources represented 0.3% of GDP in 1985 but information is not available about the total reserves. Since they form a much smaller part of the economy, the value of the depletion of these reserves would, in any case, be much smaller than that of the depletion of oil and gas.

Another area of concern, regarding consumption of natural resources, should be noted at this point. Sefton and Weale* have drawn

* *See references on page 122*

attention to the impact of trade in exhaustible resources on estimates of environmentally adjusted income, arguing that neglect of this problem will mean that the environmentally adjusted income of resource-exporting countries is understated while that of resources-importing countries is overstated.

(ii) **Defensive expenditure**

These expenditures are concerned with the preservation of land, water and air quality. They may concern expenditure to prevent deterioration or to rectify the deterioration which has already occurred. Such expenditures may be carried out by industry itself, by government or by individuals.

Expenditure on pollution abatement by producers counts, in the national accounts, as part of their intermediate expenditure on goods and services. Such expenditure cannot be directly identified in estimates of the value of GDP, though the costs will, at least in part, be incorporated in the prices paid by the final consumers of the products and hence indirectly in GDP. On the other hand preventive expenditure by government and individuals is included directly. Environmentalists have argued that this is inconsistent and that defensive expenditures should be excluded entirely from GDP or, at least, should be identified alongside the associated production so that the interaction between production and the environment would be more easily understood and analysed.

In contrast with the above approach, it has been suggested that expenditure on pollution prevention should be included as an additional part of GDP. Where environmental degradation occurs, this should be seen as a cost of consumption of the environment and should also be entered in GDP, valued at the cost that would be incurred in preventing such pollution, in parallel with the treatment of man-made capital. The same amount would then be entered as consumption of natural capital and deducted from GDP to arrive at net domestic product (NDP). This is illustrated in Table 2. With the present system of national accounts (SNA), GDP is likely to be increased by initiating a pollution prevention programme. An internationally proposed revision, to form an integrated environmental and economic account, would then show a similar increase in GDP. However, if there is no pollution prevention programme, then there will be consumption of natural capital. This, it is proposed, should be included in GDP with a corresponding increase in capital consumption to be deducted in arriving at NDP.

Table 2

An approach to interpreting consumption of natural capital into national accounts

	Present SNA		Proposed alternative	
	Without programme	With programme	Without programme	With Programme
GDP	100	105	105	105
Consumption of man-made capital	10	10	10	10
Consumption of natural capital	..	..	5	0
NDP	90	95	90	95

.. Not applicable.

* *See references on page 122*

One criticism of the above approach is that NDP still fails to differentiate, adequately, between situations where pollution occurs and where it does not. For example, if there were no anti-pollution programmes the same value of GDP on the present SNA would lead to the same value of NDP irrespective of the amount of pollution incurred. At the same time, users might find it a little surprising that GDP should be increased simply because more pollution has occurred.

There are also difficulties in identification of pollution abatement expenditure. Blades* identifies three sets of problems. First, there is the difficulty of establishing a baseline from which to measure the extent of pollution abatement activities. Such activities have been undertaken for a long time and a choice must be made whether to cover traditional as well as newer abatement procedures. Few manufacturers are likely to be able to recall a time when they were free to cause unlimited pollution to the environment. The identification of costs to meet anti-pollution controls introduced many years ago will be difficult to isolate because technical solutions to meet them will have been completely integrated into product designs. A mobile baseline based on measures undertaken because of recent legislation makes the definition of abatement expenditure somewhat vague but makes the collection of information more practical. Second, some equipment and processes benefit both industrial productivity and reduce pollution and it is not clear how much of the extra costs should be attributed to pollution abatement expenditure. In extreme cases, new and less polluting processes may be cheaper than older more polluting ones; Blades quotes the switch by pulp and paper manufacturers from sulphurate to sulphate processes as an example. A third difficulty is lack of awareness on producers' part of the cost of anti-pollution measures. A business may switch to more expensive biodegradable containers but not recognise the extra investment as expenditure on pollution abatement.

Estimates of the size of defensive expenditures in the United Kingdom have been taken from DoE's "The UK Environment*". Environmental expenditure is defined as capital and operating expenditure which has been incurred because of, and can be attributed directly to, the pursuit of an environmental objective. However, counting only expenditure in response to an environmental objective omits a portion of defensive expenditure, in particular anti-pollution expenditures which have long been incorporated into the design of goods. For example, there have been noise controls on cars for some time and expenditure on these has been excluded. DoE's figure do, however include expenditure on exhaust replacement and catalytic converters which are separately identifiable. The figures quoted are estimates and DoE stress that they should be regarded only as broad orders of magnitude.

Table 3 gives a detailed breakdown of the separately identifiable environmental expenditures and identifies the groups incurring such expenditure. The figures are given for modules (pollution abatement, environmental conservation etc.) which are part of a standard classification being developed by Eurostat, the statistical body of the European Community. DoE's estimates of environmental expenditure in 1990 of £14 billion represented around 3 % of GDP in 1990. Pollution abatement represents over half the total expenditure on the environment. The remaining half comprises expenditure on conservation, education and training, general administration, managing resources and improving amenities. Chart 3 shows the environmental expenditure divided between each environmental module.

Table 3

Summary of esimates of environmental expenditure by activity and spending group for the United Kingdom 1990-91

£ million

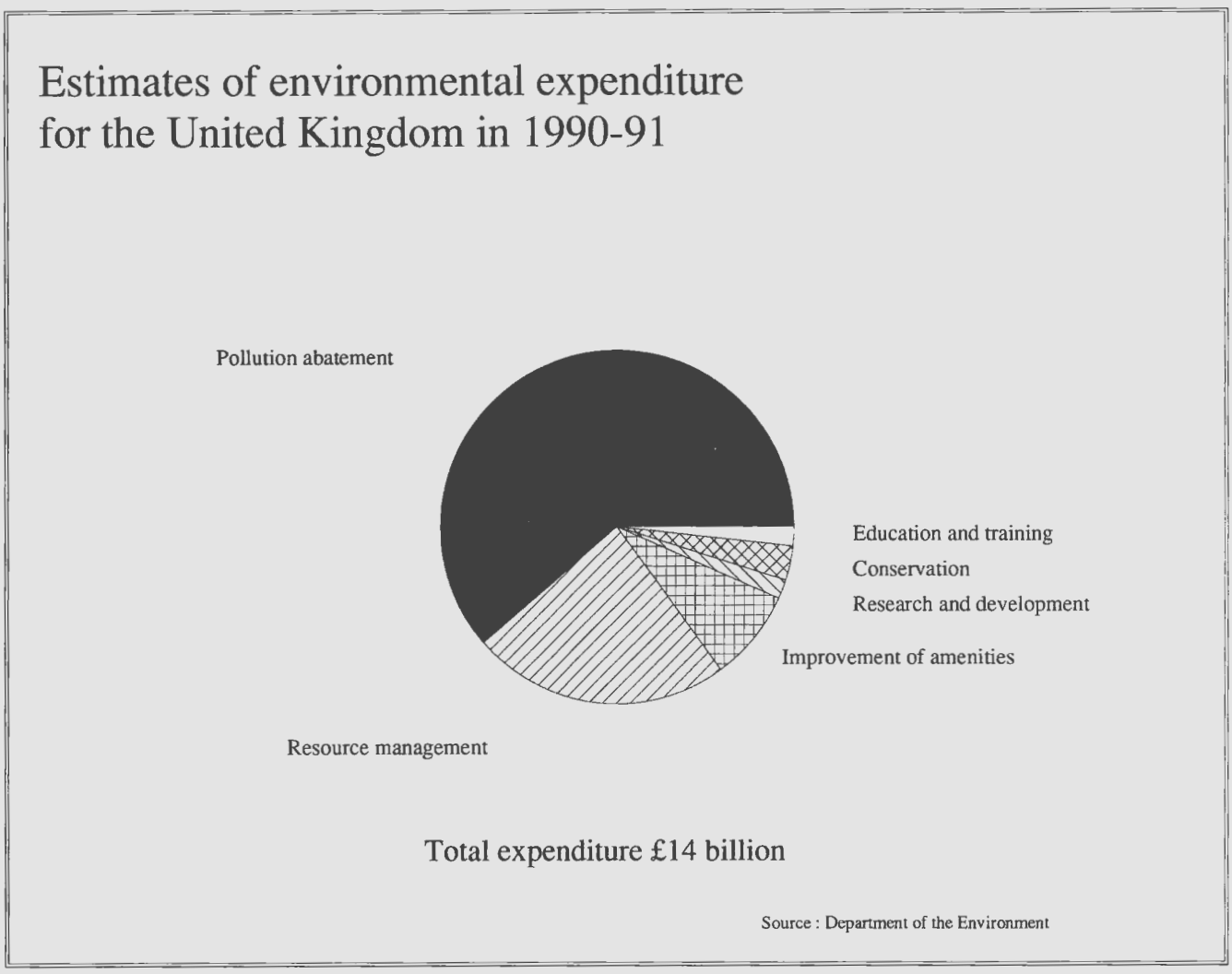
Main Modules	Spending group				Total expenditure
	Government	Enterprises	Households	NPO's	
Pollution abatement	2,200	5,900	680	..	8,800
Environmemental conservation	290	..	..	160	450
Research & development	250	..	..	..	250
Education and training	90	60	..	..	150
General administration	100	..	..	..	100
Peripheral Modules					
Management of natural resources	630	2,800	..	..	3,400
Improvement of amenities	1,200	..	..	..	1,200
	4,800	8,700	680	160	14,000

