Bank of England

Discussion Papers

Technical Series

No 27

Balancing the National Accounts
an asymptotically maximum likelihood approach
using trends

by

G P Dunn

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The object of this *Technical Series* of Discussion Papers is to give a wider circulation to research being undertaken in the Bank and to invite comment upon it; any comments should be sent to the authors at the address given below.

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Abstract

In recent years, the measurement errors inherent in the national accounts have increased significantly. This has made their interpretation even more problematical than it has been in the past. Richard Stone and his associates proposed a technique for balancing data which satisfies a set of restrictions in which the normalised distance between the observed and the true data is minimised. The normalisation reflects the relative reliabilities of the observed data so that the less reliable data take on more of the balancing adjustment. All subsequent work has utilised Stone's technique but differed in the methods used to construct the normalisation matrix. This paper proposes that the normalisation matrix can be estimated by using the deviation of the variables from a weighted three-term moving average and uses the trend approach to balance quarterly national accounts data over the period 1980—88. The authors make clear that the estimates should be regarded as illustrative of the technique and that for practical purposes further work may be needed, in particular, some variables could be constrained to take no balancing.

Introduction

A technique for balancing data so that it satisfies a set of restrictions was first introduced by Stone, Champernowne and Meade[1] in 1942. The CSO have recently applied this approach to a subset of the national accounts [2] using the subjective judgements of the data compilers on the reliability of the data. Weale [3] has shown that given certain assumptions about the nature of the measurement error, then an asymptotically maximum likelihood estimate of the balanced accounts can be obtained. The approach makes use of regressions to 'explain' bias in the data arising from measurement error, and the fitted errors are used to construct the balancing matrix. This paper first summarises these approaches and comments on their merits and weaknesses. It then goes on to suggest a trend fitting approach similar to the regression methodology. A state-space representation of the data is then presented. It is then easy to see how the regression and trend approaches are both special cases of this more general model. We favour the trend approach which is simple and straightforward to apply and requires minimal subjective judgement on the part of the analyst.

The Stone Approach

Let x be a vector of observed data items. The problem is to adjust x to a vector x^* where $Ax^* = 0$ but where the normalised distance between x and x^* is minimised.

That is, minimise $(x^* - x)^T V^{-1} (x^* - x)$ *s.t.* $Ax^* = 0$ *where* V is a normalisation matrix.

The solution is obtained by minimising the lagrangean $L = (x^* - x)^T V^{-1} (x^* - x) + \lambda A x^*$

$$\frac{\delta L}{\delta x^*} = 2V^{-1}(x^* - x) + A^T\lambda \qquad (1)$$

$$\frac{\delta L}{\delta \lambda} = Ax^* \qquad (2)$$

Setting
$$\frac{\delta L}{\delta x^*} = \frac{\delta L}{\delta \lambda} = 0$$

We obtain from *(1)*
$$(x^* - x) = -\frac{1}{2} VA^T\lambda$$

$$\therefore A(x^* - x) = -\frac{1}{2} AVA^T\lambda$$

(1) Stone, J R N, Champernowne, D G and Meade, J E (1942), 'The Precision of National Income Accounting Estimates' *Review of Economic Studies*, Vol 9, pp 111-125
(2) CSC (1989) 'An Investigation into Balancing the UK National and Financial Accounts 1985-7' *Economic Trends* No 424, February, pp 74 - 103
(3) Weale, M (1989) 'Asymptotic Maximum Likelihood Estimation of National Income and Expenditure' *DAE Working Paper 8913*, University of Cambridge, July 1989

But from *(2)* $Ax^{*} = 0 \therefore Ax = \frac{1}{2} AVA^{T}\lambda$

or $\lambda = 2\,(AVA^{T})^{-1} Ax$

Substitute in (1) we get $V^{-1}(x^{*} - x) + A^{T}(AVA^{T})^{-1} Ax = 0$

and hence $x^{*} = x - VA^{T}(AVA^{T})^{-1} Ax$

Note that $Ax^{*} = 0$ but Ax is a vector of accounting errors, or residuals. Let $e = Ax$. Hence the formula, $x^{*} = x - VA^{T}(AVA^{T})^{-1} e$, allocates the accounting errors to the components of x according to the weights given by V. Now since we are free to minimise whatever distance function we choose, indeed it does not have to be quadratic, the choice of V is arbitrary. If the variables in x, however, are observations, recorded with error, of some underlying processes that are not observable, but are known to obey the identities in A, so that x^{*} might be regarded as an estimator of underlying processes, then it seems sensible that V reflect the relative reliabilities of the observed data so that the less reliable data take more of the balancing adjustment. Hence the variance-covariance matrix of the measurement errors is a suitable choice of V, if such a matrix can be obtained, or assumed. At a later stage we see that, given further assumptions, the balanced data derived as above are maximum likelihood estimates of an assumed underlying process that obeys the accounting identities.

The point to make in this section, however, is that balancing adjustments can be made without even the assumption that an underlying process exists, yet the balanced data are meaningful in that they obey certain criterion, ie the identities, and they minimise a distance function. Introducing the assumption that an underlying process exists reduces the arbitrariness of the choice of V, since it makes sense for V to reflect the reliability of the vector x as an observation, with error, of x^{*}. We may, additionally, choose to set some rows and columns of V to reflect something other than reliability. For example, we might set them to zero if we choose not to allow the corresponding elements of x to take any balancing. Further assumptions about the error structure allow us to pin down V more tightly still. The adjustments then become maximum likelihood. Appendix 1 illustrates the application of the balancing formula in the case of a single variable measured from two sources. In addition it demonstrates that, at least in this simple example, the balanced series need not necessarily lie between the two observations. Whether it does or not depends on whether the covariance between the two error terms is smaller than both of their variances.

The CSO Approach

The CSO exercise makes use of the balancing formula proposed by Stone et al ie,

$$x^{*} = x - VA^{T}(AVA^{T})^{-1} Ax$$

The elements of the V matrix, in the CSO exercise, are obtained by asking the compilers of the various statistics for indication of their reliability, by stating ranges in which the true figure might fall, with 90% probability. The error ranges provided are used to construct the diagonal elements of V. In the work that led to the 1989 article the off-diagonal elements were assumed zero. It is the CSO's intention to do more work to construct off- diagonal elements.

Prior to applying the balancing formula, using V and x constructed as above (A, the matrix of restrictions is determined unambiguously from the national accounts identities), prior adjustments are made to the series in x to take on board deficiencies suspected by compilers but regarded as too subjective to be incorporated in the official statistics. The prior adjustments also reflect revisions that have come to light since the publication of the official statistics. The prior adjustments are quite small, in many cases, compared to the size of the series and the error ranges. The CSO produced a variant on their balancing exercise where prior adjustments were not made. They reported that further work was required before any conclusion could be reached on whether it is adequate to balance without prior adjustment. In our own exercise, we have not used the prior adjustments which are in any case only available for 1985-87.

The Weale Approach - Maximum Likelihood

The Weale approach again employs the balancing formula derived earlier but derives the rule from maximising a likelihood function based on several assumptions about the measurement error, in particular that it is normally distributed with variance-covariance matrix V and mean βZ_t where Z_t is a vector of regressors and β is a matrix of coefficients. (Note x_t is a vector of ρ data items observed at time t, so there are ρ regressions and β is a matrix with ρ rows.) The variance-covariance matrix, V, of the measurement errors, to be used in the balancing formula, is obtained from the regression residuals.

The various assumptions and propositions that Weale requires to derive his asymptotically maximum likelihood estimators are set out in Appendix 2. (Proofs of propositions are available in the Weale [1] paper.) We feel it useful to remind ourselves of these in part to be aware of the weaknesses of the Weale approach, which apply also to a greater or lesser extent to our trend approach, but also to see the similarities in other respects. One weakness, is the requirement that the measurement error be independent of the true series. Another is that there are, in fact, an infinity of solutions to the balancing problem under the Weale approach. The one chosen, although arbitrary, uniquely has the desirable property that when the data already satisfies the accouting identities then the balancing adjustments so obtained are zero.

The essence of the Weale approach is as follows. The measurement error is considered to be made up of two components, a bias component which is correlated with the true data and a second element which is independent. It is also implicitly assumed that neither component of the measurement error obey the accounting identities. Now the problem is to set the elements of the V matrix. If the bias component was zero throughout then it would be sufficient to set V as the variance-covariance matrix of the actual series to be balanced. At first sight this seems wrong because some series are genuinely more volatile than others and yet may be more reliably measured. It would be inappropriate, therefore, for these series to take more of the balancing adjustment. In fact this does not happen. Since genuine volatility in a series must be reflected elsewhere for the accounting identities in the true series to hold, Weale shows that such variance is purged from V on multiplication by the restrictions matrix within the balancing formula.

This is quite a remarkable result. It means that although we cannot, for each series, distinguish between variance due to genuine volatility and variance due to measurement error, we can employ the total variance in the construction of V. The restrictions matrix then purges that variance which satisfies the accounting identities, and the balancing adjustments should

(1) Weale, M (1989) 'Asymptotic Maximum-Likelihood Estimation of National Income and Expenditure'. DAE Working Paper 8913, University of Cambridge, July 1989

reflect only variance due to measurement error. To examine this we calculated the correlation coefficient between the mean of the absolute adjustments and the standard deviation of the errors from the trends expecting to find high, but not too high, correlations. In the event we found a correlation of 0.79 which is a little higher than we had hoped but, nevertheless, not too discouraging. It has to be remembered that the correlation coefficient is not measuring a stochastic relationship but, rather, variations from a mechanical balancing rule. It is only to the extent that the restrictions purge 'genuine' variance, that the correlation coefficient is less than unity. And, of course, one would expect those series suffering most from measurement error to be the most volatile, given the variance decomposition implied by assumption one in Appendix 2.

As the next section demonstrates, algebraically, problems occur when we drop the assumption that the bias is zero. Then, because of its correlation with the true series, the restrictions matrix is no longer able to purge 'genuine' variance from V and the balancing adjustments will reflect genuine noise. Weale overcomes this by using regressions to explain the bias, and remove it from the observed data. Note that it does not matter whether the regressions explain, and remove, variance due to genuine volatility or not, providing this is done consistently across series. In the next section, where a similar approach is introduced but using time trends to remove the bias we return to a discussion of the regression approach and set out our objections to it. The objections on theoretical grounds are not strong however, at least no stronger than objections that might be raised against our trend approach. Our claim is that the trend approach is simple to carry out, less subjective, and yet is not clearly worse on theoretical grounds.

A Trend Approach

Maximum Likelihood (ML) requires us to identify an error that is independent of the true data x_t^*. Although assumption one in Appendix 2 states $E(x_t^* \varepsilon_t^T) = 0$, it would seem that $E(x_t^* (\varepsilon_t - \beta Z_t)^T)$ is what is really required. That is, the 'unexplained' part of the measurement error is assumed independent of the true data. There is no reason why some part or even all of the explainable error should not be independent of x_t^*, however, nor that all or part of the unexplainable component should be independent of x_t^*. The assumption, and hence the partitioning, is essentially arbitrary. It seems no more arbitrary, then, to replace assumption two in Appendix 2, which governs the partitioning, by one that says the low frequency part of the spectrum of the measurement error is correlated, to some degree, with x_t^*, but that the high frequency component is independent. This assumption is, of course, *no less* arbitrary either. The reason for choosing the time trend approach is mainly one of efficiency from a practical point of view. We cannot, of course, identify trends in the measurement errors themselves, but for the same reasons put forward under proposition five of Appendix 2, it is sufficient to fit trends to the observed data themselves, and use these residuals to construct the covariance matrix required for balancing.

It is a relatively straightforward and mechanical procedure to fit trends to a set of series, compared with fitting a set of regressions. Although there is arbitrariness in the choice of trend filter the implications of any particular choice are clear to the analyst, and easy to control. The choice of regressors available to the analyst, however, is extremely large and the relevance of any particular variable to the measurement bias is difficult to determine. Note that the dependent variable is the observed series, not the measurement error, so that variables relevant to the error may not be significant in the regression whereas irrelevant variables, which nevertheless have a role in explaining the true data, may be highly significant. It is unlikely, therefore, that the partitioning between the explicable and inexplicable components of the measurement error will be achieved in practice, and in any case the analyst will not know whether it has been achieved.

Another objection to the regression approach is that the regressor variables may also be measured with error and, given the importance of the possible covariances of errors in this exercise, the risk that the errors in the regressors are correlated with the 'unexplained' part of the measurement error cannot be ruled out. In that case the coefficients will suffer from simultaneity bias and the 'unexplained' part of the error will, to some extent, be falsely explained. Even if simultaneity bias does not exist we may have an errors in variables problem.

A trend fitted to the observed data may also not be independent of that part of the error deemed to be independent of the true data. The degree of independence depends on the trend filter used. The results presented in the main case below uses a simple 3-term moving average. The reasons for using such a responsive trend filter are discussed below.

Some guidance on the choice of filter, however, is obtained by considering the question why filter at all? Why not simply use the covariance matrix of the observed data itself in the balancing formula since it has been argued that multiplication by the restrictions matrix, A, purges the covariance matrix from contributions from x_t^*. Consider

$$x_t = x_t^* + b_t + e_t$$

where x_t and x_t^* are as before, b_t is a component of the measurement error correlated with x_t and e_t is the remaining independent component.

Suppose we form

$$W = \sum_{t=1}^{T} x_t x_t^T$$

Taking expectations

$$E(W) = E\left(\sum_{t=1}^{T} (x_t^* + b_t + e_t)(x_t^* + b_t + e_t)^T\right) = \sum_{t=1}^{T} x_t^* x_t^{*T} + \sum_{t=1}^{T} b_t b_t^T + \sum_{t=1}^{T} e_t e_t^T + \sum_{t=1}^{T} x_t^* b_t^T + \sum_{t=1}^{T} b_t x_t^{*T}$$

Now $$AE(W)A^T = A\sum_{t=1}^{T} b_t b_t^T A^T + A\sum_{t=1}^{T} e_t e_t^T A^T$$

Since $$Ax_t^* = 0 \quad \text{and} \quad x_t^{*T} A^T = 0$$

but $$E(W)A^T = \sum_{t=1}^{T} b_t b_t^T A^T + \sum_{t=1}^{T} e_t e_t^T A^T + \sum_{t=1}^{T} x_t^* b_t^T A^T$$

Hence post multiplication of $E(W)$ by A^T fails to purge x_t^* from $E(W)A^T$ if some component of the measurement error is correlated with the true data. Hence b_t has first to be removed by filtering. The more fine the filter, the more that contribution from b_t will be removed, and the less likely it is that x_t^* will contribute. However, more of e_t will also be removed and the covariance matrix thus obtained will depend more on only the higher frequency component of e_t. The argument then is that the low frequency component of the measurement error is more likely to be correlated with the true series since this, especially since in many cases the true series is trended, is likely to have greater power at the lower frequencies of the spectrum.

Before going on to present the results of balancing the accounts using trends, the next section presents a state-space formulation of the measurement error problem. The presentation is useful first because it shows the close relationship between the regression and trend approaches rather clearly, second because it provides a more formal justification for the trend approach than given so far, and third because it becomes apparent that the balancing rule is, in fact, a Kalman filter applied to the unbalanced data. This last result is hardly surprising given that the Kalman filter yields maximum likelihood estimates and the balancing problem is essentially one of extracting a signal from noisy data.

A State-Space Representation

The balancing rule obtained by Weale corresponds to a Kalman filter when the x_t vector is described by the following state-space representation.

$$x_t = (I, I)\begin{pmatrix} x_t^* \\ \varepsilon_t \end{pmatrix} \qquad (1)$$

$$\begin{pmatrix} x_t^* \\ \varepsilon_t \end{pmatrix} = \begin{pmatrix} Y & 0 \\ 0 & Z \end{pmatrix}\begin{pmatrix} C \\ B \end{pmatrix} + \begin{pmatrix} n_x \\ n_\varepsilon \end{pmatrix} \qquad (2)$$

where x is the (ρ x 1) vector of observed data at time t, x_t^* is the true data, unobserved, ε is a (ρ x 1) vector of measurement errors and I denotes the identity matrix. η_x and η_ε are normally and independently distributed error vectors with covariance matrices Q and V respectively. Hence ε, the measurement error vector, is normally distributed with mean ZB and covariance matrix V. η_x is the so-called 'true' noise and η_ε corresponds to the 'inexplicable' component of the measurement error.

Y is a matrix of observations on a set of regressors that 'explains' x_t^*, and Z is a matrix of observations of regressors that explain ε. Let A be the restrictions matrix such that $Ax_t^* = 0$ and let A_I be the following matrix:-

$$\begin{pmatrix} A & 0 \\ 0 & I \end{pmatrix}$$

where 0 is a matrix of zeroes.

Pre-multiplying (1) and (2) by A and A_I respectively we get:-

$$Ax = A\varepsilon \qquad (3)$$

$$\varepsilon = ZB + \eta_{\varepsilon} \qquad (4)$$

[Note $Ax^{*} = 0$, $AYC + A\eta_{x} = 0$]

This is a state space representation of the accounting errors, Ax, with ε the unobserved process variable being generated by the second equation. This model can be estimated using a Kalman filter. The filter for ε is

$$\hat{\varepsilon} = ZB + VA^{T}[AVA^{T}]^{-1}A(x - ZB)$$

(See, for example, Harvey [1].)

$$x^{*} = x - \varepsilon$$

Hence the estimated balanced data x^{*} is given by

$$\hat{x}^{*} = x - ZB - VA^{T}[AVA^{T}]^{-1}A(x - ZB)$$

$$\hat{x}^{*} = \left[I - VA^{T}[AVA^{T}]A\right](x - ZB)$$

which, of course, is the ML estimator derived by Weale.

This result has important theoretical and practical implications. On a theoretical level it demonstrates that the asymptotically ML estimator derived by Weale corresponds to one particular state-space representation, or more specifically (given the observation equation, equation (1), is fairly uncontroversial) one particular process equation, equation (2). As argued earlier, for example, one might choose a process equation where Y and Z are replaced by deterministic time trends or, indeed, Y, Z, C and B could be chosen to define stochastic time trends eg : -

$$Z = \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix} \text{ and } B = \begin{pmatrix} \varepsilon_{t-1} \\ \delta_{t-1} \end{pmatrix}$$

In this case δ_t would become a process variable also.

On a practical level we see that balancing could be achieved by direct application of a Kalman filter to the accounting residuals. The state-space model specified here is not the one usually employed for trend fitting and regressions however. Rather the state matrix is the restrictions matrix. The filter 'explains' the accounting residuals using a linear combination of the unobserved measurement errors, and allocates the residuals according to the variance-covariance matrix V.