Notes

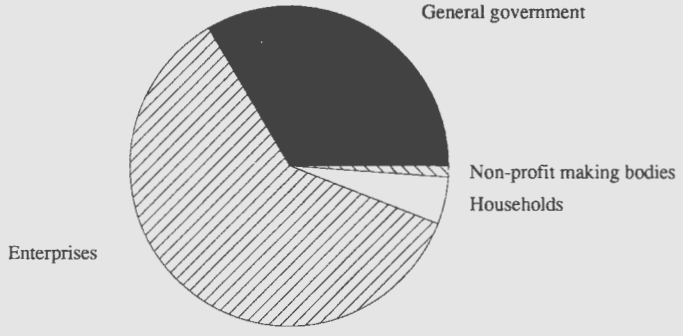
.. Figures are not available

1. Numbers have been rounded to two significant figures.
2. Totals have been calculated from unrounded numbers.
3. NPO are non-profit making organisations.

Source: Department of the Environment



Estimates of environmental expenditure for the United Kingdom in 1990-91



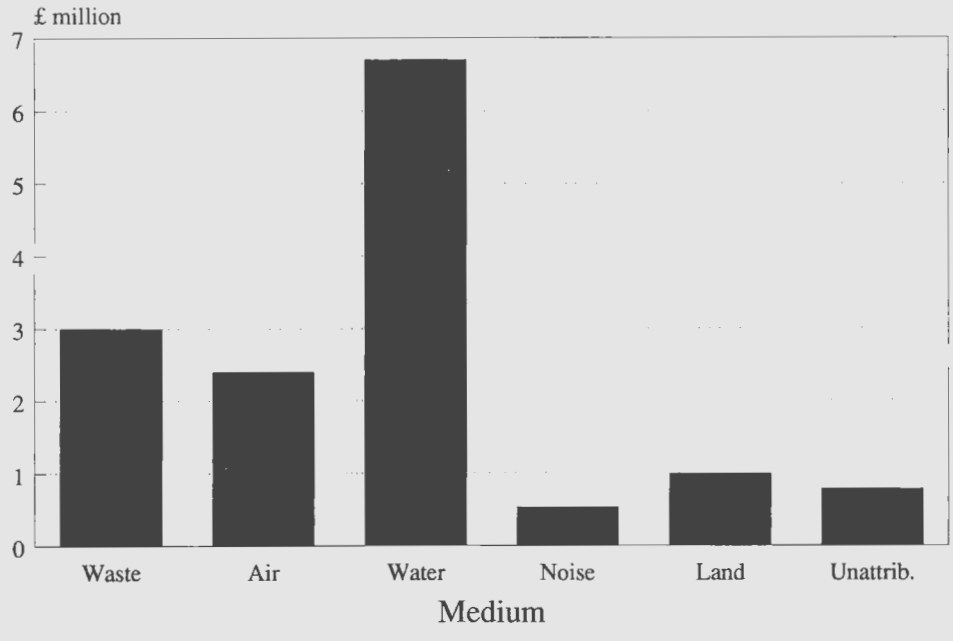
Total expenditure £14 billion

Source: Department of the Environment

The majority of environmental expenditure (94%) is incurred by general government, public corporation and enterprises. The remainder is incurred by households and non-profit making bodies. Chart 4 shows the proportion of the £14 billion environmental expenditure estimate incurred by each group.

DoE provide a further breakdown of UK environmental expenditures by environmental concern or medium. The expenditures are divided between several aspects of the environment; waste, air, water, noise and land with a small amount unaccounted for. Chart 5 shows the detailed breakdown of the £14 billion environmental expenditure between each media. Over 80% of total expenditure is on waste, air and water.

Estimates of environmental expenditure for the United Kingdom 1990-91 by medium



Source: Department of the Environment

The estimates have been derived by DoE from an interim report commissioned to investigate the feasibility of collecting environmental expenditure data for the United Kingdom. Figures originate from a combination of published sources, market research and internal estimates. DoE's report highlights the immense difficulties involved in quantifying environmental expenditure.

(iii) Residual Environmental Degradation

It was explained earlier that expenditure on protecting the environment from pollution is included in the national accounts but, degradation of the environment which is not "made good" is ignored. No deduction is made for the consumption of natural capital which occurs when the soil, air or water is polluted or left in a poorer state at the end of the accounting period than the beginning.

Just as it is difficult to attach monetary values satisfactorily to the use of natural resources, attaching monetary values to degradation is also extremely problematic. Choices have to be made about the most appropriate valuation techniques, and the data required to employ these techniques need to be collected.

There are at least three approaches that can be taken to the valuation of residual degradation:

(i) willingness to pay to avoid the degradation
(ii) the cost of preventing the degradation
(iii) the cost of making good the degradation.

Willingness to pay could be measured directly by asking people how much they would be "willing to pay" to prevent environmental degradation and then aggregating their responses to give an overall estimate of the value to the population of the degradation of the environment. As Hueting* points out there are a number of difficulties with this approach. There is a considerable difference between saying that one is willing to spend money on something and actually paying for it. Some people may not bid at all because they feel they have a "right" to a healthy and safe environment. Another problem is that the "willingness to pay" approach includes the consumers' surplus[6] whereas valuations in the national accounts are based on market prices.

An alternative approach to the use of "willingness to pay" is the investigation of surrogate markets to determine what people would be willing to pay. An example is the "hedonic price approach" which uses multiple regression techniques to estimate, for example, how much of the variation in property prices between different locations can be attributed to environmental differences and, thereby, makes inferences about how much people would be willing to pay for an improvement in environmental quality.

The cost of preventing the degradation and the cost of making it good may be very different. The latter cost may be infinite if an irreversible change in the environment has occurred whereas the cost of avoidance has an upper limit (the cost of closing down the production unit causing the pollution). In both cases the practical problems of valuation are likely to be substantial. Manufacturers' knowledge of the cost of avoidance of pollution by changes to their processes may be limited. Estimation of the cost of restoration of the environment to a previous standard could use actual or hypothetical cost data.

[6] The consumer's surplus is the excess of what a consumer is willing to pay for something over the actual price paid to acquire the good or service.

Hueting* argues in favour of estimates of expenditure required to meet environmental standards based on the pre-requisites of health and a sustainable economic development. He suggests, for example, that it is possible to decide how to use surface and groundwater for sustainable use (for drinking, agricultural and industrial procedures, recreation, etc.) Estimated expenditure to meet these standards would show how far a nation had drifted away from sustainable use of its water resources. However, if these expenditures are not marginal, the validity of subtracting them from NDP to reach an estimate of sustainable domestic product is open to question because their expenditure would displace other activities thereby influencing the whole economy. As Nyborg* points out, subtracting hypothetical cleaning costs from current GDP is like trying to explain how a totally different society would behave while assuming that no substantial reallocation of resources, and thus changes of relative prices, would be needed.

A simple aggregated account - physical and monetary terms

So far in this article, we have examined the data available and some of the difficulties in constructing environmental accounts. In this section we bring together information described earlier; integrate it into the basic framework of the UN Draft Handbook on Integrated Environmental Accounting*; and attempt to draw up some simple integrated summary accounts for the United Kingdom. The information is presented in physical terms and then in monetary terms.

(i) Physical Terms

Table 4 is an example, in physical terms, of a basic environmental account for the United Kingdom in 1990 based on the UN handbook on Integrated Accounts*. The table contains asset and flow accounts showing the interactions between economic activity and the environment. The table shows opening and closing assets for the period. The reserves of oil and natural gas classed as environment assets are ranges. These parts of the table show the changes in stocks over 1990.

Table 4 also shows the supply of economic goods and services and their uses, including intermediate consumption of goods and services, and transactions with the rest of the world. The figures come, in the main, directly from the national accounts input-output analysis*. Figures of gross output of goods and services and intermediate consumption are extrapolations of figures published for 1989.

The table also shows the flows relating to the various non-produced assets. The first column shows the use of natural resources in the production process. If data were available, the second column would show interactions with the rest of the world - for example the "export" of sulphur dioxide through the weather system to other countries and corresponding "imports". The next two columns are blank because natural assets are not consumed as part of final consumption and natural assets are non-produced. The final two columns of figures show the reduction of non-produced assets which occurs when they are "used" in the course of production and the movement of non-produced assets from the environmental sector to the economic sector.

* *See references on page 122*

Table 4

A simplified experimental aggregate environmental account for the United Kingdom in 1990 - Physical terms

	Economic activities						
				Economic Assets		Environmental Assets	
	Production	Rest of world	Final consumption	Produced Assets	Non-produced economic	(non-produced assets)	UNITS
Opening assets							
Produced assets				1,457,500			£ million
Oil					1,200	0-3960	million tonnes
Natural Gas					1,185	0-1997	billion cubic metres
Coal					43,205		million tonnes
Timber					2,326		1000 hectares
Land					N.A.	N.A	-
Water					0	N.A	-
Air					0	N.A	-
Economic supply	(938,000)	147,728					£ million
Economic uses	(459,000)	127,197	403,050	97,210			£ million
Gross domestic product (at current factor cost)	479,452						
Depreciation	61,126			-61,126			£ million
Net domestic product	418,326					£ million	
Environmental uses							
1. Depletion							
Oil depletion	92				-92		million tonnes
New finds					87	-87	million tonnes
Gas depletion	46				-46		billion cubic metres
New finds					61	-61	billion cubic metres
Coal depletion	94				-94		million tonnes
New finds					N.A.	N.A.	million tonnes
2. Land use							-
Agriculture					x	-x	
Forests: New planting	15				-15		1000 hectares
Restocking	15				-15		1000 hectares
Felling	-8				8		1000 hectares
Urban					y	-y	-
Uncultivated					-z	z	-
3. Water uses							
Ground Water Abstractions	35,249					-35,249	Megalitres/day
Degradation							
Soil erosion	0					0	
Solid wastes	109					-109	Million tonnes
Water pollution	N.A.	N.A.					-
Sulphur dioxide	3,774	N.A.				-3,774	thousand tonnes
Black smoke	453	N.A.				-453	thousand tonnes
Nitrog oxides.	2,729	N.A.				-2,729	thousand tonnes
V.O.C. s	2,395	N.A.				-2,395	thousand tonnes
Carbon monoxide	6,659	N.A.				-6,659	thousand tonnes
Carbon dioxide	160	N.A.				-160	thousand tonnes
Methane	4,371	N.A.				-4,371	thousand tonnes
Closing assets							
Produced				1,539,000			£ million
Oil					1,195	0-4131	million tonnes
Natural Gas					1,200	0-2145	billion cubic metre
Coal					43,111		million tonnes
Timber					2,336		1000 hectares
Land					N.A.	N.A.	-
Water					0	N.A.	-
Air					0	N.A.	-

Notes:-
1. Non-produced economic assets of oil and gas are "proven + probable" reserves.
2. Environment assets of oil and gas is the range of "possible" + "potential additional" + "undiscovered" reserves.
3. Figures for produced economic assets should be net capital stock at current replacement cost.These ought to be at 1990 prices but figures are not available.
4. N.A. means figures not available.
5. Figures in brackets are estimates extrapolated from 1989 input-oupput analysis
6. x, y and z represent areas of land but figures are not available. They show the flow of land when its use changes.

Table 5

A simplified and estimated experimental environmental account for the United Kingdom in 1990 - Monetary terms

£ million

	Economic activities					
				Economic assets		
	Production	Rest of World	Final Consumption	Produced assets	Non-produced economic assets	Environmental assets (non-produced assets)
Opening assets						
Produced				1,457,500		
Oil					R(oil)	A
Natural Gas					R(gas)	B
Coal					R(coal)	C
Water						0
Air						0
Economic supply	(938,000)	147,728				
Economic uses	(459,000)	127,197	403,050	97,210		
Gross domestic product (at current factor cost)	479,452					
Depreciation	61,126			-61,126		
Net domestic product	418,326					
Environmental uses						
1. Depletion						
Oil depletion	3,793				-3,793	
New finds					3,711	-3,711
Gas depletion	1,855				-1,855	
New finds					1,613	-1,613
Coal depletion	N.A				N.A.	
New finds					N.A.	N.A.
2. Defensive expenditure/Degradation						
Land remediation	240					-240
Environmental expenditure						
Water	6,700					-6,700
Air	2,400					-2,400
Others	5,300					-5,300
Oil pollution removal	1					-1
Degradation	D					-D
Substainable domestic product	459,163-D					
Closing assets						
Produced				1,539,000		
Oil					R(oil)-82	A - 3,711
Natural Gas					R(gas)-242	B - 1,163
Coal					R(coal)	C- 0
Water						-6,700
Air						-2,400

Notes:-

1. Monetary values of non-produced assets of oil, gas and coal are not made because of problems estimating reserve values. These are represented by R(oil), R(gas) and R(coal) respectively.
2. A,B and C represent the monetary values of "possible"+ "potential additional" + "undiscovered" reserves.
3. Figures for produced economic assets should be net capital stock at curent replacement cost. These ought to be at 1990 prices but figures are not available.
4. D represents enviromental degradation.
5. Figures in brackets are estimates extrapolated from 1989 input-output analysis.

(ii) **Monetary terms**

Table 5 brings together monetary values associated with the use of the environment in an integrated format similar to Table 4, the physical account. Estimates of oil and gas depletion included in the table are based on El Serafy's user cost approach. In both tables, as new finds are made, the value of the environmental assets falls and the economic non-produced assets rises as the new finds are reclassified as economic non-produced assets. When the process reserves are extracted the value of non-produced economic assets declines and the value of production rises. It is not practical to estimate the value of oil and natural gas not yet discovered. Estimates of depletion of coal reserves have not been made in this article, as discussed earlier.

In the United Kingdom in 1990, the area of forests has increased and this would, in theory, increase national income. However, there is no account taken of the change in the quality of the forests. This is because it is difficult to measure in both physical and monetary terms. As a result, figures have been excluded for deforestation because of the difficulties of estimation.

Estimates of defensive expenditures on land remediation, and other environmental expenditure have been taken from Chapter 17 of DoE's "The UK Environment*". They include the cost of prevention of degradation in connection with production in the current period and, to some extent, the cost of cleaning up degradation which occurred in earlier periods. In a full account the latter would help offset the cost of residual degradation covered by production in the current period but not prevented by defensive expenditures in the current period. However, values are not available for residual degradation because of lack of appropriate data as well as the difficulties of choosing an appropriate methodology.