(1) Harvey, A C (1981), 'Time Series Models', Philip Allan

Of course, as noted earlier, V is unknown. In the Weale case, substituting (4) into (3) we see that :-

$$Ax = AZB + A\eta_{\varepsilon}$$

Hence we can obtain an estimate of AVA^T by regressing the accounting residuals, Ax, on Z pre-multiplied by A. Then, as Weale finds, because $Ax^* = 0$ we can obtain estimates of AVA^T and VA^T simply by regressing x on Z. A similar process can be used in the deterministic trend case. More generally, V can be found by maximum likelihood. To our knowledge, however, the software does not exist to handle these general multivariate state-space models.

Values, Volumes and Prices

A particular problem arises in that we are interested in balancing data for both values and volumes. If we balance the two sets of accounts independently then, apart from the fact that we are not making use of all the information available, implausible deflators may be implied by the balanced accounts. To balance values and volumes simultaneously, however, requires us to impose the restrictions that value = volume x price for each series. These restrictions are non-linear and so cannot be handled in the matrix framework set out in previous sections. Weale[1] adopts an approach, suggested by Richard Stone, whereby logarithms of the value, volume and price data are included in the vector to be balanced, in addition to the values and volumes in natural numbers. In the logarithmic data, of course, the non-linear constraint becomes a linear one. That is :

$$C = p_c c \text{ becomes } \log C = \log c + \log p_c$$

$$G = p_g g \text{ becomes } \log G = \log g + \log p_g$$

and so on. The logarithmic data are not linked to the natural variables by any linear constraints. However, if due account is taken of the covariance between each element and its logarithm, then the balancing technique will ensure that the balanced values are almost equal to the exponents of the balanced values of the logarithms

ie $$x_t^* \approx \exp\left[(\log x_t)^*\right]$$

The accuracy of the approximation depends on the magnitude of the adjustment to be made. An important empirical question is the actual magnitude of the discrepancy between the balanced values and the exponents of the balanced values of the logarithms. This can be investigated after the balancing has been carried out. A further consistency check is provided by the deflators. The implicit deflator of each item in the balanced accounts must be defined, for each item, x, as $p_x^* = \dfrac{X^*}{x^*}$. Each of these deflators should be very little different from that derived from the balanced logarithmic variable, $\exp((\log P_x)^*)$.

Weale goes on to derive theoretical variances and covariances that are required for the V matrix, in terms of the variance of x. We have departed from Weale at this point and chosen, instead, to construct these elements of V using deviations from fitted trends, as is done for all other variables. Our view is that, providing the trends are fitted to the component series (ie volumes

(1) Weale, M (1988), 'The Reconciliation of Values, Volumes and Prices in the National Accounts', *Journal of the Royal Statistical Society Series A (General)*, Vol151, Part 1, pp 211-221

and prices) consistently with the trend fitted to the value series, so that the value = volume x price identity holds, at least approximately, in the trends then the empirical covariances should coincide with the theoretical ones based on the variance of x. To the extent that they do not coincide, then the fitted trends are not consistent. There is no reason to suppose, however, that the trend fitted to the value data is any more reliable than those fitted to the volumes and prices or, therefore, that the variance estimated from the value is any more reliable than the volume and price estimates, which is an assumption that Weale implicitly makes. Our success in ensuring the value/volume restrictions hold are discussed later.

Application of the Trend Approach

The arguments for using deviations from trends rather than from a regression have been set out earlier. The section on a state-space representation demonstrated the relationship between the two approaches as particular choices of a state-space representation of the national accounts data in terms of the 'true' series and measurement error. If the software were available to estimate multivariate state-space models then we would have a very general balancing algorithm. Since we do not, then we have to confine ourselves to specific models such as those that lead to the univariate regression and time trend approaches. On the latter, the state-space representation leads naturally to choosing a stochastic time-trend model. At the time of carrying out this exercise, however, suitable software was not available. The problem, primarily, was that only interactive software was available and, given the number of series involved, a batch process was required. Instead, then, we chose to use simple moving averages. The moving average trends could be seen either as a substitute for the regressor set in the Weale approach, or as an approximation to a stochastic trend. Either way, the method is the same as that proposed by Weale save that the V matrix is constructed using deviations from trend instead of deviations from a regression.

A problem with our approach, and would presumably exist in the regression approach too, arises when the published data already obey certain accounting identities but are involved in others that do not hold and are suspected of suffering from measurement error. This is most noticeable in the flow of funds data where the identities hold across lines, (eg deposits with banks equals the sum of deposits placed by the other sectors) but not within sectors, hence the balancing items. The identities usually only hold because of the way the published data has been constructed, cells of the flow of funds matrix calculated by residual for example, but it means that the measurement errors are effectively constrained to obey some, at least, of the accounting identities. Hence multiplying V by the restrictions matrix, A, purges all the variance due to measurement error, as well as 'genuine' variance, and leaves the matrix AVA^T singular. The way we have proceeded is to set the off-diagonal elements corresponding to covariances between flow of funds variables with each other, and with real side variables, to zero. As an assumption about measurement error this is probably reasonable, it is difficult to imagine, for example, why measurement error in one line of the flow of funds matrix should be particularly strongly correlated with that in another, or with a real variable. We have not, however, set the covariances to zero for real variables which are constructed as a residual. One has to be left with some uncertainty, however, as how successfully the 'genuine' variance is purged when some covariances have been set to zero. The results for the real side seem fairly robust, it is the balancing of the identified financial trasactions that is most affected. The remedy undoubtedly leads to more plausible balancing however. If the off-diagonal elements are not set to zero, or so many are not set to zero, large offsetting balancing adjustments result in the flow of funds matrix that look quite implausible. The problem, in fact, is reminiscent of the multicollinearity problem in regressions, where the resulting cross-product matrix of regressors is singular, or close to singular, and large offsetting regression coeffcients are obtained. One solution in such cases is to do a ridge regression and our remedy, in this balancing exercise, is similar though arguably more extreme. Certainly our remedy is a compromise and this is an area where further research may well generate preferred solutions.

The balancing was carried out using both 5-term moving averages (5MA) throughout (weights: .125, .25, .25, .25, .125) and 3MA (weights: .25, .5, .25). We take the 3MA as the main case for the purpose of exposition. However, the results seem to be encouragingly robust to choice of filter as the later sections demonstrate when we compare the main case with 5MA and 3MA using different weights. We also compare our main case with the CSO exercise, published in their February 1989 *Economic Trends* article [(1)] and investigate the 3MA case when the off-diagonal elements are set to zero (except those required to ensure the value/volume restrictions hold) (3MAC). It should, however, be noted that the figures contained in the balanced accounts are primarily designed to be illustrative of the technique and for practical purposes further adjustment of the figures (eg by constraining variables) may be desirable.

Chart 1: Residual error as a percentage of nominal GDRE and GDPY

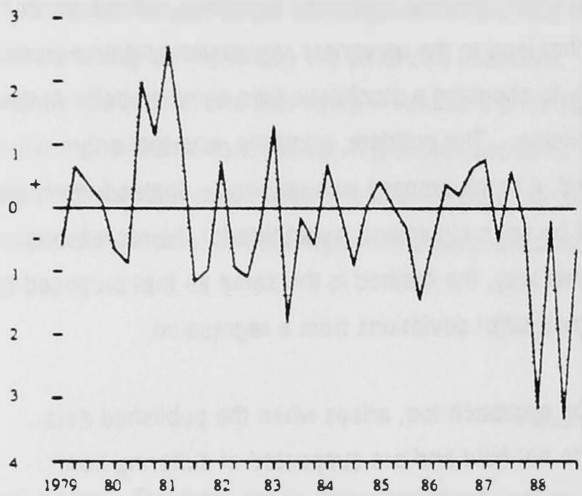
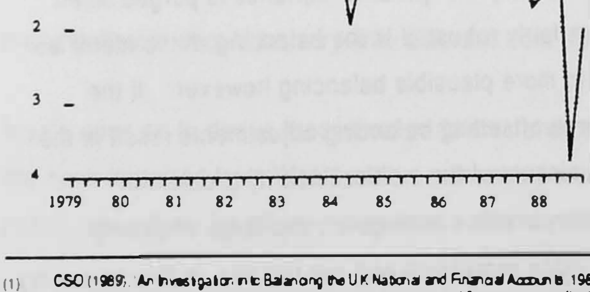


Chart 2: Percentage difference between real GDPE and GDPO



A Comparison of Published and Balanced Data[(2)]

The Scale of the Problem

Charts 1 and 2 show the large discrepancies between the measures of GDP. Although the discrepancy between real GDPE and GDPO has worsened in 1988 relative to earlier years it is noticeable that the residual error as a percentage of GDPE and GDPY has been larger in the early 1980s, consequently we would expect (and in fact find) some large adjustments in the early 1980s as well as the late 1980s when numerous commentators have highlighted the discrepancies. Charts 3 to 8 plot the sectoral balancing items as a percentage of average GDP. The changes in the personal sector and the overseas sector balancing items are particularly noticeable. Such large balancing items make the interpretation of economic statistics subject to a large degree of uncertainty.

(1) CSO (1989), 'An Investigation into Balancing the UK National and Financial Accounts 1985-7', *Economic Trends*, No 424, February, pp 74-103

(2) Balancing was performed on quarterly data although only the annual figures are described. A comprehensive set of balanced accounts are reported in the accompanying tables but not all of these tables are discussed. Appendix 3 gives the identities used and Appendix 4 the notation. Published data used is consistent with April 1988 *Economic Trends* and the May 1988 Bank of England *Quarterly Bulletin*.

Chart 3: The personal sector balancing item as a percentage of average GDP

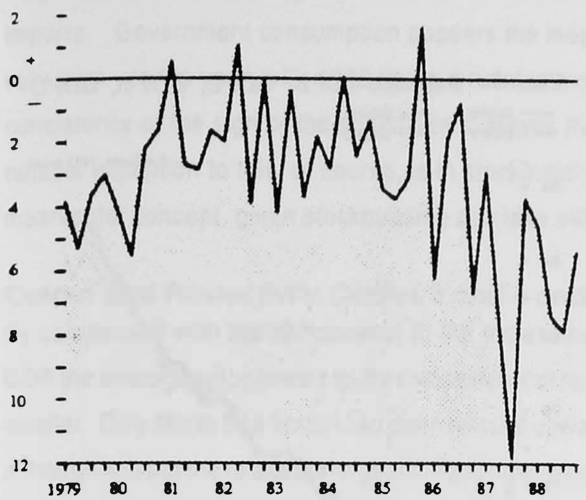


Chart 4: The public sector balancing item as a percentage of average GDP

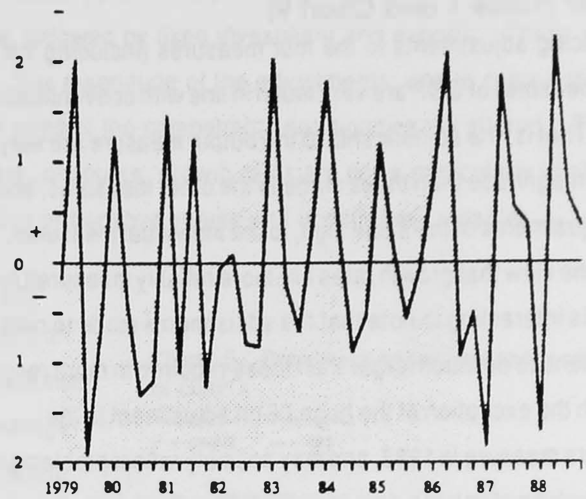


Chart 5 : The overseas sector balancing item as a percentage of average GDP

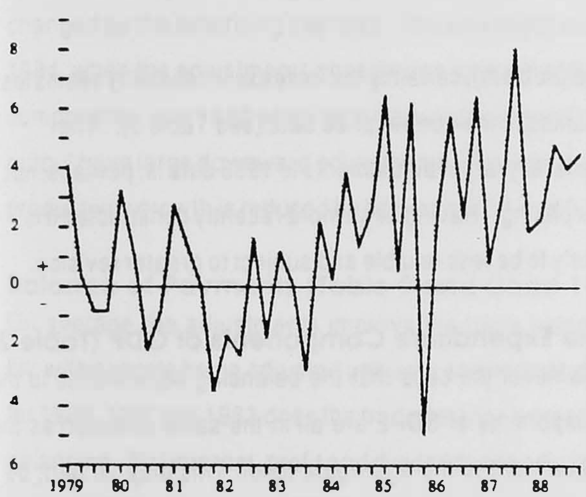


Chart 6 : The banks' balancing item as a percentage of average GDP

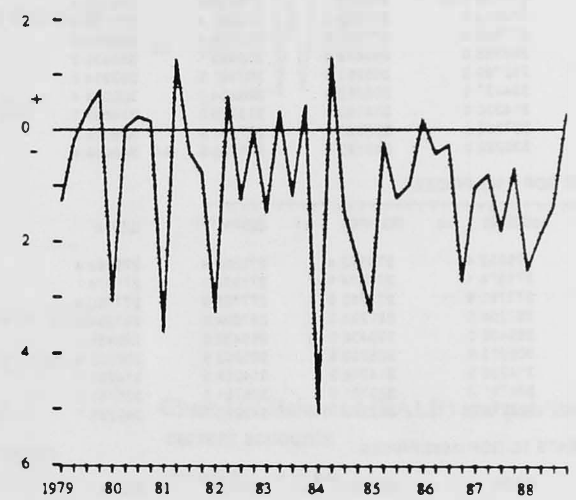


Chart 7 : The OFIs balancing item as a percentage of average GDP

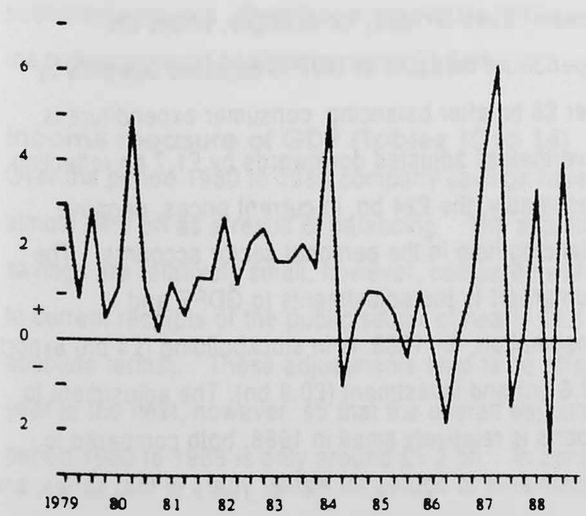
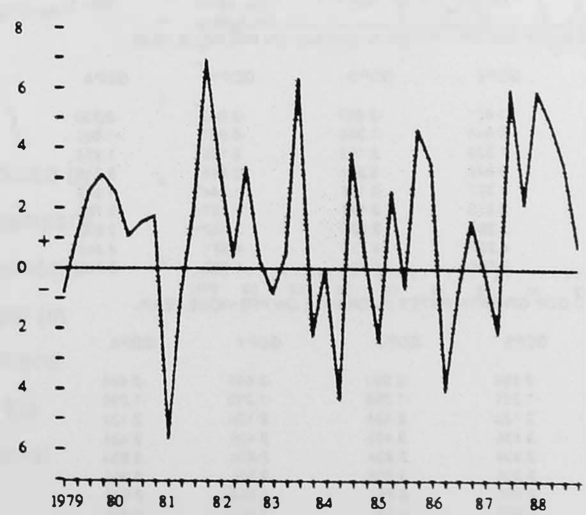


Chart 8 : The ICCs balancing item as a percentage of average GDP



Real GDP (Table 1 and Chart 9)

The balancing adjustments to the four measures (including the average measure) of GDP are very much in line with conventional wisdom. That is, the adjustments to the output measure are very much smaller in magnitude than those made to the other measures, and the runs of adjustments of the same sign, to the individual measures, supports the view that growth rates are more reliably measured than levels. It is interesting to note that the adjustments made to data pre-1985 tend to be much larger than those required in more recent years, with the exception of the huge £6 bn adjustment to the expenditure measure in 1988, and may possibly reflect problems with the chain linking of volume data (see CSO Blue Book for a discussion of the problem), certainly the increase in reliability seems less marked in the current price data (see Table 5). The generally larger adjustments to 1988 data is, perhaps, not surprising. Having been more recently constructed it is likely to be less reliable and subject to greater revision.

Chart 9 : Balanced GDPB, GDPE, GDPY, GDPO

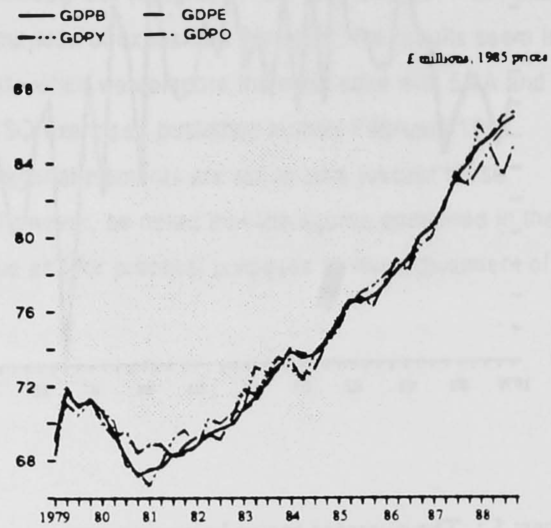


TABLE 1

PUBLISHED GDP (1985 PRICES)

	GDPE	GDPO	GDPY	GDPA
1980	277238.0	275422.7	275920.6	276193.8
1981	274614.0	271683.2	273251.4	273182.9
1982	277969.0	277559.6	279225.3	278258.0
1983	288965.0	286869.9	289963.1	288599.3
1984	292799.0	295951.5	292991.5	293914.0
1985	304437.0	305262.0	305404.1	305034.4
1986	314330.0	314190.9	313778.0	314099.7
1987	327805.0	328996.2	327336.9	328046.0
1988	336289.0	343190.7	341745.5	340408.4

BALANCED GDP (1985 PRICES)

	GDPE	GDPO	GDPY	GDPA
1980	275552.4	275552.4	275552.4	275552.4
1981	271974.1	271974.1	271974.1	271974.1
1982	277750.9	277750.9	277750.9	277750.9
1983	287294.0	287294.0	287294.0	287294.0
1984	295436.0	295436.0	295436.0	295436.0
1985	305203.9	305203.9	305203.9	305203.9
1986	314208.3	314208.3	314208.3	314208.3
1987	328761.3	328761.3	328761.3	328761.3
1988	342299.7	342299.7	342299.7	342299.7

ADJUSTMENTS TO GDP (1985 PRICES

	GDPE	GDPO	GDPY	GDPA
1980	-1685.6	129.7	-368.2	-641.3
1981	-2639.9	290.9	-1277.3	-1208.8
1982	-238.1	191.3	-1474.4	-507.1
1983	-1671.0	424.1	-2669.1	-1305.3
1984	2637.0	-515.5	2444.5	1522.0
1985	766.9	-58.1	-200.2	169.5
1986	-121.7	17.4	430.3	108.6
1987	956.3	-234.5	1424.4	715.3
1988	6010.7	-891.0	554.2	1891.3

PUBLISHED GDP GROWTH RATES (% CHANGE ON PREVIOUS YEAR)

	GDPE	GDPO	GDPY	GDPA
1980	-1.801	-2.853	-2.043	-2.233
1981	-0.946	-1.358	-0.967	-1.090
1982	1.229	2.163	2.186	1.858
1983	3.948	3.354	3.846	3.716
1984	1.327	3.166	1.044	1.842
1985	3.975	3.146	4.237	3.784
1986	3.250	2.925	2.742	2.972
1987	4.287	4.712	4.321	4.440
1988	2.588	4.314	4.402	3.768

BALANCED GDP GROWTH RATES (% CHANGE ON PREVIOUS YEAR)

	GDPE	GDPO	GDPY	GDPA
1980	-2.696	-2.696	-2.696	-2.696
1981	-1.299	-1.299	-1.299	-1.299
1982	2.124	2.124	2.124	2.124
1983	3.436	3.436	3.436	3.436
1984	2.834	2.834	2.834	2.834
1985	3.306	3.306	3.306	3.306
1986	2.950	2.950	2.950	2.950
1987	4.632	4.632	4.632	4.632
1988	4.118	4.118	4.118	4.118

The Expenditure Components of GDP (Table 2)

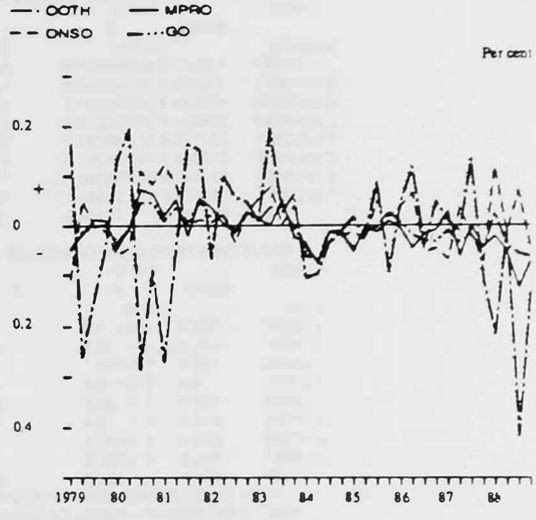
It is never the case that the balancing adjustments to the components of GDPE are all in the same direction as the adjustment to the aggregate itself. This may, in part, be because measurement error in at least some of the components may be negatively correlated, but is much more likely to be because balancing is required between the current price real and financial accounts within the sector. Even in 1988, for example, where the expenditure measure of GDP is adjusted upwards by over £6 bn after balancing, consumer expenditure is nevertheless adjusted downwards by £1.7 bn reflecting, presumably, the £24 bn, in current prices, negative balancing item in the personal sector accounts. The counterpart to the adjustments to GDPE and consumption, for 1988, is in stockbuilding (£4 bn) exports (£2.6 bn) and investment (£0.9 bn). The adjustment to imports is relatively small in 1988, both compared to adjustments to figures for earlier years in that series, and compared to most other components.

More generally, consumption has fairly consistently taken small but negative adjustments. Stockbuilding, judged by the magnitude of the balancing adjustments, is the least reliably measured of the expenditure components of GDP, followed by imports. Government consumption appears the most reliable, followed by fixed investment and exports. These rankings can vary from year to year, with 1988 being a notable exception. The magnitude of the adjustments, and to some extent the consistency of the sign of the adjustments, leaves the growth rates of the components not significantly altered. The most notable exception to this, of course, is in stockbuilding but here, of course, growth rates are not a particularly useful, or even meaningful concept, given stockbuilding can take either positive or negative values and is extremely volatile.

Output and Productivity (Tables 3 and 4 and Chart 10)

By comparison with the components of the expenditure measure of GDP the average adjustments to the components of real output are much smaller. Only North Sea output has been revised upwards on average although without the relatively large (£0.7 bn) downward adjustment in 1988 'other' output would also be raised on average by balancing. As employment is not subject to the balancing exercise changes in output feed directly into the output per head measure of productivity. The small adjustments to the output measures mean that productivity growth is little changed by the balancing exercise. The only slight exception to this is for 1984, when the adjustments change sign for each of the output components, and 1988 when both manufacturing and 'other' sector output have large downward adjustments. For both these years productivity growth is reduced by between 0.2% and 0.3%.

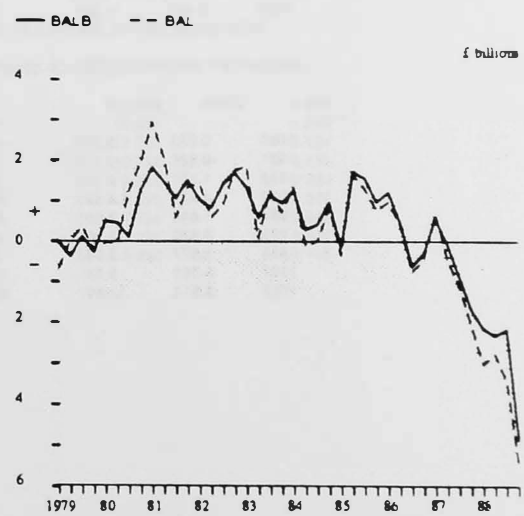
Chart 10 : Percentage adjustment to the components of GDPO



Balance of Payments (Table 9 and Chart 11)

On average the adjustments improve the trade balance by nearly £0.3 bn, with exports being adjusted upwards and imports downwards. Only for 1980, 1981 and 1983 does the trade balance worsen following balancing. Net interest, profit and dividends are adjusted upwards on average although prior to 1984 the adjustment was consistently downwards. The large upward adjustment to IPD of £1.7 bn in 1988 coupled with a £2.2 bn increase in exports results in the current balance being in deficit by £11.4 bn rather than the £14.7 bn suggested by the published accounts. Over the period 1980 to 1988 balancing improves the current account position by nearly £4.9 bn.

Chart 11 : Balanced (BALB) and published (BAL) current accounts



Income measure of GDP (Tables 10 to 14)

Over the period 1980 to 1988 company savings have been reduced by almost £4.0 bn as a result of balancing. The adjustments to company savings are relatively small, however, compared with the adjustments to current receipts of the public sector of nearly £1.1 bn per year (in absolute terms). These adjustments tend to be offsetting from one year to the next, however, so that the overall adjustment over the period 1980 to 1988 is only around £1.3 bn. In contrast, personal

TABLE 2

PUBLISHED COMPONENTS OF GDPE (1985 PRICES)

	CONS	IF	II	G	X	M	FCA	GDPE
1980	193806.0	53416.0	-3357.0	71050.0	68963.0	81185.0	45305.0	277238.0
1981	193832.0	48298.0	-3191.0	71269.0	68205.0	78922.0	44246.0	274614.0
1982	195561.0	50915.0	-1289.0	71826.0	69000.0	82847.0	44895.0	277989.0
1983	204318.0	53476.0	1306.0	73282.0	91092.0	88119.0	46390.0	288965.0
1984	207927.0	58075.0	1072.0	73897.0	97029.0	96687.0	48514.0	292799.0
1985	215535.0	60283.0	569.0	73955.0	102782.0	99168.0	49521.0	304437.0
1986	227757.0	61293.0	689.0	75398.0	106607.0	105521.0	51893.0	314330.0
1987	240100.0	66373.0	916.0	76198.0	112355.0	113370.0	54767.0	327805.0
1988	255624.0	74219.0	1945.0	78612.0	111195.0	126894.0	56412.0	336289.0

BALANCED COMPONENTS OF GDPE (1985 PRICES)

	CONS	IF	II	G	X	M	FCA	GDPE
1980	193477.0	53417.5	-3956.1	71109.4	68897.6	81860.7	45365.7	275552.4
1981	193423.4	48390.8	-4209.0	71382.3	68188.9	80112.9	44439.5	271974.1
1982	195700.4	50981.1	-1495.8	71890.5	68884.3	82896.4	45037.6	277750.9
1983	204324.8	53475.8	470.4	73378.8	90901.2	88620.8	46639.8	287294.0
1984	207790.5	58024.2	2397.5	73725.0	97351.9	95679.8	48175.6	295436.0
1985	215324.1	60292.4	1076.0	73913.3	103067.8	98985.8	49485.8	305203.9
1986	227547.8	60890.9	787.1	75299.2	106561.4	105147.1	51729.6	314208.3
1987	239756.5	65982.1	1597.5	76045.9	112354.0	112525.8	54443.2	328761.3
1988	253933.3	75154.2	5901.6	78425.0	113754.1	126625.5	56234.3	342299.7

ADJUSTMENTS TO COMPONENTS OF GDPE (1985 PRICES)

	CONS	IF	II	G	X	M	FCA	GDPE
1980	-329.0	1.5	-599.1	59.4	-65.4	675.7	60.7	-1685.6
1981	-408.6	92.8	-1018.0	113.3	-16.1	1190.9	193.5	-2639.9
1982	139.4	66.1	-206.8	64.5	-115.7	49.4	142.6	-238.1
1983	6.8	-0.2	-835.6	96.8	-190.8	501.8	249.6	-1671.0
1984	-136.5	-50.8	1325.5	-172.0	322.9	-1007.2	-338.4	2637.0
1985	-210.9	9.4	507.0	-41.7	285.8	-180.3	-35.2	766.9
1986	-209.2	-402.1	98.1	-98.8	-45.6	-373.9	-163.4	-121.7
1987	-343.5	-390.9	681.5	-152.1	-1.0	-844.2	-323.8	956.3
1988	-1690.8	935.2	3956.6	-187.0	2559.1	-268.5	-177.7	6010.7

PUBLISHED GROWTH RATES OF COMPONENTS OF GDPE (% CHANGE ON PREVIOUS YEAR)

	CONS	IF	II	G	X	M	FCA	GDPE
1980	0.006	-5.375	-200.962	1.583	0.196	-3.373	-2.800	-1.801
1981	0.013	-9.581	-4.945	0.308	-0.852	-2.787	-2.337	-0.946
1982	0.892	5.418	-59.605	0.782	0.901	4.973	1.467	1.229
1983	4.478	5.030	-201.319	2.027	2.351	6.364	3.330	3.948
1984	1.766	8.600	-17.917	0.839	6.518	9.723	4.579	1.327
1985	3.659	3.802	-46.922	0.078	5.929	2.564	2.076	3.975
1986	5.671	1.675	21.090	1.951	3.721	6.408	4.790	3.250
1987	5.419	8.288	32.946	1.061	5.392	7.438	5.538	4.287
1988	6.466	11.821	112.336	0.543	-1.032	11.929	3.004	2.588

BALANCED GROWTH RATES OF COMPONENTS OF GDPE (% CHANGE ON PREVIOUS YEAR)

	CONS	IF	II	G	X	M	FCA	GDPE
1980	0.033	-5.503	-199.681	1.765	-0.216	-2.424	-2.298	-2.696
1981	-0.028	-9.410	6.391	0.384	-0.797	-2.135	-2.042	-1.299
1982	1.177	5.353	-64.461	0.712	0.789	3.474	1.346	2.124
1983	4.407	4.893	-131.448	2.070	2.269	6.905	3.558	3.436
1984	1.696	8.505	409.684	0.472	7.096	7.965	3.293	2.834
1985	3.626	3.909	-55.121	0.255	5.871	3.455	2.720	3.306
1986	5.677	0.993	-26.850	1.875	3.390	6.225	4.534	2.950
1987	5.365	8.361	102.970	0.992	5.436	7.018	5.246	4.632
1988	5.913	13.901	269.422	0.498	1.246	12.530	3.290	4.118

TABLE 3

PUBLISHED COMPONENTS OF GDPO (1985 PRICES)

	OOTH	MPRO	GO	ONSO	GDPO
1980	149953.9	70325.6	42630.0	12513.2	275422.7
1981	148995.9	66128.0	42761.4	13798.1	271683.2
1982	152492.8	66255.1	43095.6	15715.9	277559.6
1983	157578.7	68108.7	43969.2	17213.4	286869.9
1984	162247.9	70961.7	44338.2	18403.7	295951.5
1985	169306.1	72688.1	44373.0	18895.0	305262.0
1986	176465.2	73360.4	45238.8	19126.5	314190.9
1987	187143.3	77503.7	45718.8	18630.5	328996.2
1988	197257.5	82937.0	45967.2	17029.1	343190.7

BALANCED COMPONENTS OF GDPO (1985 PRICES)

	OOTH	MPRO	GO	ONSO	GDPO
1980	149930.1	70383.6	42665.6	12573.0	275552.4
1981	148997.5	66200.8	42829.4	13946.5	271974.1
1982	152592.2	66293.6	43134.3	15730.5	277750.9
1983	157788.5	68140.4	44027.3	17337.8	287294.0
1984	162067.5	70865.5	44235.0	18268.1	295436.0
1985	169297.7	72644.5	44348.0	18914.0	305203.9
1986	176598.8	73301.2	45179.5	19128.8	314208.3
1987	187160.9	77441.9	45627.6	18531.1	328761.3
1988	196594.2	82707.9	45855.0	17143.1	342299.7

ADJUSTMENTS TO COMPONENTS OF GDPE (1985 PRICES)

	OOTH	MPRO	GO	ONSO	GDPO
1980	-23.8	58.0	35.6	59.8	129.7
1981	1.6	72.8	68.0	148.4	290.9
1982	99.4	38.5	38.7	14.6	191.3
1983	209.8	31.7	58.1	124.5	424.1
1984	-180.4	-96.2	-103.2	-135.6	-515.5
1985	-8.4	-43.6	-25.0	19.0	-58.1
1986	133.6	-59.2	-59.3	2.3	17.4
1987	17.6	-61.8	-91.2	-99.4	-234.9
1988	-663.4	-229.1	-112.2	113.9	-891.0

PUBLISHED GROWTH RATES OF THE COMPONENTS OF GDPO (% CHANGE ON PREVIOUS YEAR)

	OOTH	MPRO	GO	ONSO	GDPO
1980	-1.469	-8.683	1.583	1.378	-2.853
1981	-0.639	-5.969	0.308	10.268	-1.358
1982	2.347	0.192	0.782	13.899	2.163
1983	3.335	2.798	2.027	9.528	3.354
1984	2.963	4.189	0.839	6.915	3.166
1985	4.350	2.433	0.078	2.669	3.146
1986	4.229	0.925	1.951	1.225	2.925
1987	6.051	5.648	1.061	-2.593	4.712
1988	5.405	7.010	0.543	-8.595	4.314

BALANCED GROWTH RATES OF THE COMPONENTS OF GDPO (% CHANGE ON PREVIOUS YEAR)

	OOTH	MPRO	GO	ONSO	GDPO
1980	-1.348	-8.576	1.765	2.238	-2.696
1981	-0.622	-5.943	0.384	10.924	-1.299
1982	2.413	0.140	0.712	12.792	2.124
1983	3.405	2.786	2.070	10.218	3.436
1984	2.712	3.999	0.472	5.365	2.834
1985	4.461	2.510	0.255	3.536	3.306
1986	4.313	0.904	1.875	1.136	2.950
1987	5.981	5.649	0.992	-3.124	4.632
1988	5.040	6.800	0.498	-7.490	4.118

TABLE 4

PUBLISHED & BALANCED PRODUCTIVITY IN MANUFACTURING 'OTHER' & WHOLE ECONOMY

	PRDMAN	PRDMAN(B)	PRDOTH	PDROTH(B)	PRDWH	PRDWH(B)
1980	2554.1	2556.4	2811.1	2810.6	2967.8	2969.2
1981	2666.0	2668.9	2827.1	2827.2	3054.3	3057.6
1982	2844.1	2845.7	2913.9	2915.7	3201.2	3203.4
1983	3086.1	3087.5	2996.2	3000.2	3352.2	3357.1
1984	3277.7	3273.3	2973.6	2970.2	3429.6	3423.6
1985	3380.6	3378.6	3019.0	3018.8	3488.4	3497.8
1986	3492.7	3489.9	3098.3	3100.6	3586.0	3586.2
1987	3739.9	3737.0	3170.7	3171.1	3702.2	3699.5
1988	3949.2	3938.3	3186.0	3175.3	3751.6	3741.9

(B)=BALANCED

PUBLISHED & BALANCED PRODUCTIVITY GROWTH IN MANUFACTURER'S & WHOLE ECONOMY (% CHANGE ON PREVIOUS YEAR)

	PRDMAN	PRDMAN(B)	PRDOTH	PDROTH(B)	PRDWH	PRDWH(B)
1980	-3.735	-3.617	-3.293	-3.174	-1.882	-1.723
1981	4.379	4.403	0.571	0.589	2.914	2.977
1982	6.681	6.625	3.069	3.133	4.808	4.767
1983	8.509	8.497	2.826	2.896	4.717	4.799
1984	6.209	6.017	-0.755	-0.998	2.309	1.980
1985	3.140	3.218	1.527	1.636	2.008	2.166
1986	3.314	3.293	2.626	2.709	2.503	2.528
1987	7.079	7.080	2.339	2.272	3.239	3.160
1988	5.595	5.387	0.480	0.133	1.335	1.145

(B)=BALANCED

TABLE 5

PUBLISHED.BALANCED & ADJUSTMENTS TO NOMINAL GDP (£ MILLIONS)

	GDP9	GDP9(B)	GDP9(A)	GDPY9	GDPY9(B)	GDPY9(A)
1980	200453.0	198996.9	-1456.1	199377.0	198996.9	-380.1
1981	218736.0	216620.9	-2115.1	217716.0	216620.9	-1095.2
1982	236951.0	236995.3	44.3	238025.0	236995.3	-1029.7
1983	260027.0	259032.0	-995.0	260925.0	259032.0	-1893.0
1984	277981.0	279924.5	1943.5	278175.0	279924.5	1749.5
1985	304437.0	305238.8	801.8	305429.7	305238.8	-190.9
1986	322550.0	322414.6	-135.4	321977.7	322414.6	436.9
1987	352791.0	353401.0	610.0	352295.5	353401.0	1105.4
1988	384781.0	390545.8	5764.7	390991.9	390545.8	-446.2