Table 5 is far from exhaustive and excludes such items as soil erosion, the decline in air and water quality and damage to ecosystems (such as loss of species). This table simply illustrates the integration of environmental and economic information in an accounting framework. Its illustrative nature needs to be emphasised. Tables 4 and 5 are simple examples of the sort of presentation that seems appropriate; they could be extended to cover other environmental and economic interactions (eg decline in water quality or loss of species.)

Conclusion

78. The United Nations has proposed that all its member states should establish integrated economic and environmental accounts at the earliest date and this article has attempted, in a limited way, to apply the UN's guidelines to the UK context. The article has explored some of the basic ideas and concepts involved. It has reviewed the data already available on the environment and examined areas where, perhaps different data are required. It has explained the problems of evaluating, in monetary terms, the present condition of the environment and changes in that condition. Finally, it has illustrated the type of accounts which could be prepared for the United Kingdom in the form of summary tables (tables 4 and 5) and of the stock and flow accounts (in the appendix tables A.0 to A.9.)

79. The Central Statistical Office would welcome views from readers of this article and users of economic and environmental statistics on the value of the accounts presented, including any detailed comments on their structure and content. Comments should be sent to:

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Great George Street
London
SW1P 3AQ

* *See references on page 122*

ANNEX 1

An examination of the physical data available on the UK environment

The following sections, i to iv, look at the type of physical data on UK natural resources which are available and the extent to which they can be expressed in an accounting format. A basic account for the United Kingdom in physical terms is given in the section titled "A simple aggregated account".

(i) Non-Renewable Sub-Soil Assets

Physical accounts are most easily produced for sub-soil assets. Statistics are usually readily available for extraction of sub-soil assets and, indeed, this extraction is traditionally counted as part of GDP. Information on reserves is also needed if a set of accounts showing stocks and flows is to be constructed. In the case of oil and natural gas, such information is compiled by the Department of Trade and Industry* (DTI). Figures for reserves of oil and gas are estimated depending on the technology and the prices of the day in order to estimate the likelihood of the reserves being extracted. Figures of coal reserves are estimated by British Coal as the amount of coal that is technically but not necessarily economically extractable.

UK continental shelf reserves of oil and gas are classified by the DTI under two main headings "discovered" and "undiscovered" together with an intermediate category "potential additional reserves", which comprises discoveries about which insufficient is known to meet the technical and economic criteria to be classified as "discovered". DTI classify "discovered" recoverable reserves, on a field by field basis, into three categories:

(i) Proven - those reserves which on the available evidence are virtually certain to be technically and economically producible (ie they have a better than 90% chance of being extracted).

(ii) Probable - those reserves which are not yet "proven" but which are estimated to have a better than 50% chance of being technically and economically producible.

(iii) Possible - those reserves which at present cannot be regarded as "probable" but are estimated to have a significant but less than 50% chance of being technically and economically producible.

Estimates of "undiscovered" reserves are, inevitably, extremely uncertain. They are a statistical assessment of reserves in identified geological prospects which have yet to be tested by drilling. Estimates are currently only available for selected areas in the United Kingdom. Table 6 (See top of next column) shows the estimates available for the UK oil and gas reserves at the end of 1991.

Table A.1 gives more detailed information in the form of a physical account, for the "discovered" reserves. This shows the total of "proven" and "probable" reserves at the beginning and end of each year, with a reconciliation of these balances through net additions to reserves(through new discoveries or reassessment of existing discoveries) and depletions through the process of extraction.

Using standard national accounting concepts the extraction of mineral oil and natural gas contributed 1.6% of the UK's GDP in 1989. The next most important non-renewable resource was coal which contributed 0.6% of GDP in 1989. Other sub-soil resources include

* *See references on page 122*

Table 6
UK reserves of oil and natural gas 31 December 1991

	Oil (Million tonnes)	Natural gas (Billion cubic metres)
Discovered:		
Proven	2020	1345
Probable	675	695
Possible	730	570
Total discovered	2020-3425	1345-2610
Potential additional	150-360	135-305
Undiscovered recoverable	540-3395	260-1252
Estimated total potential recoverable reserves	2710-7180	1740-4167
Less cumulative production up to 31 December 1991	1465	804
Remaining potential recoverable reserves	1245-5715	936-3363

Source: Department of Trade and Industry

Notes
1. Figures shown in some cases are ranges of estimates.
2. Figures for natural gas reserves exclude coal bed methane.

sand and gravel, ball and china clay and salt extraction, whose total contribution to GDP in 1989 was less than 0.1% Figures showing the volumes of these mineral extractions are shown in Table A.0, a summary of UK economic production and environmental uses.

Accounts showing the transformation of a natural resource in the course of economic activity are sometimes called material balances. In similar fashion, the Department of Trade and Industry construct estimates of UK energy balances which show the sources of fuel supplies and their uses, either directly or for conversion into other forms of energy. A time series of UK energy balances is shown in Table A 2.

(ii) Forests

An important natural renewable resource is forests. Much of the UK forest resources were exploited many years ago and about 10% of the United Kingdom is now under forestation; this proportion is low by European standards. As a result, the United Kingdom is reliant on imported timber and most of our needs are met by others' natural resources. In the United Kingdom, 40% of forest land is managed by the Forestry Commission (FC), the rest being privately owned. The area of the Great Britain under forestation has increased from 1.4 million hectares to 2.3 million hectares since 1947. Chart 6 shows the increase in forest area in Great Britain since 1905. Much of the increase in forest areas in since 1947 has been in coniferous forest. When forests are felled they are usually replaced and, in general, could be considered to be managed sustainably. Figures of new planting, fellings, restocking and areas of forest under cultivation are compiled by the Forestry Commission. The physical change in stock over a period is the area of new planting less the area of felling. Table A.3 shows monetary estimates of the forest stocks and their change in the course of 1990-91. The physical accounts for forestry could present more information; Anne Harrison in "A Forestry Account for the United Kingdom*", shows for example, the transformation of felled trees into various end products as part of the

Table 7
Forestry account for the UK 1988

(1000 cubic metres)

Raw materials \ Converted by	Saw - mills	Pulp mills	Wood panels	Other	Softwood sawlogs	residues	Hardwood sawlogs	Total
Coniferous Roundwood	2856	939	892	238				4925
Broadleaved Roundwood	475	242	115	176				1008
Saw mills (softwood)	-2856				1602	1254		0
Saw mills (hardwood)	-475					216	259	0
Residues	126	1364				-1490		0
Total input	0	1307	2371	414	1602	-20	259	5933

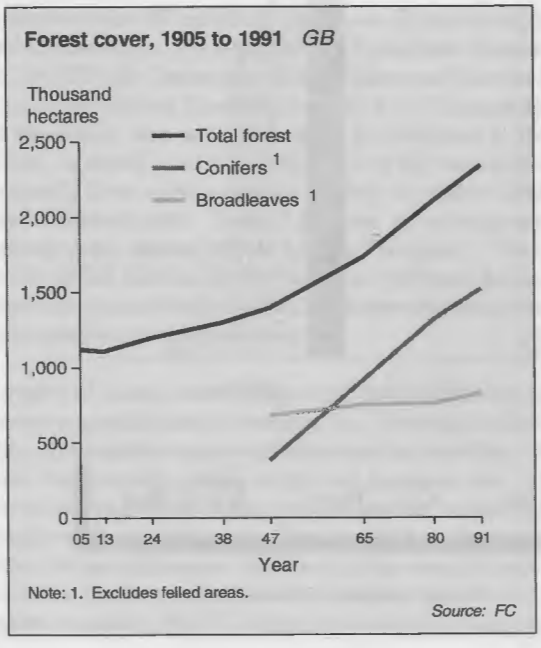
(1000 tonnes)

Uses \ Output	Saw - mills	Pulp mills	Wood Panels	Other	Softwood Sawlogs	Residues	Hardwood Sawlogs	Total
Construction				116	1602		260	1978
Furniture							57	57
Board uses			1693					1693
Paper uses		466						466
Other uses				290		-20		270
Total output	0	466	1693	406	1602	-20	317	4464

Source: A Forestry Account for the UK, Anne Harrison, 1989.

economic process, in the form of an input-output table which is reproduced in summary form at Table 2. The table shows by which processes roundwood is converted into final products. Harrison shows how this table could be extended to include imports and exports to provide a more complete picture. She also demonstrates how a physical account might show the distribution of forest area by age of trees, type of tree (broadleaved or coniferous) and nature of owner (Forestry Commission or other owner).