(A)=ADJUSTMENTS (B)=BALANCED

GROWTH RATES OF PUBLISHED & BALANCED NOMINAL GDP (% CHANGE ON PREVIOUS YEAR)

	GDP9	GDP9(B)	GDPY9	GDPY9(B)
1980	16.469	15.279	16.122	15.279
1981	9.121	8.856	9.198	8.856
1982	8.327	9.406	9.328	9.406
1983	9.739	9.298	9.621	9.298
1984	6.905	8.066	6.611	8.066
1985	9.517	9.043	9.798	9.043
1986	5.950	5.627	5.418	5.627
1987	9.376	9.611	9.416	9.611
1988	9.068	10.511	10.984	10.511

(B)=BALANCED

TABLE 6

PUBLISHED COMPONENTS OF GDPE (£ MILLIONS)

	GDP9	G9	IF9	II9	C9	X9	M9	TE	ESAB
1980	200453.0	49022.0	41561.0	-2572.0	137896.0	62926.0	57824.0	36475.0	5719.0
1981	218736.0	55457.0	41304.0	-2768.0	153566.0	67694.0	60421.0	42485.0	6369.0
1982	236951.0	60446.0	44824.0	-1188.0	168545.0	73015.0	[illegible]	46467.0	5811.0
1983	260027.0	65873.0	48615.0	1465.0	184619.0	80641.0	77895.0	49460.0	6269.0
1984	277981.0	69871.0	55025.0	1271.0	197494.0	92349.0	82987.0	62580.0	7538.0
1985	304437.0	73955.0	60283.0	569.0	216535.0	102782.0	99166.0	56723.0	7202.0
1986	322550.0	79612.0	64254.0	699.0	237640.0	98475.0	101544.0	62694.0	6108.0
1987	352791.0	85552.0	73163.0	1038.0	259966.0	107240.0	112080.0	68172.0	6084.0
1988	384781.0	91547.0	86477.0	2404.0	290706.0	107715.0	124799.0	75131.0	5862.0

BALANCED COMPONENTS OF GDPE (£ MILLIONS)

	GDP9	G9	IF9	II9	C9	X9	M9	TE	ESAB
1980	198996.9	49024.4	41373.7	-3275.8	137632.6	62844.8	58013.2	36444.8	5744.5
1981	216620.9	55517.2	41076.0	-3953.4	153260.8	67686.9	61128.4	42445.4	6401.0
1982	236995.3	60532.7	44740.1	-1373.1	168624.6	72952.5	67943.0	46468.0	5805.5
1983	259032.0	65969.0	48348.2	538.7	184595.4	80421.8	77930.4	49373.1	6286.8
1984	279924.5	69791.6	55383.8	2715.5	197378.2	92547.2	82502.0	62623.3	7483.1
1985	305238.8	74012.8	60419.7	1077.3	215352.5	103021.1	99014.3	56718.1	7149.5
1986	322414.6	79485.6	64055.3	734.4	237432.9	98384.9	101071.3	62491.0	6105.0
1987	353401.0	85405.7	73077.2	1724.5	259618.3	107121.9	111345.7	68001.8	6059.6
1988	390545.8	92129.5	88119.7	6431.3	289398.3	109874.4	125169.6	75587.0	5478.9

ADJUSTMENTS TO COMPONENTS OF GDPE (£ MILLIONS)

	GDP9	G9	IF9	II9	C9	X9	M9	TE	ESAB
1980	-1456.1	2.4	-80.5	-703.8	-263.4	-81.2	389.2	-30.2	25.5
1981	-2115.1	60.2	-29.6	-1185.4	-305.2	-7.1	707.4	-19.6	32.0
1982	44.3	86.7	38.5	-185.1	79.6	-62.5	-92.0	1.0	-5.5
1983	-995.0	96.0	-97.4	-926.3	-23.6	-119.2	35.4	-86.9	17.8
1984	1943.5	-79.4	116.0	1444.5	-115.8	198.2	-485.0	43.3	-54.9
1985	801.8	57.8	74.5	508.3	-182.5	239.1	-151.7	-4.9	-52.5
1986	-135.4	-126.4	-419.1	35.4	-207.1	-90.1	-472.7	-203.0	-3.0
1987	610.0	-146.3	-340.7	686.5	-347.7	-118.1	-734.3	-170.2	-24.4
1988	5764.7	582.5	1509.2	4027.3	-1307.7	2159.4	370.6	456.0	-383.1

PUBLISHED GROWTH RATE OF THE COMPONENTS OF NOMINAL GDP (% CHANGE ON PREVIOUS YEAR)

	GDP9	G9	IF9	II9	C9	X9	M9	TE	ESAB
1980	16.469	26.063	12.555	-218.964	16.219	14.611	5.936	22.936	23.175
1981	9.121	13.127	-0.618	7.621	11.364	7.577	4.854	16.422	11.366
1982	8.327	8.996	8.522	-57.081	9.754	7.860	12.602	9.424	-8.761
1983	9.739	8.978	8.458	-223.316	9.537	10.307	14.493	6.441	7.882
1984	6.905	6.069	13.185	-13.242	6.974	14.661	19.375	6.308	20.242
1985	9.517	5.845	9.556	-55.232	9.135	11.297	6.645	7.879	-4.457
1986	5.950	7.649	6.587	22.847	10.256	-4.190	2.398	10.527	-15.193
1987	9.376	7.461	13.865	48.498	9.395	8.901	10.376	8.738	-0.393
1988	9.068	7.007	18.198	131.599	11.825	0.443	11.348	10.208	-3.649

BALANCED GROWTH RATE OF THE COMPONENTS OF NOMINAL GDP (% CHANGE ON PREVIOUS YEAR)

	GDP9	G9	IF9	II9	C9	X9	M9	TE	ESAB
1980	15.279	26.106	11.352	-216.382	16.285	14.073	6.488	22.553	24.598
1981	8.856	13.244	-0.720	20.684	11.355	7.705	5.370	16.465	11.429
1982	9.406	9.034	8.920	-65.268	10.025	7.779	11.148	9.477	-9.303
1983	9.298	8.981	8.065	-139.230	9.471	10.239	14.700	6.252	8.291
1984	8.066	5.795	14.552	404.103	6.925	15.077	18.698	6.583	19.025
1985	9.043	6.048	9.093	-60.329	9.107	11.317	7.040	7.781	-4.458
1986	5.627	7.394	6.017	-31.830	10.253	-4.500	2.078	10.178	-14.610
1987	9.611	7.448	14.085	134.832	9.344	8.880	10.165	8.819	-0.743
1988	10.511	7.873	20.584	272.936	11.471	2.569	12.415	11.154	-9.567

TABLE 7

PUBLISHED STOCKBUILDING BY SECTOR (£ MILLIONS)

	II9	IIG9	IIJ9	III9	IIF9
1980	-2572.0	282.0	-340.0	-2600.0	6.0
1981	-2768.0	-33.0	-211.0	-2533.0	9.0
1982	-1188.0	416.0	88.0	-1866.0	4.0
1983	1485.0	898.0	132.0	897.0	38.0
1984	1271.0	-171.0	183.0	1225.0	24.0
1985	569.0	420.0	-40.0	188.0	0.0
1986	699.0	-478.0	371.0	807.0	0.0
1987	1038.0	-728.0	289.0	1477.0	0.0
1988	2404.0	-289.0	358.0	2315.0	0.0

BALANCED STOCKBUILDING BY SECTOR (£ MILLIONS)

	II9	IIG9	IIJ9	III9	IIF9
1980	-3275.8	133.5	-307.7	-3120.1	18.5
1981	-3958.4	-248.0	-312.6	-3422.9	30.1
1982	-1373.1	411.7	84.5	-1876.2	8.9
1983	538.7	453.8	109.2	-77.0	52.8
1984	2715.5	7.6	240.8	2458.2	8.9
1985	1077.3	445.2	-15.3	644.9	2.4
1986	734.4	-521.2	355.9	897.6	2.0
1987	1724.5	-680.2	307.2	2101.2	-3.8
1988	6431.3	-10.4	500.3	5926.9	14.5

ADJUSTMENTS TO STOCKBUILDING BY SECTOR (£ MILLIONS)

	II9	IIG9	IIJ9	III9	IIF9
1980	-703.8	-128.5	-67.7	-520.1	12.5
1981	-1185.4	-215.0	-101.6	-889.9	21.1
1982	-185.1	-4.3	26.5	-210.2	2.9
1983	-926.3	-144.2	-22.8	-774.0	14.8
1984	1444.5	178.6	57.8	1223.2	-15.1
1985	508.3	25.2	24.7	455.9	2.4
1986	35.4	-42.2	-15.1	90.6	2.0
1987	686.5	47.8	18.2	624.2	-3.8
1988	4027.3	258.6	142.3	3611.9	14.5

PUBLISHED GROWTH RATES OF STOCKBUILDING BY SECTOR (% CHANGE ON PREVIOUS YEAR)

	II9	IIG9	IIJ9	III9	IIF9
1980	-219.0	-427.5	-161.5	-239.1	-135.3
1981	7.6	-112.6	-12.1	-2.6	50.0
1982	-57.1	-1360.6	-127.5	-34.2	-55.6
1983	-223.3	43.8	127.6	-141.8	850.0
1984	-13.2	-128.6	38.6	77.2	-36.8
1985	-55.2	-345.6	-121.9	-84.7	-100.0
1986	22.8	-214.0	-1027.5	327.0	N/A
1987	48.5	52.0	-22.1	83.0	N/A
1988	131.6	-63.0	23.9	56.7	N/A

BALANCED GROWTH RATES OF STOCKBUILDING BY SECTOR (% CHANGE ON PREVIOUS YEAR)

	II9	IIG9	IIJ9	III9	IIF9
1980	-216.4	-507.2	-179.6	-225.9	-202.1
1981	20.7	-285.8	1.6	9.7	62.6
1982	-65.3	-266.0	-127.0	-45.2	-77.1
1983	-139.2	10.2	29.2	-95.9	665.5
1984	404.1	-98.3	120.5	-3290.5	-83.1
1985	-60.3	5775.7	-106.4	-73.8	-72.5
1986	-31.8	-217.1	-2422.5	39.2	-17.4
1987	134.8	30.5	-13.7	134.1	-286.4
1988	272.9	-98.5	62.9	182.1	-486.3

TABLE 8

PUBLISHED FIXED INVESTMENT BY SECTOR (£ MILLIONS)

	IF9	IFG9	IFJ9	IFI9	IFF9
1980	41561.0	12152.0	8284.0	14893.0	6232.0
1981	41304.0	11358.0	9716.0	14716.0	5514.0
1982	44824.0	11429.0	11897.0	15292.0	6206.0
1983	48615.0	13591.0	13796.0	15890.0	5338.0
1984	55025.0	13798.0	14638.0	19565.0	7024.0
1985	60283.0	12240.0	16452.0	24762.0	7829.0
1986	64254.0	12558.0	17999.0	28336.0	7361.0
1987	73163.0	11468.0	21089.0	32195.0	8411.0
1988	86477.0	10437.0	27095.0	37375.0	11570.0

BALANCED FIXED INVESTMENT BY SECTOR (£ MILLIONS)

	IF9	IFG9	IFJ9	IFI9	IFF9
1980	41373.7	11982.7	9157.2	16001.8	6338.8
1981	41076.0	11066.3	9557.0	14938.7	5712.4
1982	44740.1	11367.1	11792.0	15375.0	6328.4
1983	48348.2	13382.7	13565.6	16061.8	5507.4
1984	55383.8	14164.3	14902.4	19293.0	6781.2
1985	60419.7	12367.5	15530.3	24692.8	7766.8
1986	64055.3	12648.5	17888.9	28156.8	7140.7
1987	73077.2	11707.9	21039.9	31918.3	8156.1
1988	88119.7	11271.5	28132.2	37145.9	11436.5

ADJUSTMENTS TO FIXED INVESTMENT BY SECTOR (£ MILLIONS)

	IF9	IFG9	IFJ9	IFI9	IFF9
1980	-80.5	-169.3	-126.8	108.8	106.8
1981	-29.6	-291.7	-159.0	222.7	198.4
1982	38.5	-61.9	-105.0	83.0	122.4
1983	-97.4	-208.3	-230.4	171.8	169.4
1984	116.0	366.3	264.4	-272.0	-242.6
1985	74.5	127.5	78.3	-69.2	-62.2
1986	-419.1	90.5	-110.1	-179.2	-220.3
1987	-340.7	239.9	-49.1	-276.7	-254.9
1988	1509.2	834.5	1037.2	-229.1	-133.5

PUBLISHED GROWTH RATES OF FIXED INVESTMENT BY SECTOR (% CHANGE ON PREVIOUS YEAR)

	IF9	IFG9	IFJ9	IFI9	IFF9
1980	12.555	12.665	13.802	6.091	32.691
1981	-0.618	-6.534	4.653	-1.188	5.390
1982	8.522	0.625	22.448	3.914	12.550
1983	8.458	18.917	15.962	3.911	-13.986
1984	13.185	1.523	6.103	23.128	31.585
1985	9.556	-11.291	5.561	26.563	11.461
1986	6.587	2.596	16.483	6.357	-5.976
1987	13.865	-8.680	17.168	22.247	14.264
1988	18.198	-8.990	28.479	16.089	37.558

BALANCED GROWTH RATES OF FIXED INVESTMENT BY SECTOR (% CHANGE ON PREVIOUS YEAR)

	IF9	IFG9	IFJ9	IFI9	IFF9
1980	11.352	9.610	9.932	7.533	37.695
1981	-0.720	-7.647	4.365	-0.420	6.998
1982	8.920	2.718	23.386	2.921	10.784
1983	8.065	17.732	15.041	4.467	-12.973
1984	14.552	5.840	9.854	20.117	23.129
1985	9.093	-12.685	4.213	27.988	14.535
1986	6.017	2.272	15.187	5.929	-8.062
1987	14.085	-7.436	17.614	22.027	14.221
1988	20.584	-3.728	33.709	16.378	40.220

TABLE 9

PUBLISHED COMPONENTS OF THE BALANCE OF PAYMENTS (£ MILLIONS)

	X9	M9	BIPD	EGTA	EJTA	BAL
1980	62926.0	57824.0	-196.0	1780.0	204.0	3122.0
1981	67694.0	60421.0	1210.0	1607.0	-60.0	6936.0
1982	73015.0	68035.0	1446.0	1789.0	-48.0	4685.0
1983	80541.0	77895.0	2847.0	1930.0	-330.0	3893.0
1984	82349.0	82987.0	4432.0	2099.0	-382.0	2077.0
1985	102782.0	99166.0	2747.0	3332.0	-324.0	3355.0
1986	88475.0	101544.0	5356.0	2233.0	-97.0	151.0
1987	107240.0	112080.0	6387.0	3288.0	164.0	-2905.0
1988	107715.0	124799.0	6001.0	3269.0	313.0	-14665.0

BALANCED COMPONENTS OF THE BALANCE OF PAYMENTS (£ MILLIONS)

	X9	M9	BIPD	EGTA	EJTA	BAL
1980	62844.8	58013.2	-528.4	1759.9	206.8	2336.4
1981	67686.9	61128.4	780.6	1511.0	-55.4	5863.5
1982	72952.5	67943.0	1425.4	1604.3	-49.9	4980.5
1983	80421.8	77930.4	2638.4	1432.8	-329.9	4026.8
1984	82547.2	82502.0	4900.8	2410.5	-383.5	2919.1
1985	103021.1	99014.3	2988.1	3214.6	-324.6	4105.0
1986	88384.9	101071.3	5379.3	2023.5	-96.8	766.2
1987	107121.9	111345.7	6542.1	3193.1	162.5	-2037.4
1988	109874.4	125169.6	7681.2	3497.3	313.1	-11424.5

ADJUSTMENTS TO THE COMPONENTS OF THE BALANCE OF PAYMENTS (£ MILLIONS)

	X9	M9	BIPD	EGTA	EJTA	BAL
1980	-81.2	389.2	-332.4	-20.1	2.8	-785.6
1981	-7.1	707.4	-449.4	-96.0	4.6	-1072.5
1982	-62.5	-92.0	-20.6	-284.7	-1.9	295.5
1983	-119.2	35.4	-208.6	-497.2	0.1	133.8
1984	198.2	-485.0	468.8	311.5	-1.5	842.1
1985	239.1	-151.7	241.1	-117.4	-0.6	750.0
1986	-90.1	-472.7	23.3	-209.5	0.2	615.2
1987	-118.1	-734.3	155.1	-94.9	-1.5	867.6
1988	2159.4	370.6	1680.2	228.3	0.1	3240.5

TABLE 10

PUBLISHED COMPONENTS OF THE NOMINAL INCOME MEASURE OF GDP (£ MILLIONS)

	GDPY9	YGC	YD	SC	EJTA	TE	YSA	YJG	EDBT	BIPD
1980	199377.0	98452.0	180151.0	22253.0	204.0	38475.0	8391.0	25524.0	11489.0	-188.0
1981	217716.0	112339.0	178244.0	23542.0	-80.0	42465.0	5974.0	31242.0	13458.0	1210.0
1982	238025.0	124908.0	191281.0	25491.0	-48.0	46467.0	4276.0	36584.0	14834.0	1448.0
1983	260925.0	134137.0	206132.0	32224.0	-330.0	49460.0	4204.0	39843.0	14884.0	2847.0
1984	278175.0	141182.0	220899.0	37398.0	-382.0	52580.0	4496.0	43020.0	16394.0	4432.0
1985	305429.7	153093.0	238804.0	41053.0	-324.0	56723.0	2816.0	46792.0	18119.0	2747.0
1986	321977.7	160693.0	256946.0	43133.0	-97.0	62694.0	2014.0	50823.0	17810.0	5356.0
1987	352295.5	170888.0	275386.0	55285.0	164.0	68172.0	4915.0	52553.0	18401.0	5387.0
1988	390991.9	187683.0	303051.0	60134.0	313.0	75131.0	6090.0	54312.0	18855.0	6001.0

BALANCED COMPONENTS OF THE NOMINAL INCOME MEASURE OF GDP (£ MILLIONS)