These kinds of presentation give information about the interaction between a natural resource and the environment. They go beyond simple statements of stocks (the balance sheet) and flows (explaining changes in balance sheet values) to yield information that can help to illustrate how, for example, increased demand for certain products will impact on a natural resource.



(iii) Air

The energy balances referred earlier do not show the interactions between energy uses in economic activity and the environment. It is difficult to describe the impact on the environment of emissions into the atmosphere, particularly as their distribution and redistribution is important and the emissions are likely to undergo physical changes. It is also probably not the average level across the country of a particular substance, (for example sulphur dioxide) that is of greatest interest. There is likely to be more interest in concentrations at individual locations where levels of a particular substance (for example sulphur dioxide) exceed an acceptable limit.

Table A.4 reproduces information from the Department of the Environment* (DoE) on trends in the emissions of sulphur dioxide (SO_2), black smoke, oxides of nitrogen (NO_x), volatile organic compounds (VOCs), carbon monoxide (CO), lead (Pb), ozone (O_3), carbon dioxide (CO_2) and methane (CH_4). In Table A.4, national estimates of emissions are shown by industry group alongside estimates of GDP (value added) measured at constant factor cost. This table therefore shows "flows" of air pollution associated with national production and consumption.

Fossil-fuel combustion is a major source of emissions to the atmosphere. There are other non-combustion related sources such as natural gas leakage in distribution, industrial processes, coal mines, landfill, solvent use and natural sources.

Estimating the stock of pollution in the air is not straightforward. Nevertheless, air quality monitoring is undertaken at a number of sites across the United Kingdom. For example, data on ambient concentrations of sulphur dioxide, nitrogen dioxide and ozone are used to provide air quality bulletins. However, concentrations may vary over different areas and may change as pollutants are dispersed naturally. DoE therefore publish concentration data for certain sites, often highly populated areas. Such information cannot be meaningfully aggregated for the United Kingdom as a whole. As a result, stocks of air pollutants are difficult to measure and are relevant only for individual sites.

* *See references on page 122*

iv. Water

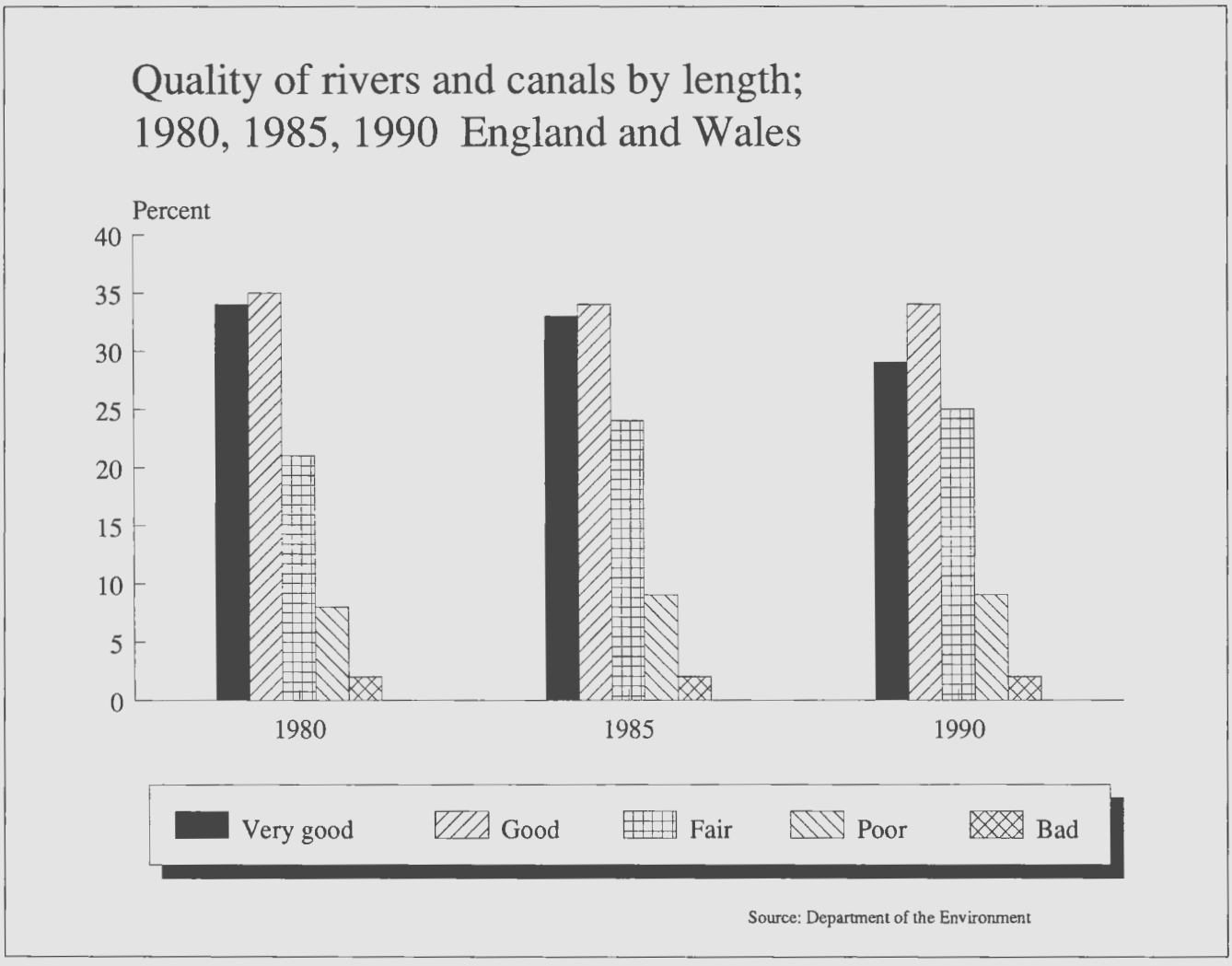
Water is used for drinking and for use by industry and agriculture but also as a medium for controlled discharges of sewage and industrial effluents. Water may become polluted by discharges (eg, from industry, agriculture or sewage treatment works), run-off (eg, from roads, industrial sites or land), or accidental spillages. Table A.5 shows annual abstractions of water by industry in England and Wales together with estimates of economic output.

Tables A.6a shows the amounts of different types of waste disposed of in coastal waters around the United Kingdom. The amounts of liquid industrial waste, sewage sludge and solid industrial waste disposed of at sea have increased steadily since 1980, although they fell slightly in 1990. The amount of dredged material discharged at sea has decreased in the period. Table A.6b shows the total quantities of different metals which have been discharged. Each metal causes differing types and degrees of pollution. but for all metals discharged the amount discharged has dropped considerably since 1987. Table A.6c shows various data relating to oil spills. The data omit the spills which are not cleaned up; where the oil is left to degrade naturally without treatment.

Water abstractions, disposals of water and oil spills are "flows" associated with economic activity. The corresponding stock position needs to include information on the total volume of water that is available in reservoirs, lakes etc and the quality of that water in terms of the level of impurities. A full physical account would then link the stocks and flows. Pearce* shows a national water account for France which reconciles stocks of water in lakes, snow and glaciers, groundwater and rivers with "flows" in the form of precipitation, evaporation, transpiration and surface run-off.

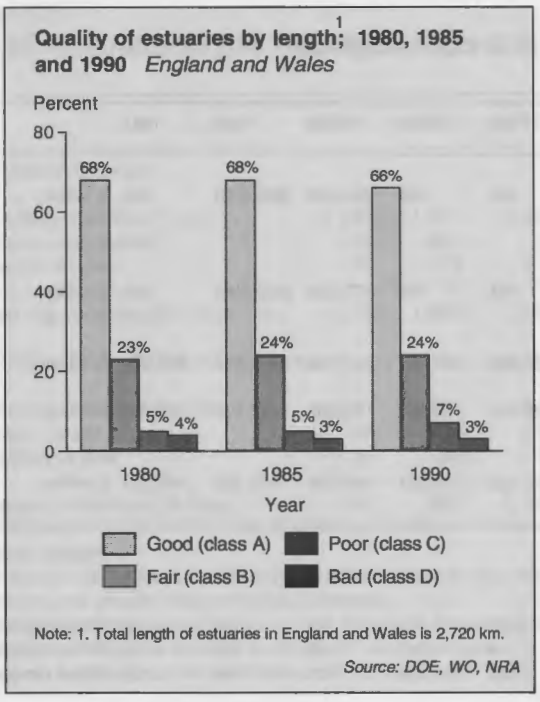
Information on water stocks at a national level is of limited use. Figures of total stocks of water in the UK's lakes, rivers and reservoirs do not help to meet the information needs of the bodies responsible for planning water requirements. National figures do not realistically show water availability - figures must be shown on a regional basis. Ideally, some environmental accounts would be compiled on a regional basis.

Figures of the water quality would also be compiled regionally. The quality of river, canal and estuarial water in England and Wales has been monitored in a series of national surveys beginning in 1958. Table A.7 shows the results for the 1980, 1985 and 1990 surveys. Results from the 1990 Survey show around 90 % of rivers, canals and estuaries in England and Wales to be of 'good' or 'fair' quality. These results are illustrated in charts 7 and 8.



Source: Department of the Environment

* See references on page 122



Notes: *WO is the Welsh Office*
NRA is the National Rivers Authority

Tables A.8 and A.9 show indicators of coastal water quality. Sea water quality is affected by many factors and is its measurement complicated by the tides, currents and weather. Table A.8 shows figures reflecting the quality of bathing waters. This is affected by sewage which is discharged straight into the sea with only screening for the removal of gross solids. Since 1976 there have been EC standards for bathing water. The 1988-1991 results for the United Kingdom are shown in Table A.8. The current expenditure to improve the quality of bathing water will be recorded in the national accounts, but an associated increase in quality of bathing waters and beaches will not be reflected in changes in national wealth. However, the quality decrease in the preceding years is not reflected by a corresponding decrease in national wealth. Obviously there is a difficulty in estimating the "value" of the quality decrease but this treatment may still be considered inconsistent.

The concentration of pollutants in the sea is monitored by the fisheries laboratories of the Ministry of Agriculture, Fisheries and Food, (MAFF), the Department of Agriculture and Fisheries (Scotland), and the National Rivers Authority (NRA). Concentrations of toxic chemicals, such as heavy metals, are measured in fish and shellfish. In recent years monitoring activity has been confined to "hot spots"; those areas which are known to receive substantial inputs of contaminants. Table A.9 shows the concentrations of chemicals in the muscles of cod in three "hot spots". The levels found in all fish sampled in the "hot spots" were not judged high enough to be a hazard to man or fish. Such measures reflect the flow of materials through the ecosystem.

The quality of coastal water is important when considering another important renewable natural resource, fish. A serious decline in the quality of our coastal waters will affect our stocks of fish. MAFF monitor the quantities of fish caught and quotas are set. UK fish resources are, in general, managed sustainably by imposing quotas, although overfishing can occur. Figures of fish stocks are difficult to collect for several reasons. Fish are a mobile natural resource and therefore difficult to isolate in one area. The specification of a boundary containing the UK's fish stocks is an unworkable concept in practice. This article has not looked closely at fish stocks but it is an area for which countries such as Norway, have produced resource accounts. The effects of overfishing are clearly visible in chart 9 which shows a large decline in the population of North Sea herring as a result of overfishing in the 1960's. While the North Sea herring fishery was closed, the stocks recovered but at the expense of stocks of mackerel off the west coast of the United Kingdom.

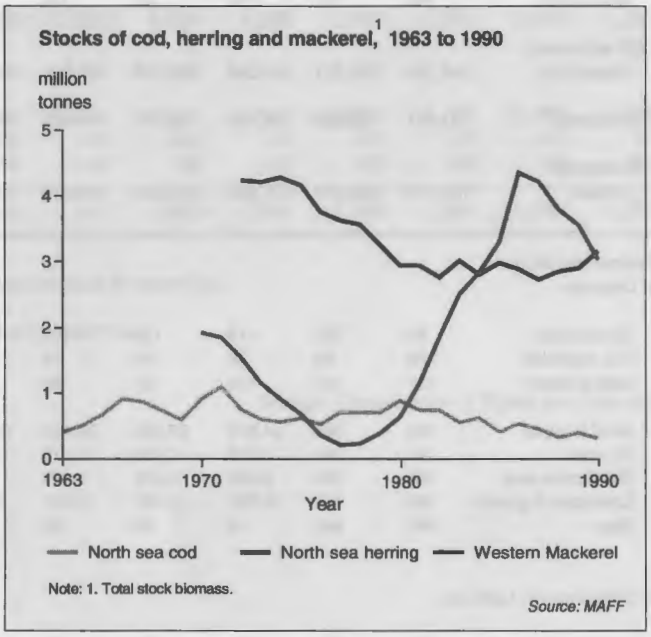


Table A.O

Summary of UK economic production and environmental consumption

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	
Resident producer gross output	NA	NA	NA	NA	NA	NA	NA	NA	863,000	(938,000)	NA	£ million
Resident producer intermediate consumption	NA	NA	NA	NA	NA	NA	NA	NA	423,000	(459,000)	NA	£ million
GDP at Current Factor Cost	218,755	238,231	261,083	280,758	307,901	328,130	360,599	401,127	441,136	479,452	497,001	£ million
Depreciation	31,641	33,653	36,150	38,758	41,883	45,084	48,149	52,596	56,632	61,126	63,968	£ million
Net domestic product	187,114	204,578	224,933	242,000	266,018	283,046	312,450	348,531	384,504	418,326	433,033	£ million
Environmental uses												Physical units
1. Depletion												
Oil depletion	90	103	115	126	127	127	123	115	92	92	91	Million tonnes
Gas depletion	36	36	36	36	40	42	44	42	42	46	52	Billion cubic metre
Coal depletion	127	125	119	51	94	108	105	104	101	94	96	Million tonnes
Sand & gravel	NA	NA	94,848	97,608	99,428	103,296	110,338	128,129	126,132	112,972	94,936	Thousand tonnes
Gypsum	NA	NA	2,979	3,156	3,075	3,254	3,377	3,665	3,700	3,267	2,410	Thousand tonnes
Ball & china clay	NA	NA	3,068	3,432	3,483	3,537	3,764	4,031	3,968	3,849	3,517	Thousand tonnes
Limestone & granite	NA	NA	10,832	10,687	9,967	14,294	16,914	18,384	18,303	20,980	15,607	Thousand tonnes
Slate	NA	NA	74	83	69	74	97	77	86	98	96	Thousand tonnes
2. Deforestation / Land use												
Volume removed by thinning/felling	NA	NA	NA	NA	NA	NA	NA	NA	NA	-8	NA	Thousand hectares
New planting	NA	NA	NA	NA	NA	NA	NA	NA	NA	15	NA	Thousand hectares
Restocking	NA	NA	NA	NA	NA	NA	NA	NA	NA	15	NA	Thousand hectares
3. Water use												
Ground Water use	33,446	32,903	32,923	32,384	31,549	33,742	33,970	32,329	34,462	35,249	NA	Megalitres/Day
Degradation												
Soil erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-
Solid wastes	NA	NA	NA	NA	NA	NA	NA	NA	NA	109	NA	Million tonnes
Water pollution	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-
Sulphur dioxide	4,436	4,211	3,861	3,719	3,724	3,895	3,898	3,811	3,719	3,774	NA	Thousand tonnes
Black smoke	530	529	511	474	545	574	528	522	502	453	NA	Thousand tonnes
Nitrogen oxides.	2,424	2,221	2,234	2,216	2,327	2,416	2,544	2,626	2,717	2,729	NA	Thousand tonnes
V.O.C. s	2,282	2,286	2,254	2,251	2,267	2,302	2,325	2,371	2,427	2,395	NA	Thousand tonnes
Carbon monoxide	5,096	5,233	5,206	5,311	5,531	5,764	6,035	6,382	6,770	6,659	NA	Thousand tonnes
Carbon dioxide	158	155	153	148	155	159	160	160	157	160	NA	Thousand tonnes
Methane	4,569	4,620	4,657	3,959	4,480	4,700	4,672	4,589	4,417	4,371	NA	Thousand tonnes

Notes:-
1. NA - figures not available.
2. Figures for gas reserves do not include coal bed methane.
3. Figures in brackets are extrapolated from 1989 input-output analysis.