	GDPY9	YGC	YD	SC	EJTA	TE	YSA	YJG	EDBT	BIPD
1980	198996.9	98828.1	180196.8	22070.3	206.8	38444.8	8414.6	25469.4	11504.7	-520.4
1981	216620.9	111074.7	178124.0	23511.1	-55.4	42445.4	6241.2	31157.1	13429.6	780.8
1982	236995.3	124577.7	191186.0	24963.8	-49.9	46468.0	4551.4	36563.4	14674.2	1425.4
1983	259032.0	132651.1	206051.8	31868.8	-329.9	49373.1	4704.8	39801.1	14692.6	2638.4
1984	279924.5	142809.8	221181.0	37332.9	-383.5	52623.3	3838.4	43072.9	18579.9	4900.8
1985	305238.8	153278.8	238882.9	40724.7	-324.6	56718.1	2710.8	46785.4	18121.3	2988.1
1986	322414.8	160290.4	257377.4	43174.5	-96.8	62491.0	1698.8	50858.4	17903.0	5379.3
1987	353401.0	171398.9	276038.2	54724.8	162.5	68001.8	4243.4	52588.7	18547.6	5542.1
1988	390545.8	190748.1	302904.3	58195.5	313.1	75587.0	5367.4	54176.9	18803.3	7681.2

ADJUSTMENTS TO COMPONENTS OF THE NOMINAL INCOME MEASURE OF GDP (£ MILLIONS)

	GDPY9	YGC	YD	SC	EJTA	TE	YSA	YJG	EDBT	BIPD
1980	-380.1	-623.9	45.6	-182.7	2.8	-30.2	23.6	-54.5	15.7	-332.4
1981	-1095.2	-1264.3	-120.0	-30.9	4.6	-19.6	267.2	-84.9	-28.4	-449.4
1982	-1029.7	-330.3	-95.0	-527.2	-1.9	1.0	275.4	-20.6	-159.8	-20.6
1983	-1893.0	-1485.9	-80.2	-355.4	0.1	-86.9	500.8	-41.9	-191.4	-208.6
1984	1749.5	1627.7	282.0	-65.1	-1.5	43.3	-657.6	52.9	185.9	468.8
1985	-190.9	185.7	78.9	-328.3	-0.6	-4.9	-105.2	-6.6	2.3	241.1
1986	436.9	-402.6	431.4	41.5	0.2	-203.0	-315.2	35.4	93.0	23.3
1987	1105.4	510.9	652.2	-560.2	-1.5	-170.2	-671.6	35.7	146.6	155.1
1988	-446.2	3065.1	-146.7	-1938.5	0.1	456.0	-722.6	-135.1	148.3	1680.2

PUBLISHED GROWTH RATES OF COMPONENTS OF THE NOMINAL INCOME MEASURE OF GDP (% CHANGE ON PREVIOUS YEAR)

	GDPY9	YGC	YD	SC	EJTA	TE	YSA	YJG	EDBT	BIPD
1980	16.122	22.090	17.918	-16.399	5.155	22.936	-27.679	22.025	23.498	-116.266
1981	9.198	16.471	10.049	5.792	-129.412	16.422	-6.525	22.402	17.138	-717.347
1982	9.328	11.188	8.532	8.279	-20.000	9.424	-28.423	17.099	10.224	19.504
1983	9.621	7.389	7.764	26.413	587.500	6.441	-1.684	8.908	0.337	96.888
1984	6.611	5.252	7.164	16.056	15.758	6.308	6.946	7.974	10.145	55.673
1985	9.798	8.437	8.106	9.773	-15.183	7.879	-37.367	8.768	10.522	-38.019
1986	5.418	4.964	7.597	5.067	-70.062	10.527	-28.480	8.615	-1.705	94.976
1987	9.416	6.344	7.177	28.173	-269.072	8.738	144.042	3.404	3.318	0.579
1988	10.984	9.828	10.046	8.771	90.854	10.208	23.906	3.347	1.380	11.398

BALANCED GROWTH RATES OF COMPONENTS OF THE NOMINAL INCOME MEASURE OF GDP (% CHANGE ON PREVIOUS YEAR)

	GDPY9	YGC	YD	SC	EJTA	TE	YSA	YJG	EDBT	BIPD
1980	15.279	19.949	17.816	-16.455	5.999	22.553	-23.764	21.848	21.701	-139.278
1981	8.856	15.910	9.942	6.528	-126.793	16.465	-2.704	22.331	16.731	-243.934
1982	9.406	12.157	8.552	6.179	-9.881	9.477	-27.074	17.352	9.268	87.411
1983	9.298	6.481	7.776	27.659	560.807	6.252	3.369	8.855	0.125	85.090
1984	8.066	7.658	7.342	17.146	16.252	6.583	-18.414	8.220	12.845	85.751
1985	9.043	7.331	8.003	9.085	-15.373	7.781	-29.377	8.619	9.297	-39.028
1986	5.627	4.574	7.742	6.015	-70.176	10.178	-37.332	8.706	-1.205	80.022
1987	9.611	6.930	7.250	26.753	-267.907	8.819	149.789	3.402	3.601	3.027
1988	10.511	11.289	9.733	6.342	92.646	11.154	26.488	3.020	1.378	38.597

TABLE 11

PUBLISHED COMPONENTS OF PERSONAL DISPOSABLE INCOME (£ MILLIONS)

	YD	YWS	YEC	YJG	YRJ	YSE	YDU
1980	160151.0	119005.0	18634.0	25524.0	8381.0	17485.0	9885.0
1981	176244.0	127884.0	21700.0	31242.0	10917.0	19405.0	9729.0
1982	191281.0	136245.0	22376.0	36584.0	12154.0	22066.0	11061.0
1983	206132.0	145469.0	24111.0	39843.0	13383.0	24523.0	12292.0
1984	220899.0	155118.0	24980.0	43020.0	14255.0	27149.0	12530.0
1985	238804.0	168566.0	26048.0	46792.0	15443.0	[illegible]	14270.0
1986	256946.0	182677.0	26988.0	50823.0	16813.0	31252.0	15093.0
1987	275386.0	198515.0	27964.0	52553.0	17975.0	34055.0	16533.0
1988	303051.0	221890.0	29823.0	64312.0	19567.0	36932.0	21046.0

BALANCED COMPONENTS OF PERSONAL DISPOSABLE INCOME (£ MILLIONS)

	YD	YWS	YEC	YJG	YRJ	YSE	YDU
1980	160196.6	118998.8	18643.5	25469.4	8379.8	17491.1	9980.5
1981	176124.0	127820.9	21704.8	31157.1	10925.0	19414.2	9702.0
1982	191186.0	136250.0	22364.4	36563.4	12169.6	22067.5	10980.4
1983	206051.8	145420.4	24096.7	39801.1	13407.5	24530.0	12185.7
1984	221181.0	155204.4	24993.4	43072.9	14231.5	27138.6	12667.2
1985	238882.9	168586.2	26049.0	46785.4	15444.5	28995.0	14224.0
1986	257377.4	182715.2	26999.4	50858.4	16804.1	31254.2	15333.5
1987	276038.2	198643.1	27985.1	52588.7	17954.0	34053.0	16934.6
1988	302904.3	221974.5	29836.9	64176.9	19563.0	36903.2	20384.1

ADJUSTMENTS TO COMPONENTS OF PERSONAL DISPOSABLE INCOME (£ MILLIONS)

	YD	YWS	YEC	YJG	YRJ	YSE	YDU
1980	45.6	-6.2	9.5	-54.5	-1.2	6.1	95.5
1981	-120.0	-63.1	4.8	-84.9	8.0	9.2	-27.0
1982	-95.0	5.0	-11.6	-20.6	15.6	1.5	-80.6
1983	-80.2	-48.6	-14.3	-41.9	24.5	7.0	-106.3
1984	282.0	86.4	13.4	52.9	-23.5	-10.4	137.2
1985	78.9	20.2	1.0	-6.6	1.5	-3.0	-46.0
1986	431.4	38.2	11.4	35.4	-8.9	2.2	240.5
1987	652.2	128.1	21.1	35.7	-21.0	-2.0	401.6
1988	-146.7	84.5	13.9	-135.1	-4.0	-28.8	-661.9

PUBLISHED GROWTH RATES OF COMPONENTS PERSONAL DISPOSABLE INCOME (£ MILLIONS)

	YD	YWS	YEC	YJG	YRJ	YSE	YDU
1980	17.918	18.479	20.827	22.025	19.946	10.651	25.908
1981	10.049	7.461	16.454	22.402	16.374	10.981	-1.578
1982	8.532	6.538	3.115	17.099	11.331	13.713	13.691
1983	7.764	6.770	7.754	8.908	10.112	11.135	11.129
1984	7.164	6.633	3.604	7.974	6.516	10.708	1.936
1985	8.106	8.670	4.275	8.768	8.334	6.811	13.887
1986	7.597	8.371	3.609	8.615	8.871	7.773	5.767
1987	7.177	8.670	3.616	3.404	6.911	8.969	9.541
1988	10.046	11.775	6.646	3.347	8.857	8.448	27.297

BALANCED GROWTH RATES OF COMPONENTS PERSONAL DISPOSABLE INCOME (£ MILLIONS)

	YD	YWS	YEC	YJG	YRJ	YSE	YDU
1980	17.816	18.412	20.762	21.848	20.204	10.721	25.539
1981	9.942	7.414	16.420	22.331	18.473	10.995	-2.791
1982	8.552	6.594	3.039	17.352	11.392	13.667	13.177
1983	7.776	6.731	7.746	8.855	10.172	11.159	10.976
1984	7.342	6.728	3.721	8.220	6.146	10.634	3.951
1985	8.003	8.622	4.224	8.619	8.524	6.841	12.290
1986	7.742	8.381	3.649	8.706	8.803	7.791	7.800
1987	7.250	8.717	3.651	3.402	6.843	8.955	10.442
1988	9.733	11.745	6.617	3.020	8.962	8.370	20.369

TABLE 12

PUBLISHED DEDUCTIONS FROM PERSONAL INCOME (£ MILLIONS)

	EJTA	TYJ	ENIH
1980	204 0	25683 0	13939 0
1981	-60 0	28969 0	15916 0
1982	-48 0	31396 0	18095 0
1983	-330 0	33230 0	20780 0
1984	-382 0	34576 0	22320 0
1985	-324 0	37535 0	24251.0
1986	-97 0	40995 0	26125 0
1987	164 0	43610 0	28363 0
1988	313 0	48729 0	31551.0

BALANCED DEDUCTIONS FROM PERSONAL INCOME (£ MILLIONS)

	EJTA	TYJ	ENIH
1980	206 8	25621 7	13925 7
1981	-55 4	28853.2	15869 6
1982	-49 9	31426.2	18045 7
1983	-329 9	33133 3	20689 4
1984	-383 5	34588 1	22418 3
1985	-324 6	37449 7	24255 9
1986	-96 8	40866 9	26142 8
1987	162 5	43519.5	28426 2
1988	313 1	48295.3	31654 8

ADJUSTMENTS TO DEDUCTIONS FROM PERSONAL INCOME (£ MILLIONS)

	EJTA	TYJ	ENIH
1980	2 8	-61 3	-13 3
1981	4 6	-115 8	-46 4
1982	-1 9	30 2	-49 3
1983	0 1	-96 7	-90 6
1984	-1 5	12 1	98 3
1985	-0 6	-85 3	4 9
1986	0 2	-128 1	17 8
1987	-1 5	-90 5	63 2
1988	0 1	-433 7	103 8

PUBLISHED GROWTH RATES OF DEDUCTIONS FROM PERSONAL INCOMES (% CHANGE ON PREVIOUS YEAR

	EJTA	TYJ	ENIH
1980	5 2	19 0	20 9
1981	-129 4	12 8	14.2
1982	-20 0	8 4	13 7
1983	587 5	5 8	14 8
1984	15 8	4 1	7 4
1985	-15 2	8 6	8 7
1986	-70 1	9 2	7 7
1987	-269 1	6 4	8 6
1988	90 9	11.7	11.2

BALANCED GROWTH RATES OF DEDUCTIONS FROM PERSONAL INCOMES (% CHANGE ON PREVIOUS YEAR,

	EJTA	TYJ	ENIH
1980	6 0	18 9	20 1
1981	-126 8	12 6	14 0
1982	-9 9	8 9	13 7
1983	560 8	5 4	14 7
1984	16 3	4 4	8 4
1985	-15 4	8 3	8 2
1986	-70.2	9 1	7 8
1987	-267 9	6 5	8 7
1988	92 6	11.0	11.4

TABLE 13

PUBLISHED,BALANCED & ADJUSTMENTS TO PERSONAL SECTOR SAVING RATIO (PERCENTAGE)

	SR	SR(B)	SR(A)
1980	13 845	14 028	0.183
1981	12 875	12.998	0 123
1982	11 902	11.819	-0.083
1983	10 438	10 417	-0.021
1984	10 589	10 757	0 168
1985	9 747	9 857	0.110
1986	7.522	7.757	0.235
1987	5 619	5.968	0.349
1988	4 079	4 462	0.383

(A)=ADJUSTMENTS (B)=BALANCED

TABLE 14

PUBLISHED & BALANCED EMPLOYMENT COSTS IN MANUFACTURING & NON-NORTH SEA UNIT LABOUR COSTS (INDICES)

	ECMM	ECMM(B)	ULC	ULC(B)
1980	216.4	216.4	53.7	53.7
1981	247.9	247.9	59.5	59.4
1982	272.4	272.3	61.7	61.6
1983	295.2	295.2	63.6	63.5
1984	318.1	318.1	65.3	65.4
1985	343.2	343.2	68.0	68.0
1986	367.2	367.2	71.1	71.1
1987	394.5	394.5	73.0	73.0
1988	425.3	425.3	77.2	77.4

(B)=BALANCED

PUBLISHED & BALANCED GROWTH RATES OF NON-NORTH SEA UNIT LABOUR COSTS (% CHANGE ON PREVIOUS YEAR)

	ECMM	ECMM(B)	ULC	ULC(B)
1980	17.507	17.510	22.668	22.449
1981	14.553	14.556	10.617	10.534
1982	9.860	9.839	3.707	3.732
1983	8.398	8.403	3.139	3.060
1984	7.736	7.741	2.637	2.985
1985	7.890	7.889	4.140	3.980
1986	6.993	6.998	4.537	4.516
1987	7.437	7.435	2.678	2.772
1988	7.808	7.807	5.764	6.015

(B)=BALANCED

TABLE 15

PUBLISHED FINANCIAL SURPLUSES/DEFICITS BY SECTOR (£ MILLIONS)

	FG	FO	FJ	FFI	FFM
1980	-11308.0	-2128.0	12745.0	366.0	-751.0
1981	-7885.0	-6832.0	12683.0	1777.0	-763.0
1982	-7593.0	-4685.0	10865.0	3382.0	-895.0
1983	-10240.0	-3893.0	8128.0	5984.0	919.0
1984	-12949.0	-2077.0	9634.0	6602.0	-1016.0
1985	-9481.0	-3355.0	7770.0	5492.0	566.0
1986	-7852.0	-151.0	612.0	2491.0	4328.0
1987	-4853.0	2905.0	-6784.0	3599.0	4637.0
1988	5751.0	14665.0	-17241.0	-3161.0	6197.0

BALANCED FINANCIAL SURPLUSES/DEFICITS BY SECTOR (£ MILLIONS)

	FG	FO	FJ	FFI	FFM
1980	-10570.1	-2336.4	13210.3	789.8	-1089.8
1981	-8383.4	-5863.5	13067.4	2518.9	-1332.1
1982	-7469.2	-4980.5	10763.9	2915.9	-1228.6
1983	-10776.5	-4026.8	8302.5	6231.0	275.8
1984	-12222.9	-2919.1	9754.9	5710.0	-329.2
1985	-9270.4	-4105.0	7940.7	4781.8	652.6
1986	-8100.4	-766.2	1406.2	2996.2	4463.9
1987	-4490.0	2037.4	-5711.5	3240.7	4919.3
1988	7823.6	11424.5	-17250.2	-9054.1	7059.5

ADJUSTMENTS TO FINANCIAL SURPLUSES/DEFICITS BY SECTOR (£ MILLIONS)

	FG	FO	FJ	FFI	FFM
1980	737.9	-208.4	465.3	423.8	-338.8
1981	-498.4	968.5	384.4	741.9	-569.1
1982	123.8	-295.5	-101.1	-466.1	-333.6
1983	-536.5	-133.8	174.5	247.0	-643.2
1984	726.1	-842.1	120.9	-892.0	686.8
1985	210.6	-750.0	170.7	-710.2	86.6
1986	-248.4	-615.2	794.2	505.2	135.9
1987	363.0	-867.6	1072.5	-358.3	282.3
1988	2072.6	-3240.5	-9.2	-5893.1	862.5

TABLE 16

PUBLISHED BANK LENDING TO THE PRIVATE SECTOR (£ MILLIONS)

	LDJ	LDI	LDB	LDV
1980	-2965.0	-6095.0	10550.0	-1490.0
1981	-4017.0	-4120.0	10137.0	-2000.0
1982	-4989.0	-4181.0	11769.0	-2599.0
1983	-4893.0	-2380.0	10085.0	-2812.0
1984	-4174.0	-5719.0	17031.0	-7138.0
1985	-6655.0	-6913.0	19084.0	-5516.0
1986	-5303.0	-8630.0	29669.0	-15736.0
1987	-8656.0	-15188.0	40045.0	-16201.0
1988	-12487.0	-30686.0	64475.0	-11302.0

BALANCED BANK LENDING TO THE PRIVATE SECTOR (£ MILLIONS)

	LDJ	LDI	LDB	LDV
1980	-3218.3	-5830.5	9994.5	-945.6
1981	-4144.6	-3903.9	9688.5	-1640.0
1982	-5139.4	-4030.0	10829.7	-1660.3
1983	-5149.3	-2281.2	9490.8	-2060.3
1984	-4309.2	-6798.6	16075.6	-5967.8
1985	-6862.8	-6491.7	18456.6	-5102.1
1986	-5678.9	-8167.7	29772.1	-15925.5
1987	-9469.8	-14730.4	39061.1	-14860.8
1988	-13351.3	-29637.7	63525.1	-10536.1

ADJUSTMENTS TO BANK LENDING TO THE PRIVATE SECTOR (£ MILLIONS)

	LDJ	LDI	LDB	LDV
1980	-253.3	264.5	-555.5	544.4
1981	-127.6	216.1	-448.5	360.0
1982	-150.4	151.0	-939.3	938.7
1983	-256.3	98.8	-594.2	751.7
1984	-135.2	-79.6	-955.4	1170.2
1985	-207.8	421.3	-627.4	413.9
1986	-375.9	462.3	103.1	-189.5
1987	-813.8	457.6	-983.9	1340.2
1988	-864.3	1048.3	-949.9	765.9