Source: Department of the Environment, CSO, Department of Trade and Industry, Forestry Commission

Table A.1

UK oil and natural gas reserves 1981-1991

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
OIL (Million Tonnes)											
Remaining reserves (1 Jan)	1,436	1,271	1,468	1,378	1,302	1,235	1,328	1,285	1,190	1,200	1,195
Change in estimation	-75	300	25	50	60	220	80	20	102	87	126
Extraction in year	90	103	115	126	127	127	123	115	92	92	91
Remaining reserves (31 Dec)	1,271	1,468	1,378	1,302	1,235	1,328	1,285	1,190	1,200	1,195	1,230
NATURAL GAS (Billion cubic metres)											
Remaining reserves (1 Jan)	1,101	1,007	941	1,149	1,325	1,242	1,325	1,298	1,195	1,185	1,200
Change in estimation	-58	-30	244	212	-43	125	17	-61	32	61	87
Extraction in year	36	36	36	36	40	42	44	42	42	46	52
Remaining reserves (31 Dec)	1,007	941	1,149	1,325	1,242	1,325	1,298	1,195	1,185	1,200	1,235

Notes:
1. All figures taken from the "Brown book". There may be small discrepencies due to rounding.
2. Figures are proven plus probable reserves.
3. Changes in estimates are due to new finds and re-assessment of existing reserves.
4. Comparable figures are not available for coal reserves.
5. Figures for gas reserves exclude coal bed methane.

Source: Department of Trade and Industry

Table A.2

Energy balance

Million Therms

United Kingdom	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Production of primary fuels	83,013	86,909	93,090	97,823	85,914	99,134	103,273	101,091	97,431	87,296	86,468
Arrivals (1)	29,937	25,372	25,085	23,008	31,652	29,656	31,048	29,972	31,970	34,291	35,710
Shipments (1)	-24,496	-30,369	-34,255	-37,893	-40,872	-43,288	-45,572	-43,264	-39,246	-29,710	-32,082
Marine bunkers (2)	-1,017	-856	-1,078	-841	-941	-889	-878	-697	-767	-1,002	-1,058
Stock changes (3)	-2,675	742	-1,332	-873	5,067	491	-948	1,219	-362	-1,283	565
Total fuel supply	84,762	81,798	81,510	81,224	80,820	85,104	86,923	88,321	89,026	89,592	89,603
Fuel Input for conversion	67,965	63,643	62,258	62,411	62,930	64,871	66,088	66,831	69,470	70,724	71,505
Fuel Output from conversion	49,521	45,637	44,941	45,041	45,564	46,725	45,895	45,194	49,999	50,902	51,397
Net input for conversion (4)	18,444	18,006	17,317	17,370	17,366	18,146	20,193	21,637	19,471	19,822	20,108
Used by energy industries	4,826	4,536	4,691	4,702	4,614	5,067	5,228	5,138	5,278	5,284	5,237
Losses in distribution (5)	1,123	1,320	1,025	1,421	1,321	1,502	1,492	913	458	669	898
Final energy consumption	56,547	54,920	54,279	54,179	54,052	56,333	57,860	58,677	59,471	59,078	59,381
Non-energy uses	2,963	3,220	3,229	3,424	3,512	3,664	4,068	4,085	4,355	4,298	3,968
Total fuel consumption	83,903	82,002	80,541	81,096	80,865	84,712	88,841	90,450	89,033	89,151	89,592

Notes
1. Arrivals/shipments are approximately equal to imports/exports
2. Marine bunkers are fuel stores at sea
3. Stock rise (-) stock fall (+)
4. Net input for conversion is energy effectively lost as a result of conversion processes
5. Losses in distribution from gas leaks etc.

Source: Department of Trade and Industry

Table A.3

Forest stocks for Forestry Commission land and private woodland in the United Kingdom 1990-91

Monetary value	£ million
Opening stocks (31 March 1990)	8,431
Revaluation to current prices	656
Expenditure on forest costs	253
Net investment in plantations	-817
Grants	-20
Growth in value	330
Sales of timber	-136
Land disposed of	-5
Closing stocks (31 March 1991)	8,629

Source: Forestry Commission

Table A.4

Emissions into the air by industry source (excluding domestic emissions) 1980-90

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Agriculture, forestry and fishing											
Sulphur dioxide	21	17	15	12	10	8	9	8	7	7	8
Black smoke	1	1	1	1	1	1	1	1	1	1	1
Nitrogen oxides	5	5	5	5	5	5	5	4	4	4	4
V.O.C.	80	80	80	80	80	80	80	80	80	80	80
Carbon monoxide	1	1	1	1	1	1	1	1	1	1	1
Carbon dioxide	1	1	1	1	1	1	1	1	1	1	1
Methane	1182	1170	1184	1185	1181	1168	1158	1144	1145	1164	1173
GDP (Constant 1985 prices)	83.0	85.2	92.3	87.3	105.5	100.0	100.1	97.0	95.5	101.0	106.3
Energy and water supply											
Sulphur dioxide	3244	3032	2913	2748	2704	2723	2830	2932	2825	2749	2831
Black smoke	33	30	29	27	36	30	28	28	28	27	29
Nitrogen oxides	923	877	836	823	747	809	842	860	834	805	813
V.O.C.	1205	1198	1199	1202	1205	1208	1217	1224	1230	1233	1236
Carbon monoxide	55	52	50	48	54	50	49	50	49	48	51
Carbon dioxide	64	61	58	57	54	57	59	60	58	57	59
Methane	2436	2468	2487	2503	1783	2289	2492	2452	2346	2155	2101
GDP (Constant 1985 prices)	82.6	86.5	91.6	96.8	88.8	100.0	105.0	103.9	99.3	89.6	88.9
Other production											
Sulphur dioxide	1093	884	795	662	593	562	621	583	617	616	601
Black smoke	82	80	80	79	81	78	80	77	79	77	59
Nitrogen oxides	279	268	258	250	237	243	242	243	247	236	231
V.O.C.	41	41	41	41	41	41	41	41	41	41	41
Carbon monoxide	288	290	287	289	281	290	290	292	296	292	289
Carbon dioxide	43	41	40	38	36	37	37	37	38	37	36
Methane	0	0	0	0	0	0	0	0	0	0	0
GDP (Constant 1985 prices)	96.8	91.0	91.2	93.8	97.4	100.0	101.3	106.6	114.1	119.0	118.4
Transport and communication											
Sulphur dioxide	117	117	116	101	106	102	103	97	105	121	128
Black smoke	124	117	122	129	140	146	159	171	188	202	211
Nitrogen oxides	976	962	994	1026	1101	1234	1187	1302	1409	1549	1556
V.O.C.	890	886	890	861	869	863	884	914	961	1021	996
Carbon monoxide	4145	4246	4391	4394	4593	4688	4930	5258	5639	6083	6009
Carbon dioxide	24	23	24	25	27	28	28	29	31	33	34
Methane	10	10	10	9	9	9	9	10	10	11	10
GDP (Constant 1985 prices)	89.7	89.9	89.0	91.6	96.1	100.0	104.3	112.5	119.4	125.6	128.1
Service Industries (Other than transport and communication)											
Sulphur dioxide	197	178	170	143	148	128	135	107	101	89	90
Black smoke	6	6	6	6	6	6	5	5	4	4	4
Nitrogen oxides	62	61	61	62	63	64	65	61	60	55	56
V.O.C.	1	1	1	1	1	1	1	1	1	1	1
Carbon monoxide	12	11	12	12	11	12	11	10	9	8	8
Carbon dioxide	9	9	9	9	9	10	10	9	9	8	8
Methane	904	921	939	960	984	1013	1039	1065	1087	1087	1088
GDP (Constant 1985 prices)	88.8	89.1	90.7	93.7	97.1	100	104.1	109.3	114.1	116.8	117.9
TOTAL											
Sulphur dioxide	4,672	4,228	4,009	3,666	3,561	3,523	3,698	3,727	3,655	3,582	3,658
Black smoke	246	234	238	242	264	261	273	282	300	311	304
Nitrogen oxides	2,245	2,173	2,154	2,166	2,153	2,355	2,341	2,470	2,554	2,649	2,660
V.O.C.	2,217	2,206	2,211	2,185	2,196	2,193	2,223	2,260	2,313	2,376	2,354
Carbon monoxide	4,501	4,600	4,741	4,744	4,940	5,041	5,281	5,611	5,994	6,432	6,358
Carbon dioxide	141	135	132	130	127	133	135	136	137	136	138
Methane	4,532	4,569	4,620	4,657	3,957	4,479	4,698	4,671	4,588	4,417	4,372
GDP (Constant 1985 prices)	90.3	89.3	90.9	94.2	96.1	100.0	103.8	108.6	113.5	115.8	116.6