TABLE 17

PUBLISHED TOTAL DOMESTIC BANK DEPOSITS (£ MILLIONS)

	DBJ	DBI	DBB	DBV
1980	6618.0	2957.0	-11246.0	1671.0
1981	4229.0	4980.0	-11204.0	1995.0
1982	3788.0	1872.0	-8407.0	2747.0
1983	3222.0	4774.0	-10924.0	2928.0
1984	3318.0	1059.0	-10391.0	6014.0
1985	5139.0	4331.0	-17058.0	7588.0
1986	8443.0	11256.0	-29806.0	10107.0
1987	8296.0	9568.0	-40617.0	22753.0
1988	16703.0	6508.0	-39210.0	15999.0

BALANCED TOTAL DOMESTIC BANK DEPOSITS (£ MILLIONS)

	DBJ	DBI	DBB	DBV
1980	6049.9	3435.6	-11823.9	2338.4
1981	3945.1	5346.6	-11719.8	2428.1
1982	3465.1	2207.3	-9505.6	3833.2
1983	2651.6	5039.0	-11517.5	3826.9
1984	3034.8	1087.6	-11476.7	7354.3
1985	4672.7	5009.4	-17782.9	8100.7
1986	7577.0	11968.3	-29525.2	9979.9
1987	6460.7	10511.7	-41407.4	24435.0
1988	14740.0	8241.5	-40035.1	17053.7

ADJUSTMENTS TO TOTAL DOMESTIC BANK DEPOSITS (£ MILLIONS)

	DBJ	DBI	DBB	DBV
1980	-568.1	478.6	-577.9	667.4
1981	-283.9	366.6	-515.8	433.1
1982	-322.9	335.3	-1098.6	1086.2
1983	-570.4	265.0	-593.5	898.9
1984	-283.2	28.6	-1085.7	1340.3
1985	-466.3	678.4	-724.9	512.7
1986	-866.0	712.3	280.8	-127.1
1987	-1835.3	943.7	-790.4	1682.0
1988	-1963.0	1733.5	-825.1	1054.7

TABLE 18

PUBLISHED DEPOSITS WITH BUILDING SOCIETIES (£ MILLIONS)

	LZG	LZO	LZJ	LZI	LZB	LZV
1980	0.0	-13.0	7175.0	-22.0	0.0	-7140.0
1981	0.0	0.0	7082.0	60.0	0.0	-7142.0
1982	0.0	7.0	10294.0	91.0	0.0	-10392.0
1983	64.0	5.0	10250.0	697.0	694.0	-11610.0
1984	82.0	31.0	13249.0	564.0	595.0	-14521.0
1985	66.0	-19.0	13314.0	493.0	42.0	-13896.0
1986	619.0	503.0	11847.0	525.0	420.0	-13914.0
1987	404.0	911.0	13626.0	-18.0	407.0	-15330.0
1988	1056.0	474.0	20163.0	-90.0	403.0	-22006.0

BALANCED DEPOSITS WITH BUILDING SOCIETIES (£ MILLIONS)

	LZG	LZO	LZJ	LZI	LZB	LZV
1980	0.8	-12.7	6838.9	5.0	8.0	-6840.0
1981	-0.4	0.2	6904.8	75.4	1.1	-6981.1
1982	-8.5	6.6	10044.2	101.2	-7.7	-10135.7
1983	66.3	5.1	9893.0	617.0	700.1	-11281.5
1984	87.1	31.5	12991.4	562.5	583.6	-14256.2
1985	75.0	-18.1	13035.6	521.5	46.1	-13660.0
1986	639.8	505.1	11426.7	576.3	451.0	-13598.9
1987	423.9	913.0	12577.7	59.8	445.8	-14420.3
1988	1092.7	476.3	19096.5	16.0	449.7	-21131.3

ADJUSTMENTS TO DEPOSITS WITH BUILDING SOCIETIES (£ MILLIONS)

	LZG	LZO	LZJ	LZI	LZB	LZV
1980	0.8	0.3	-336.1	27.0	8.0	300.0
1981	-0.4	0.2	-177.2	15.4	1.1	160.9
1982	-8.5	-0.4	-249.8	10.2	-7.7	256.3
1983	2.3	0.1	-357.0	20.0	6.1	328.5
1984	5.1	0.5	-257.6	-1.5	-11.4	264.8
1985	9.0	0.9	-278.4	28.5	4.1	236.0
1986	20.8	2.1	-420.3	51.3	31.0	315.1
1987	19.9	2.0	-1048.3	77.8	38.8	909.7
1988	36.7	2.3	-1066.5	106.0	46.7	874.7

TABLE 19

PUBLISHED LIFE ASSURANCE & PENSION FUND RECEIPTS (£ MILLIONS)

	LVG	LVJ	LVV
1980	-699.0	12846.0	-12147.0
1981	-646.0	14863.0	-14217.0
1982	-621.0	15556.0	-14935.0
1983	-691.0	16622.0	-15931.0
1984	-768.0	18523.0	-17755.0
1985	-553.0	18973.0	-18420.0
1986	-682.0	19360.0	-18678.0
1987	-736.0	20993.0	-20257.0
1988	-656.0	22314.0	-21658.0

BALANCED LIFE ASSURANCE & PENSION FUND RECEIPTS (£ MILLIONS)

	LVG	LVJ	LVV
1980	-698.5	12646.3	-11947.8
1981	-645.9	14757.0	-14111.1
1982	-622.1	15398.5	-14776.4
1983	-690.3	16406.9	-15716.6
1984	-767.1	18359.3	-17592.2
1985	-551.4	18810.7	-18259.3
1986	-678.3	19126.5	-18448.2
1987	-731.9	20376.6	-19644.6
1988	-649.3	21700.5	-21051.3

ADJUSTMENTS TO LIFE ASSURANCE & PENSION FUND RECEIPTS (£ MILLIONS)

	LVG	LVJ	LVV
1980	0.5	-199.7	199.2
1981	0.1	-106.0	105.9
1982	-1.1	-157.5	158.6
1983	0.7	-215.1	214.4
1984	0.9	-163.7	162.8
1985	1.6	-162.3	160.7
1986	3.7	-233.5	229.8
1987	4.1	-616.4	612.4
1988	6.7	-613.5	606.7

TABLE 20

PUBLISHED LOANS FOR HOUSE PURCHASE BY BUILDING SOCIETIES & BANKS (£ MILLIONS)

	LHZJ	LZNA	LHBJ	LHBB
1980	-5715.0	5715.0	-600.0	600.0
1981	-6323.0	6323.0	-2265.0	2265.0
1982	-8133.0	8133.0	-5078.0	5078.0
1983	-10904.0	10904.0	-3531.0	3531.0
1984	-14530.0	14530.0	-2043.0	2043.0
1985	-14627.0	14627.0	-4223.0	4223.0
1986	-19427.0	19427.0	-5190.0	5190.0
1987	-15126.0	15126.0	-10056.0	10056.0
1988	-24322.0	24322.0	-10877.0	10877.0

BALANCED LOANS FOR HOUSE PURCHASE BY BUILDING SOCIETIES & BANKS (£ MILLIONS)

	LHZJ	LZNA	LHBJ	LHBB
1980	-5757.1	5757.1	-614.4	614.4
1981	-6345.3	6345.3	-2271.5	2271.5
1982	-8166.3	8166.3	-5083.7	5083.7
1983	-10949.3	10949.3	-3545.4	3545.4
1984	-14564.4	14564.4	-2047.6	2047.6
1985	-14661.1	14661.1	-4234.0	4234.0
1986	-19475.8	19475.8	-5215.8	5215.8
1987	-15255.5	15255.5	-10106.1	10106.1
1988	-24450.6	24450.6	-10930.7	10930.7

ADJUSTMENTS TO LOANS FOR HOUSE PURCHASE BY BUILDING SOCIETIES & BANKS (£ MILLIONS)

	LHZJ	LZNA	LHBJ	LHBB
1980	-42.1	42.1	-14.4	14.4
1981	-22.3	22.3	-6.5	6.5
1982	-33.3	33.3	-5.7	5.7
1983	-45.3	45.3	-14.4	14.4
1984	-34.4	34.4	-4.6	4.6
1985	-34.1	34.1	-11.0	11.0
1986	-48.8	48.8	-25.8	25.8
1987	-129.5	129.5	-50.1	50.1
1988	-128.6	128.6	-53.7	53.7

TABLE 21

PUBLISHED OVERSEAS TAKE UP OF GILTS (£ MILLIONS)

	BSGO	BGSO
1980	-1516.0	1516.0
1981	-408.0	408.0
1982	-356.0	356.0
1983	-941.0	941.0
1984	-969.0	969.0
1985	-2920.0	2920.0
1986	-2104.0	2104.0
1987	-4075.0	4075.0
1988	-400.0	400.0

BALANCED OVERSEAS TAKE UP OF GILTS (£ MILLIONS)

	BSGO	BGSO
1980	-1563.5	1563.5
1981	-451.4	451.4
1982	-332.0	332.0
1983	-954.3	954.3
1984	-1038.1	1038.1
1985	-3023.9	3023.9
1986	-2372.8	2372.8
1987	-4330.9	4330.9
1988	-618.1	618.1

ADJUSTMENTS TO OVERSEAS TAKE UP OF GILTS (£ MILLIONS)

	BSGO	BGSO
1980	-47.5	47.5
1981	-43.4	43.4
1982	24.0	-24.0
1983	-13.3	13.3
1984	-69.1	69.1
1985	-103.9	103.9
1986	-268.8	268.8
1987	-255.9	255.9
1988	-218.1	218.1

TABLE 22

PUBLISHED OTHER SHORT DEBT BY SECTOR (£ MILLIONS)

	BSGG	BSGJ	BSGI	BSGV
1980	-1727.0	2993.0	279.0	-1545.0
1981	-2881.0	3263.0	-189.0	-213.0
1982	-3421.0	1877.0	1034.0	510.0
1983	-2920.0	2714.0	92.0	114.0
1984	-3622.0	3808.0	286.0	-472.0
1985	-1871.0	1981.0	139.0	-249.0
1986	-1110.0	1583.0	-662.0	89.0
1987	-2484.0	1626.0	234.0	724.0
1988	1090.0	891.0	-501.0	-1480.0

BALANCED OTHER SHORT DEBT BY SECTOR (£ MILLIONS)

	BSGG	BSGJ	BSGI	BSGV
1980	-1726.5	2702.8	324.6	-1300.9
1981	-2896.5	3114.7	-141.8	-76.4
1982	-3570.1	1719.0	1064.2	786.9
1983	-2894.0	2398.2	122.8	373.0
1984	-3545.3	3557.9	274.1	-286.8
1985	-1737.4	1685.2	173.9	-121.7
1986	-784.8	1093.5	-504.9	196.1
1987	-2190.8	513.7	337.9	1339.1
1988	1648.3	-249.0	-374.1	-1025.2

ADJUSTMENTS TO OTHER SHORT DEBT BY SECTOR (£ MILLIONS)

	BSGG	BSGJ	BSGI	BSGV
1980	0.5	-290.2	45.6	244.1
1981	-15.5	-148.3	27.2	136.6
1982	-149.1	-158.0	30.2	276.9
1983	26.0	-315.8	30.8	259.0
1984	76.7	-250.1	-11.9	185.2
1985	133.6	-295.8	34.9	127.3
1986	325.2	-489.5	57.1	107.1
1987	293.2	-1012.3	103.9	615.1
1988	558.3	-1140.0	126.9	454.8

TABLE 23

PUBLISHED LONG DEBT BY SECTOR (£ MILLIONS)

	BLGG	BLGJ	BLGI	BLGV
1980	-7243.0	1522.0	55.0	5666.0
1981	-7503.0	2287.0	-530.0	5746.0
1982	-6694.0	1577.0	316.0	4801.0
1983	-7864.0	562.0	343.0	6959.0
1984	-7038.0	910.0	-108.0	6236.0
1985	-5299.0	650.0	-398.0	5047.0
1986	-2402.0	1190.0	-220.0	1432.0
1987	-142.0	1236.0	-327.0	-767.0
1988	3806.0	-2217.0	-544.0	-1045.0

BALANCED LONG DEBT BY SECTOR (£ MILLIONS)

	BLGG	BLGJ	BLGI	BLGV
1980	-6799.8	609.9	91.5	6098.4
1981	-7308.1	1831.8	-508.9	5985.2
1982	-6762.6	1174.1	341.6	5246.9
1983	-7334.6	-451.6	371.9	7414.4
1984	-6513.5	62.5	-106.2	6557.2
1985	-4573.3	-365.0	-369.6	5308.0
1986	-984.3	-553.8	-175.3	1713.5
1987	1994.1	-2140.7	-235.5	382.1
1988	6690.5	-6157.4	-439.7	-93.4

ADJUSTMENTS TO LONG DEBT BY SECTOR (£ MILLIONS)

	BLGG	BLGJ	BLGI	BLGV
1980	443.2	-912.1	36.5	432.4
1981	194.9	-455.2	21.1	239.2
1982	-68.6	-402.9	25.6	445.9
1983	529.4	-1013.6	28.9	455.4
1984	524.5	-847.5	1.8	321.2
1985	725.7	-1015.0	28.4	261.0
1986	1417.7	-1743.8	44.7	281.5
1987	2136.1	-3376.7	91.5	1149.1
1988	2884.5	-3940.4	104.3	951.6

TABLE 24

PUBLISHED NOTES & COINS BY SECTOR (£ MILLIONS)

	NCG	NCJ	NCI	NCV
1980	-707.0	623.0	63.0	21.0
1981	-348.0	309.0	30.0	9.0
1982	-374.0	336.0	34.0	4.0
1983	-684.0	599.0	59.0	26.0
1984	-587.0	526.0	52.0	9.0
1985	-527.0	449.0	45.0	33.0
1986	-768.0	676.0	67.0	25.0
1987	-528.0	422.0	42.0	64.0
1988	-1413.0	1171.0	118.0	124.0

BALANCED NOTES & COINS BY SECTOR (£ MILLIONS)

	NCG	NCJ	NCI	NCV
1980	-648.0	562.6	64.2	21.2
1981	-319.7	279.9	30.7	9.1
1982	-359.0	319.8	34.9	4.3
1983	-616.7	530.5	59.9	26.3
1984	-527.0	465.7	52.1	9.2
1985	-451.6	372.6	45.9	33.1
1986	-631.3	537.9	68.3	25.1
1987	-288.5	179.0	44.9	64.6
1988	-1117.3	871.7	121.1	124.5

ADJUSTMENTS TO NOTES & COINS BY SECTOR (£ MILLIONS)

	NCG	NCJ	NCI	NCV
1980	59.0	-60.4	1.2	0.2
1981	28.3	-29.1	0.7	0.1
1982	15.0	-16.2	0.9	0.3
1983	67.3	-68.5	0.9	0.3
1984	60.0	-60.3	0.1	0.2
1985	75.4	-76.4	0.9	0.1
1986	136.7	-138.1	1.3	0.1
1987	239.5	-243.0	2.9	0.6
1988	295.7	-299.3	3.1	0.5

TABLE 25

PUBLISHED REMAINING FINANCIAL TRANSACTIONS BY SECTOR (£ MILLIONS)

	PUBM	OUSM	PERM	ICCM	BANM	OFIM
1980	1467.0	-5195.0	-3188.0	-300.0	1428.0	4794.0
1981	3734.0	-7621.0	-3094.0	-31.0	677.0	6231.0
1982	4845.0	-2715.0	-1519.0	-143.0	-6182.0	5714.0
1983	1839.0	-5307.0	5.0	58.0	-2198.0	5542.0
1984	-459.0	-8749.0	-5452.0	10470.0	-4001.0	8191.0
1985	1103.0	-12406.0	-721.0	4488.0	-1999.0	9535.0
1986	-2565.0	-16458.0	-21.0	-203.0	-2823.0	22070.0
1987	1802.0	-14437.0	4058.0	3840.0	-6070.0	10807.0
1988	685.0	-1436.0	-4213.0	7628.0	-21321.0	18657.0

BALANCED REMAINING FINANCIAL TRANSACTIONS BY SECTOR (£ MILLIONS)

	PUBM	OUSM	PERM	ICCM	BANM	OFIM
1980	865.4	-3887.2	-6710.3	2699.5	1307.0	5725.6
1981	3238.7	-6315.1	-5004.5	1620.9	-241.2	6701.3
1982	4185.0	-5319.1	-2967.5	3196.9	-6399.9	7304.6
1983	1647.3	-4986.3	-3482.2	2301.5	-2218.8	6738.5
1984	81.0	-3988.8	-7795.6	9638.5	-7230.0	9294.9
1985	992.2	-7110.8	-4513.1	5892.4	-4953.8	9693.1
1986	-3288.7	-3644.1	-7431.1	-768.8	-5913.6	21046.3
1987	634.2	-3206.5	-8847.1	7252.3	-8205.6	12372.8
1988	776.9	10330.1	-18520.0	13018.9	-24870.5	19264.6

ADJUSTMENTS TO REMAINING FINANCIAL TRANSACTIONS BY SECTOR (£ MILLIONS)

	PUBM	OUSM	PERM	ICCM	BANM	OFIM
1980	-601.6	1307.8	-3522.3	2999.5	-121.0	931.6
1981	-495.3	1305.9	-1910.5	1651.9	-918.2	470.3
1982	-660.0	-2604.1	-1448.5	3339.9	-217.9	1590.6
1983	-191.7	320.7	-3487.2	2243.5	-20.8	1196.5
1984	540.0	4760.2	-2343.6	-831.6	-3229.0	1103.9
1985	-110.8	5295.2	-3792.1	1404.4	-2954.8	158.1
1986	-723.7	12813.9	-7410.1	-565.8	-3090.6	-1023.7
1987	-1167.8	11230.5	-12905.1	3412.3	-2135.6	1565.8
1988	91.9	11766.1	-14307.0	5390.9	-3549.5	607.6

TABLE 26

PERCENTAGE DIFFERENCES BETWEEN THE LOGGED & NON-LOGGED MEASURES OF GDP

	GDP9	GDPE
1980	-0.188	-0.056
1981	-0.222	-0.082
1982	-0.070	-0.017
1983	-0.085	-0.040
1984	0.018	0.023
1985	-0.023	-0.020
1986	-0.053	-0.023
1987	-0.091	-0.013
1988	-0.225	-0.177

TABLE 27

PERCENTAGE DIFFERENCES BETWEEN THE LOGGED & NON-LOGGED VALUES OF EXPENDITURE

	C9	IF9	G9	X9	M9	FCA9
1980	-0.094	0.306	-0.044	0.172	-0.238	-0.240
1981	-0.051	0.465	-0.113	0.012	-0.642	-0.320
1982	0.004	0.097	-0.056	-0.084	-0.322	-0.220
1983	-0.020	0.195	-0.052	0.052	-0.235	-0.268
1984	0.072	-0.999	0.065	-0.124	-0.060	0.106
1985	0.017	-0.385	-0.010	-0.088	-0.128	0.035
1986	-0.004	-0.827	0.019	0.108	-0.067	-0.127
1987	0.144	-1.200	0.062	0.131	-0.610	-0.425
1988	-0.303	-0.302	-0.322	-0.078	-1.318	-0.361

PERCENTAGE DIFFERENCES BETWEEN THE LOGGED & NON-LOGGED VOLUMES OF EXPENDITURE

	CONS	IF	G	X	M	FCA
1980	-0.015	-0.060	-0.002	-0.026	-0.274	-0.030
1981	-0.011	-0.088	-0.010	-0.007	-0.396	-0.050
1982	-0.003	-0.099	-0.007	-0.042	-0.201	-0.035
1983	0.007	-0.096	0.006	-0.014	-0.191	-0.008
1984	0.028	0.014	-0.008	-0.043	-0.055	-0.027
1985	0.012	-0.065	-0.001	-0.019	-0.089	-0.031
1986	0.002	-0.051	-0.002	0.090	-0.091	-0.002
1987	0.096	-0.249	-0.008	0.197	-0.381	0.095
1988	-0.200	-0.326	-0.056	0.135	-1.105	-0.289

TABLE 28

PUBLISHED PRICE DEFLATORS FOR THE EXPENDITURE COMPONENTS OF GDP

	PC	PIF	PG	PX	PM	PFCA	PGDP
1980	0.712	0.779	0.690	0.708	0.710	0.680	0.723
1981	0.792	0.855	0.778	0.767	0.764	0.816	0.797
1982	0.862	0.880	0.842	0.820	0.821	0.905	0.852
1983	0.903	0.909	0.899	0.884	0.884	0.931	0.900
1984	0.950	0.947	0.945	0.951	0.961	0.928	0.949
1985	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1986	1.043	1.048	1.056	0.924	0.962	1.080	1.026
1987	1.082	1.102	1.123	0.954	0.989	1.133	1.076
1988	1.137	1.165	1.195	0.969	0.983	1.227	1.144

BALANCED PRICE DEFLATORS FOR THE EXPENDITURE COMPONENTS OF GDP

	PC	PIF	PG	PX	PM	PFCA	PGDP
1980	0.712	0.777	0.689	0.707	0.709	0.677	0.723
1981	0.792	0.853	0.778	0.767	0.762	0.811	0.796
1982	0.861	0.880	0.842	0.821	0.820	0.903	0.853
1983	0.903	0.907	0.899	0.885	0.879	0.924	0.901
1984	0.950	0.950	0.947	0.950	0.966	0.937	0.947
1985	1.000	1.001	1.001	0.999	1.000	1.001	1.000
1986	1.043	1.045	1.056	0.923	0.961	1.090	1.026
1987	1.083	1.103	1.123	0.953	0.989	1.137	1.075
1988	1.139	1.170	1.205	0.966	0.988	1.246	1.141

ADJUSTMENTS TO THE PRICE DEFLATORS FOR THE EXPENDITURE COMPONENTS OF GDP

	PC	PIF	PG	PX	PM	PFCA	PGDP
1980	0.000	-0.002	-0.001	0.000	-0.001	-0.002	-0.001
1981	0.000	-0.002	0.000	0.000	-0.002	-0.005	0.000
1982	0.000	0.000	0.000	0.000	-0.002	-0.003	0.001
1983	0.000	-0.002	0.000	0.000	-0.005	-0.007	0.002
1984	0.000	0.003	0.001	-0.001	0.005	0.009	-0.002
1985	0.000	0.001	0.001	0.000	0.000	0.002	0.000
1986	0.000	0.000	0.000	0.000	-0.001	0.000	0.000
1987	0.000	0.001	0.000	-0.001	0.001	0.004	-0.001
1988	0.002	0.006	0.011	-0.003	0.005	0.019	-0.003

RATE OF INCREASE OF THE PUBLISHED PRICE DEFLATORS

	PC	PIF	PG	PX	PM	PFCA	PGDP
1980	16.3	19.2	24.1	14.6	9.6	26.2	16.7
1981	11.3	9.7	12.6	8.4	7.5	20.1	10.1
1982	8.8	2.9	8.1	7.0	7.6	10.9	7.0
1983	4.9	3.3	6.8	7.8	7.6	2.8	5.6
1984	5.1	4.2	5.2	7.6	8.7	-0.3	5.5
1985	5.3	5.6	5.8	5.1	4.1	7.7	5.3
1986	4.3	4.8	5.6	-7.6	-3.8	9.0	2.6
1987	3.8	5.1	6.3	3.3	2.7	4.0	4.9
1988	5.0	5.7	6.4	1.5	-0.5	8.3	6.3

RATE OF INCREASE OF THE BALANCED PRICE DEFLATORS

	PC	PIF	PG	PX	PM	PFCA	PGDP
1980	16.3	18.6	23.9	14.6	9.3	24.9	16.6
1981	11.3	9.7	12.9	8.5	7.5	19.6	10.2
1982	8.7	3.1	8.3	7.0	7.6	11.3	7.1
1983	4.9	3.1	6.8	7.6	7.2	2.3	5.7
1984	5.1	4.6	5.3	7.4	9.6	1.4	5.1
1985	5.3	5.4	5.8	5.2	3.6	6.9	5.6
1986	4.3	4.7	5.4	-7.6	-3.9	8.6	2.6
1987	3.8	5.2	6.4	3.2	3.0	4.4	4.7
1988	5.2	6.1	7.4	1.3	-0.1	9.6	6.1

disposable income which is over 1 1/2 times larger than public sector current receipts has average adjustments (in absolute terms) of just £0.2 bn. Within this income from dividends and net interest receives by far the greatest share of the balancing adjustment. This is not surprising given that the personal sector's allocation is calculated by residual. The decline in the personal sector's saving ratio between 1980 and 1983 has been made slightly greater by the balancing exercise but since 1983 the decline has been marginally moderated with the saving ratio for 1988 being 0.4% higher than the published accounts suggest. The small adjustments to income from wages and salaries and employers' national insurance contributions result in employment costs per manufacturing employee being virtually unchanged by the balancing exercise (see Table 14). Employment costs per unit of non-North Sea output are only marginally changed although the growth rate of employment costs in 1988 was 0.2% higher mainly due to balanced non-North Sea output being 0.3% lower.

Financial Transactions(1)

The net outcome of the balanced income and expenditure figures can be seen in the sectoral financial surpluses and deficits (Table 15). The balanced accounts give a broadly similar picture to the published accounts. The personal sector still moves into substantial deficit in 1988 although its financial surplus has been adjusted upwards in each year with the exception of 1982 and 1988. The financial deficit of ICCs has been made more pronounced in 1988 by the reduction in company saving and the increase in stockbuilding.

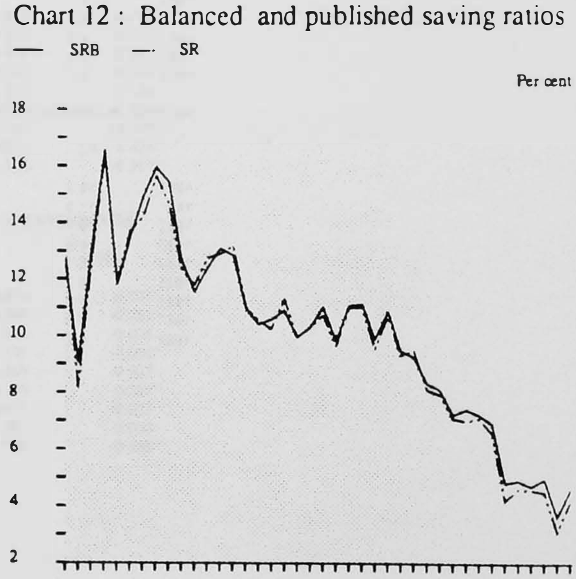
Personal Sector

Throughout the period 1980—1988, the balanced accounts suggest that the personal sector has borrowed more from banks for non-housing purposes and to a lesser extent for housing from both banks and building societies than the published accounts report, although the adjustments are relatively small. Deposits with banks and building societies have also been reduced by balancing. Personal sector purchases of both short and long government debt are reduced by the balancing exercise with net redemptions of long-debt taking place from the mid-1980s onwards.

ICCs

The adjustments to ICCs financial statistics are the reverse of those made for the personal sector. According to the balanced accounts, between 1980 and 1988 ICCs borrowed less from banks and deposited more with both banks and building societies than the published accounts suggest. They also increase ICCs holdings of both long and short government debt (except in 1984 for shorts).

Chart 12 : Balanced and published saving ratios



OFIs and Banks

With the exception of 1986 there have been downward balancing adjustments to OFIs borrowing from banks and, combined with the reduced borrowing of ICCs, this is sufficient to ensure that bank lending is reduced in each year except for 1986. OFIs have increased their deposits with banks (except 1986) over the period and, again, when combined with the adjustment from ICCs, total deposits with banks have been increased by almost £6.0 bn. Deposits with building societies have been adjusted downwards due

(1) The published, balanced and adjustments to financial transactions are reported in Table 15 to Table 25.

to the reduced deposits made by persons, upward adjustments from other sectors are relatively small. OFIs have also increased their holdings of both long and short dated government debt but, despite these adjustments, OFIs still reduced their stock of short government debt over the period. Life assurance and pension fund receipts have been adjusted downwards by the balancing exercise with virtually all the adjustment coming from the personal sector.

The Public Sector

The reduced purchases of long and short-debt by the personal sector are sufficient to reduce total purchases of long and short-debt by £8.8 bn and £1.3 bn over the period 1980 to 1988. Repurchases of long-debt began in 1987 according to the balanced accounts. The overseas take up of gilts was, however, slightly increased by £1.0 bn over the period by the balancing exercise. The balanced accounts also suggest that less notes and coins were issued by the public sector with the holdings of the personal sector being mainly responsible. Assuming that the public sectors financing items which are not directly covered by the balancing exercise do not contain measurement errors then the adjustments to the sales of government debt and notes and coins are consistent with a reduction to the PSBR by £3.5 bn in 1988 and £2.4 bn in 1987. The adjustments prior to 1985 are all less than £1.0 bn.

Other Transactions (Table 25 and Charts 13 to 18)

The largest changes occur in the miscellaneous categories. [1] Whilst the present level of disaggregation does not identify which categories have been adjusted it is clear that the personal sector and banks have reduced their assets and/or increased their liabilities according to the balanced accounts data. On the other hand, ICCs, and the overseas sectors have increased their assets and/or reduced their liabilities. The adjustments to these miscellaneous categories play an important role in removing the balancing items from the sectoral accounts because changes elsewhere tend to be small and/or offsetting. This is particularly true for the overseas sector. The charts do indicate, however, that in more recent years adjustments to these assets and liabilities alone have not been sufficient to remove all of the balancing items.

Comparison of Balanced Log and Non-Log Variables and Prices (Tables 26, 27 and 28)

We explained in an earlier section that there were two methods of obtaining prices from the balanced accounts: by taking the exponent of the balanced log price level or the ratio of the balanced (non-logged) values to volumes. Table 26 shows that there are only minor differences between the balanced versions of the expenditure measures of GDP and, consequently, the difference between the measures of the GDP deflator are also small. The differences between the two measures of both the real and the nominal components of balanced GDP(E) are also small with the exception of nominal fixed investment and both nominal and real imports in 1988. Only imports have the exponential series being consistently lower in each year and in general the differences between the volume measures are smaller. In order to preserve consistency we take the balanced deflator to be the ratio of the balanced value to the balanced volume.

As can be seen from Table 28 the adjustments to the price deflators are relatively small except for the factor cost adjustment deflator in 1988 which is adjusted upwards by 1.6%. On average, the price deflators for general government expenditure and the factor cost adjustment deflator have been reduced by balancing whilst the export deflator has, on average, been increased. Overall, the GDP deflator has been little changed, by the balancing exercise.

(1) These contain public sector lending, accruals adjustment, NSB/TSB/HP companies etc lending, credit extended by retailers, other loans for house purchase, portfolio investment, overseas investment, bank lending overseas, non-resident bank deposits, reserves, other external finance, commercial bills, bank finance of the PSBR and miscellaneous private sector transactions.

Chart 13 : Adjusmens to personal sector miscellaneous assets and the personal sector balancing item

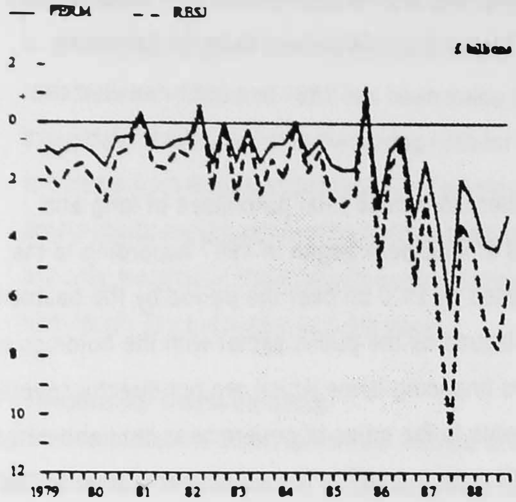


Chart 14 : Adjustments to monetary sector miscellaneous assets and the monetary sector balancing item

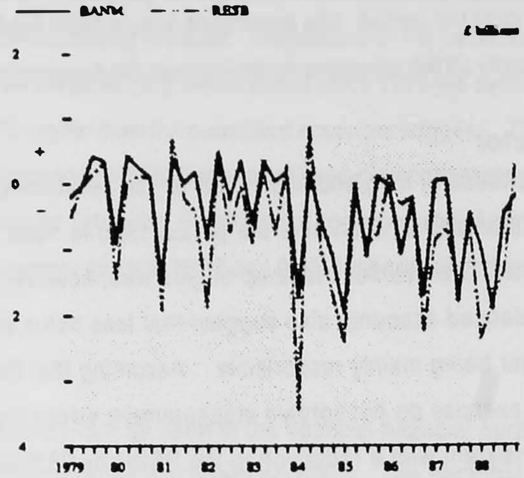


Chart 15 : Adjustments to public sector miscellaneous Assets and the public sector balancing item

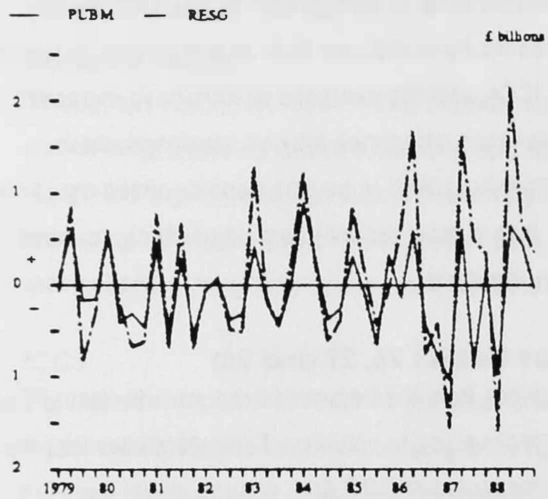


Chart 16 : Adjustments to ICCs miscellaneous assets and the ICCs balancing item

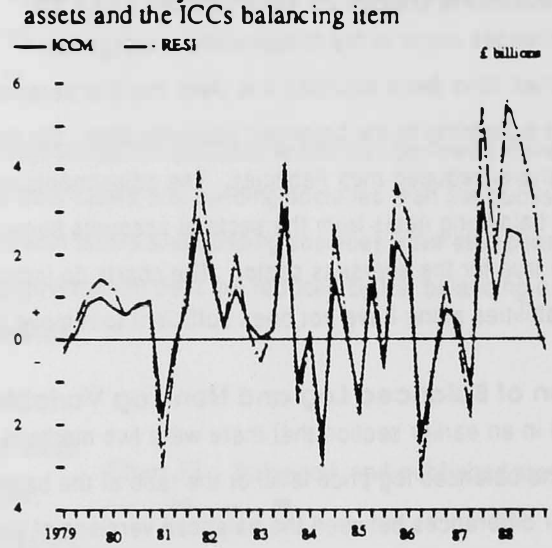


Chart 17 : Adjustments to overseas sector miscellaneous assets and the overseas sector balancing item

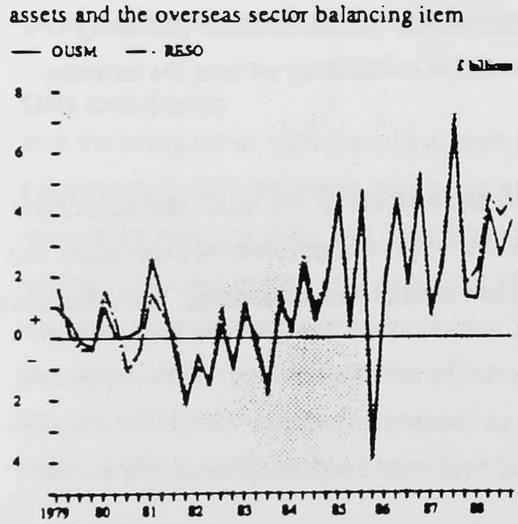
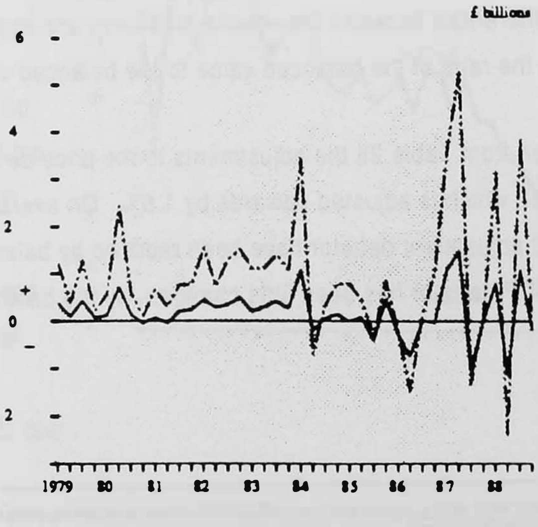


Chart 18 : Adjustments to OFIs miscellaneous assets and the OFIs balancing item



A Comparison of 3MA with the CSO's Balanced Accounts (Table 29)

Such a comparison is not straightforward for a number of reasons. The CSO's work was based on an earlier vintage of data (1988 *Blue Book*), the CSO's disaggregation is slightly greater, although it did not cover any real variables, the variance matrix is allowed to change in each year, the covariance of the measurement errors were set to zero, prior adjustments were made to the data and the measures of GDP are constrained to equal the (unbalanced) average measure. Thus identifying the exact source of the differences between the CSO and 3MA is not possible. The CSO do supply some variants (but only for 1987) which allow some calibration of the relative importance of the above differences. Some of these differences are more important than others as noted above. If the level of GDP is not constrained to equal the (unbalanced) average measure of GDP there is very little difference in the main component series from its main balanced case, and the financial accounts are virtually unchanged. If the balancing exercise is conducted without prior adjustment (and, consequently, with larger variances on series where prior adjustments had been undertaken) the balancing adjustments are nearly always much larger. The total adjustment, however, is not necessarily larger, since the prior adjustments themselves are large. For this reason the very limited information available on the CSO's balanced accounts excluding the prior adjustment (for 1987) are also compared with the results from the three term moving average method described above.