Note:
1. All figures are in thousand tonnes except for indices of output.

Sources: Department of the Environment, CSO

Table A.5

Water abstractions: inland water

Estimates of water abstractions from surface water and groundwater

Megalitres / day

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Energy and water supply	29,273	28,247	27,918	28,539	28,189	27,406	29,361	30,046	29,384	30,394	30,948
Index of output	82.6	86.5	91.6	96.8	88.8	100.0	105.0	103.9	99.3	89.6	88.9
Agriculture	225	227	256	289	323	224	293	223	253	413	507
Index of output	83.0	85.2	92.3	87.3	105.5	100.0	100.1	97.0	95.5	101.0	106.3
Other industry	4,423	4,972	4,729	4,095	3,872	3,919	4,099	3,702	2,692	3,654	3,795
Index of output	91.1	89.3	90.6	93.6	97.3	100.0	103.3	109.0	115.3	119.2	119.9
Total abstractions	33,921	33,446	32,903	32,923	32,384	31,549	33,753	33,971	32,329	34,461	35,250
GDP	90.3	89.3	90.9	94.2	96.1	100.0	103.8	108.6	113.5	115.8	116.6

Note:
1. GDP and output are measured at constant factor cost

Sources: Department of the Environment, CSO

Table A.6

Water pollution: coastal and marine waters

Table A.6a

Dumping of sewage sludge and industrial waste at sea

Thousand dry tonnes

	1985	1986	1987	1988	1989	1990
Sewage sludge	252	297	281	288	296	274
Liquid industrial waste	102	115	123	142	142	125
Solid industrial waste	1,786	2,066	2,373	3,374	3,937	3,653
Dredged materials	20,745	19,357	21,545	18,973	20,953	16,259
Total	22,885	21,835	24,322	22,777	25,328	20,311

Source: Ministry of Agriculture, Fisheries and Food

Table A.6b

Quantities of metals dumped at sea as part of sludge, waste and dredgings

Tonnes

	1985	1986	1987	1988	1989	1990
Zinc	7,294	7,124	7,876	6,376	6,107	4,671
Lead	3,298	3,034	3,421	2,750	2,451	1,899
Copper	1,780	1,732	1,874	1,547	1,510	1,225
Chromium	1,701	1,528	1,697	890	1,509	1,214
Nickel	1,209	1,022	1,134	890	769	608
Cadmium	34	39	42	28	23	16
Mercury	21	17	18	14	12	9
Total	15,337	14,497	16,061	12,495	12,380	9,642

Source: Ministry of Agriculture, Fisheries and Food

Table A.6c

Oil spillages requiring clean up and cost incurred

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
No. of oil spills requiring clean up	181	171	170	117	140	130	126	105	120	160	136
Cost incurred (£ thousand)	113	118	66	149	67	107	134	198	217	234	1,193
GDP for oil and natural gas extraction (£ million)	8,736	11,834	13,753	16,154	19,577	19,072	9,036	10,091	7,619	7,342	7,781

Source: Department of the Environment

TABLE A.8
Coastal water quality

Number of identified beaches complying with EC bathing standards

	1988	1989	1990	1991
England & Wales	241	304	318	312
Scotland	12	16	12	15
Northern Ireland	14	16	15	16
Great Britain	267	336	345	343

Note:- EC directive effective from 1988

Source: Department of the Environment

TABLE A.9
Average concentrations of mercury, copper and zinc in the muscles of cod

mg/kg wet weight

		1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Thames	Mercury	0.11	0.10	0.13	0.12	0.08	..	0.07	0.11	..	0.09	..
	Copper	0.20	..	..	..	0.20	..	0.30	0.20	..	0.10	..
	Zinc	3.30	..	..	..	3.50	..	3.30	4.20	..	3.50	..
Liverpool Bay	Mercury	0.37	0.26	0.30	0.28	0.27	0.15	0.25	0.17	0.15	0.11	..
	Copper	0.40	..	..	..	0.20	0.20	0.20	0.30	0.10	0.20	..
	Zinc	3.60	..	..	..	3.60	3.50	3.20	3.20	3.20	3.10	..
North Sea	Mercury	..	0.10	0.10	0.08	0.07	0.08	0.07	0.08	0.10	0.07	..
	Copper	..	..	..	..	0.30	0.20	0.20	0.20	0.20	0.20	..
	Zinc	..	..	..	..	3.30	3.10	3.50	3.30	3.30	3.40	..

Note:
1. .. figures not available

Source: Minitry of Agriculture, Fisheries and Food

ANNEX 2

The user cost approach : splitting net receipts between capital and income

In the discussion of the "user cost" approach to evaluating reserve depletion, the operating surplus or net receipts (receipts net of extraction costs) are divided between the "true" income and the capital element of income or "user cost." The capital element of income is known as the "user cost" because it could be considered as the cost to the user of consuming the natural resource.

A natural resource is assumed to yield receipts, **R**, per year over its remaining lifetime, **n**, assuming the current rate of extraction. A portion of these receipts could be re-invested at a real return, **r**, to ensure a continuous income stream, **X**, indefinitely. The user cost can be expressed as **R-X** and could be set aside and invested (and excluded from GDP) each year at an interest rate of **r** to yield the same level of income, **X**. The percentage of annual receipts that is true income (**X/R**) and the percentage that is the capital element (**1-X/R**) need to be determined. The present value of the finite series, **R**, should equal the present value of the perpetual income, **X**.

The present value of the finite series, **R** is:

$$\sum_{t=0}^{n} \frac{R}{(1+r)^t} = \frac{R\left[\frac{1}{(1+r)^{n+1}}\right]}{1-\frac{1}{1+r}}$$

The present value of the infinite series X is:

$$\sum_{t=0}^{\infty} \frac{X}{(1+r)^t} = \frac{X}{1-\frac{1}{1+r}}$$

Setting the above two equations equal and multiplying by the denominator gives:

$$X = R\left[1-\frac{1}{(1+r)^{n+1}}\right]$$

Hence, the percentage of the operating surplus which can be considered as income is:

$$\frac{X}{R} = 1-\frac{1}{(1+r)^{n+1}}$$

The complement of this is the percentage of the operating surplus which is considered as the user cost and is expressed as:

$$1-\frac{X}{R} = \frac{1}{(1+r)^{n+1}}$$

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