The magnitude of the adjustments varies considerably between the two methods for individual series. For example, for 1985 the CSO increase total gross capital formation by 1.3% whereas the three term moving average method adjusts the series upwards by only 0.1%. In particular, it is noticeable that the adjustments made to public sector variables by 3MA are nearly always larger (in absolute terms) than the CSO's adjustment whilst the adjustments to exports made by the CSO are always larger. It is noticeable that, with the exception of the public sector, the adjustments to the financial surpluses are smaller with 3MA than the CSO report. Consequently, financial variables have to have comparatively larger adjustments to remove the balancing items when 3MA is used than when the CSO's method is employed. However, neither method produces adjustments which are always larger in absolute terms than the adjustment made by the other. Nor do the adjustments made by the two methods always result in agreement about direction. For example, for each of the 3 years the adjustments to investment by ICCs and financial companies are in the opposite direction. However, there are a number of adjustments for which both 3MA and the CSO agree about the sign. The adjustments to imports, the personal sector's saving ratio and the financial deficits of persons and financial companies are always revised in the same direction by the two methods. The CSO's balancing exercise does not necessarily produce results closer to the 3MA when there are no prior adjustments than when there are. Reaching a conclusion from this comparison is difficult but it is clear that there is little agreement about the magnitude or the direction of the adjustments.

Some variants on 3MA - zero covariances and 5MA

This section provides a comparison of the three term moving average (3MA) used in the preceeding sections with a covariance matrix based on a five term moving average (5MA) and the three term moving average when the covariances are all set to zero except for those required to ensure the logged and non-logged variables also balance (3MAC). A comparison of the 3MA with a three term moving average using as weights 0.1, 0.8, 0.1 is not reported because the results are almost indistinguishable from the 3MA. The remaining comparisons are summarised in Tables 30 to 42.

Table 29: Comparison of the 3 Term Moving Average (3MA) and the CSO's Balanced Accounts

% Difference from Actual

	1985 3MA	CSO	1986 3MA	CSO	1987 3MA	CSO	CSO(1)
Consumers' Expenditure	-0.1	0.2	-0.1	-0.2	-0.1	0.1	-0.5
Gross Capital Formation							
Personal Sector	0.5	0.0	-0.6	0.0	-0.2	0.5	-
ICCs	-0.3	2.4	-0.7	2.6	-0.9	7.5	6.3
Financial Companies	-0.8	2.5	-3.0	2.7	-3.0	3.8	-
Public Sector	1.0	0.0	0.7	0.0	2.1	0.9	-
Total	0.1	1.3	-0.7	1.6	-0.5	3.9	-
Public Sector Current Expenditure on Goods & Services	0.1	0.1	-0.2	0.1	-0.2	0.1	-
Exports of Goods and Services	0.2	-0.4	-0.1	-0.4	-0.1	-0.5	1.2
Imports of Goods and Services	-0.2	-0.5	-0.5	-0.9	-0.7	-0.7	-0.5
Factor Cost Adjustment	-0.1	0.0	-0.4	0.0	-0.2	0.0	-
Gross Domestic Product							
Expenditure measure	0.3	0.2	0.0	0.3	0.2	0.7	0.7
Income measure	-0.1	-0.2	0.1	-0.5	0.3	-0.7	-0.7
Income from Wages and Salaries	0.0	0.4	0.0	0.2	0.1	0.9	0.8
Savings							
Personal sector	1.1	12.3	3.3	18.4	6.5	38.2	-
ICCs	-0.8	-11.9	0.1	-12.4	-1.0	-16.9	-
Public Sector	10.9	-2.9	-5.4	-7.9	12.0	-6.0	-
Current Balance of Payments (£ billion)	0.8	1.2	0.6	2.7	0.9	1.0	-
Personal Sector Saving Ratio (%)	0.4	1.0	0.2	1.3	0.1	1.9	-
Financial Surplus or Deficit							
Personal Sector (£ billion)	0.2	2.7	0.8	3.4	1.1	5.5	-
ICCs (£ billion)	-0.7	-3.7	0.5	-4.8	-0.4	-9.4	-
Financial Companies (£ billion)	0.1	1.3	0.1	1.8	0.3	-0.4	-
Public Sector (£ billion)	0.2	-0.1	-0.3	-0.4	0.4	-0.3	-

(1) Without prior adjustments (-) not published

Drawing conclusions from these tables is difficult because counter examples can always be found. Nevertheless, the tables tentatively suggest that the adjustments made to real variables by 3MA and 5MA are closer in terms of size and sign than either are with 3MAC. However, for financial assets it is not clear which of the three sets of adjustments are the closest because the adjustments are of similar magnitude with the exception of some of the adjustments to the miscellaneous financial flows. The comparisons appear to indicate that the presence of the covariance terms plays an important role in the size and direction of the adjustments and tentatively that their presence or absence may be more important than the choice of moving average process which is used as a filter. Obviously more work is needed in this area before firm conclusions can be drawn.

Conclusion

We have proposed a method of balancing the National Accounts making use of deviations from trend to form a normalisation matrix. We have shown that this method, along with others that have been employed, can all be regarded as special cases of a Kalman filter once the appropriate 'state-space' representation of the accounting errors has been formulated.

Which approach is to be preferred on theoretical grounds is still open to debate, although we would naturally tend to prefer the trend approach that we have proposed. Whatever the outcome of that debate, however, we would claim that our approach is much easier to apply in practice. Nevertheless, the balanced accounts presented in this paper should be regarded as illustrative rather than final, even as far as our own methodology is concerned. Problems of singularity introduced when the measurement error obeys the accounting identities is one area for possible further research. In addition, in producing data for forecasting or interpretive exercises, one may wish to restrain some series, regarded as very reliable, from taking any balancing adjustment. This is easily achieved, although we have not presented such results in this paper.

Table 30: Comparison of Adjustments to Real GDP

(£ billion, 1985 prices)

	GDPE			GDPO			GDPY		
	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA
1980	-1.7	-1.5	-1.5	0.1	0.3	0.3	-0.4	-0.2	-0.2
1981	-2.8	-2.8	-2.4	0.3	0.3	0.6	-1.3	-1.3	-1.0
1982	-0.2	-0.9	-0.2	0.2	-0.5	0.2	-1.5	-2.1	-1.5
1983	-1.7	-2.7	-1.8	0.4	-0.6	0.5	-2.7	-3.7	-2.6
1984	2.6	3.6	2.5	-0.5	0.4	-0.7	2.4	3.4	2.3
1985	0.8	0.8	0.8	-0.1	0.0	-0.1	-0.2	-0.2	-0.2
1986	-0.1	-0.1	-0.2	0.0	0.0	-0.1	0.4	0.4	0.3
1987	1.0	1.4	0.8	-0.2	0.2	-0.4	1.4	1.9	1.2
1988	6.0	7.8	6.3	-0.9	0.9	-0.6	0.6	2.3	0.9
Mean	0.4	0.8	0.5	-0.1	0.1	0.0	-0.1	0.1	-0.1
Absolute Mean	1.9	2.4	1.8	0.3	0.4	0.4	1.2	1.7	1.1

Table 31: Adjustments to the Real Components of the Expenditure Measure of GDP (£ billion)

	CONS			IF			II			G		
	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA
1980	-0.3	-0.4	-0.1	0.0	-0.1	0.1	-0.6	-0.4	-0.6	0.1	0.0	0.0
1981	-0.4	-0.5	0.0	0.1	-0.4	0.2	-1.0	-1.2	-1.1	0.1	0.0	0.0
1982	0.1	0.1	0.1	0.1	-0.5	0.1	-0.2	-1.4	-0.3	0.1	-0.1	0.1
1983	0.0	0.0	0.1	0.0	-0.9	0.1	-0.8	-2.6	-1.1	0.1	-0.1	0.1
1984	-0.1	-0.1	-0.4	-0.1	0.9	-0.2	1.3	2.6	1.6	-0.2	0.1	-0.1
1985	-0.2	0.0	-0.3	0.0	0.1	0.5	0.2	0.5	0.0	0.0	0.0	0.0
1986	-0.2	-0.4	-0.2	-0.4	0.0	-0.4	0.1	0.0	0.0	-0.1	0.0	-0.1
1987	-0.3	-0.5	-0.5	-0.4	0.4	-0.4	0.7	1.2	0.7	-0.2	0.0	-0.2
1988	-1.7	-0.1	-1.9	0.9	1.6	0.8	4.0	4.7	4.7	-0.2	0.2	0.0
Mean	-0.4	0.2	-0.3	0.0	0.1	0.0	0.4	0.3	0.5	0.0	0.0	0.0
Absolute Mean	0.4	0.3	0.4	0.2	0.5	0.3	1.0	1.6	1.2	0.1	0.1	0.1

	X			M			FCA		
	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA
1980	-0.1	-0.3	0.0	0.7	0.5	0.8	0.1	0.0	0.1
1981	0.0	-0.4	0.1	1.2	0.8	1.3	0.2	0.2	0.3
1982	-0.1	0.3	-0.1	0.0	-0.5	0.0	0.1	0.2	0.1
1983	-0.2	0.4	-0.2	0.5	-0.7	0.4	0.2	0.3	0.3
1984	0.3	-0.1	0.3	-1.0	0.3	-0.9	-0.3	-0.3	-0.3
1985	0.3	0.2	0.4	0.2	-0.3	-0.1	0.0	0.0	0.0
1986	-0.1	0.1	-0.2	0.4	-0.2	-0.5	-0.2	0.0	-0.1
1987	0.0	0.1	-0.1	-0.8	0.0	-0.9	-0.3	-0.2	-0.3
1988	2.8	0.4	3.4	-0.3	-0.4	0.7	-0.2	-0.6	0.0
Mean	0.3	0.1	0.4	0.0	-0.1	0.1	0.0	0.0	0.0
Absolute Mean	0.4	0.3	0.5	0.8	0.4	0.5	0.2	0.2	0.2

Table 32: Adjustments to the Components of the Output Measure of GDP

(£ billion)

	OOTH			MPRO			GO			ONSO		
	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA
1980	0.0	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.1
1981	0.0	0.2	0.2	0.1	0.1	0.2	0.1	0.0	0.0	0.1	0.1	0.2
1982	0.1	-0.2	0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1983	0.2	-0.3	0.3	0.0	-0.2	0.1	0.1	-0.1	0.0	0.1	-0.1	0.1
1984	-0.2	0.2	-0.3	-0.1	0.1	-0.2	-0.1	0.1	-0.1	-0.1	0.1	-0.1
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.1	0.0	0.1	-0.1	0.0	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.0
1987	0.0	0.1	-0.1	-0.1	0.1	-0.2	-0.1	0.0	-0.1	-0.1	0.0	-0.1
1988	-0.6	0.4	-0.6	-0.2	0.2	0.0	-0.1	0.1	0.0	0.1	0.1	0.1
Mean	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absolute Mean	0.1	0.2	0.2	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1

Table 33: Percentage Increase in the Price Deflators of the Components of GDP

	PC			PIF			PG			PX			PM			PFCA		
	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA
1980	16.3	16.5	16.5	16.8	22.8	18.5	23.9	24.7	23.8	14.6	15.6	14.8	9.3	9.0	9.5	24.9	24.5	25.4
1981	11.3	11.4	11.4	9.7	11.1	9.7	12.9	13.0	12.8	8.5	8.5	8.6	7.5	7.5	7.8	19.8	19.8	20.0
1982	8.7	8.9	8.7	3.1	3.7	3.3	8.3	8.4	8.3	7.0	7.7	8.9	7.8	6.5	7.4	11.3	10.8	11.2
1983	4.9	4.9	4.9	3.1	4.8	3.0	6.8	7.0	6.7	7.8	8.1	7.8	7.2	7.3	7.3	2.3	2.3	2.4
1984	5.1	4.9	4.9	4.8	-1.9	5.0	5.3	4.4	5.4	7.4	5.9	7.3	9.8	10.5	9.5	1.4	2.3	0.9
1985	5.3	5.4	5.4	5.4	8.5	5.3	5.8	6.2	5.8	5.2	5.9	5.3	3.8	3.3	3.8	8.9	6.4	7.1
1986	4.3	4.4	4.3	4.7	4.8	4.6	5.4	5.6	5.4	-7.6	-7.8	-7.7	-3.9	-3.7	-4.0	8.8	9.0	8.8
1987	3.8	3.7	3.8	5.2	4.1	5.3	6.4	6.2	6.4	3.2	3.0	3.2	3.0	3.0	2.9	4.4	4.4	4.2
1988	5.2	4.9	5.2	8.1	3.5	6.3	7.4	6.1	7.5	1.3	0.9	1.7	-0.1	-0.1	0.3	9.8	9.6	9.5
MEAN	7.2	7.2	7.2	6.8	6.8	6.8	9.1	9.1	9.1	5.3	5.3	5.3	4.9	4.8	4.9	9.9	9.9	9.9

Table 34: Adjustments to Balance of Payments (£ billion) and Personal Sector Saving Ratio (%)

	BAL			SR		
	3MA	3MAC	5MA	3MA	3MAC	5MA
1980	-0.8	-0.8	-0.9	0.2	0.2	0.0
1981	-1.1	-0.8	-1.4	0.1	0.2	-0.2
1982	0.3	1.4	0.2	-0.1	-0.1	-0.1
1983	0.1	2.2	-0.1	0.0	-0.1	-0.1
1984	0.8	-1.1	1.3	0.2	0.0	0.3
1985	0.8	0.7	0.9	0.1	0.0	0.1
1986	0.6	0.6	0.6	0.2	0.1	0.3
1987	0.9	0.0	1.1	0.3	0.3	0.4
1988	3.2	0.1	4.1	0.4	0.1	0.3
Mean	0.5	0.3	0.6	0.2	0.1	0.1

Table 35: Increase in the Balanced Labour Costs and Productivity (% change on previous year)

	ECMM			ULC			PRDMAN			PRDWH		
	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA
1980	17.5	17.5	17.5	22.4	22.7	22.3	-3.6	-3.8	-3.5	-1.7	-2.0	-1.7
1981	14.6	14.6	14.6	10.5	10.7	10.5	4.4	4.4	4.5	3.0	2.9	3.0
1982	9.8	9.9	9.8	3.7	4.0	3.9	6.6	6.4	6.4	4.8	4.5	4.7
1983	8.4	8.4	8.4	3.1	3.2	3.0	8.5	8.5	8.6	4.8	4.7	4.8
1984	7.7	7.7	7.8	3.0	2.3	3.2	6.0	6.6	5.8	2.0	2.7	1.9
1985	7.9	7.9	7.9	4.0	4.3	3.9	3.2	3.0	3.4	2.2	1.8	2.2
1986	7.0	7.0	7.0	4.5	4.5	4.6	3.3	3.4	3.2	2.5	2.5	2.5
1987	7.4	7.4	7.4	2.8	2.6	2.8	7.1	7.2	7.0	3.2	3.3	3.1
1988	7.8	7.8	7.8	6.0	5.6	5.8	5.4	5.8	5.8	1.1	1.5	1.3
Mean	9.8	9.8	9.8	6.7	6.7	6.7	4.5	4.6	4.6	2.4	2.4	2.4

Table 36: Adjustments to Financial Surpluses and Deficits (£ billion)

	FG			FO			FJ			FFI			FFM		
	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA
1980	0.7	1.1	0.8	-0.2	0.8	-0.1	0.5	0.5	0.2	0.4	-0.2	0.5	-0.3	0.0	-0.3
1981	-0.5	0.2	-0.4	1.0	0.8	1.2	0.4	0.3	-0.2	0.7	-0.1	0.8	-0.8	-0.1	-0.4
1982	0.1	0.7	0.0	-0.3	-1.4	-0.2	-0.1	-0.4	-0.1	-0.5	-0.1	-0.5	-0.3	-0.1	-0.3
1983	-0.5	1.1	-0.8	-0.1	-2.2	0.1	0.2	-0.3	0.0	0.2	0.7	0.1	-0.8	-0.2	-0.5
1984	0.7	0.9	0.9	-0.8	1.1	-1.3	0.1	0.3	0.5	-0.9	-0.7	0.8	0.7	0.0	0.5
1985	0.2	0.0	0.3	-0.8	-0.7	-0.9	0.2	0.1	0.1	-0.7	-0.3	-0.7	0.1	0.0	0.1
1986	-0.2	0.3	-0.2	-0.8	-0.8	-0.8	0.8	0.5	0.9	0.5	0.3	0.5	0.1	0.1	0.0
1987	0.4	0.0	0.4	-0.9	0.0	-1.1	1.1	1.1	1.4	-0.4	-0.5	-0.3	0.3	0.0	0.1
1988	2.1	-2.8	3.1	-3.2	-0.1	-4.1	0.0	0.8	-0.7	-5.9	-4.2	-5.3	0.9	-0.1	0.9
Mean	0.3	0.2	0.5	-0.7	-0.3	-0.8	0.3	0.3	0.2	-0.7	-0.5	-0.8	0.0	0.0	0.0

Table 37: Adjustments to Bank Lending to UK Private Sector, Persons, ICCs, Banks and OFIs (£ billion)

	LDJ			LDI			LDB			LDV		
	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA
1980	-0.3	-0.3	-0.2	0.3	0.2	0.3	-0.6	-0.6	-0.8	0.5	0.6	0.7
1981	-0.1	-0.1	-0.1	0.2	0.1	0.2	-0.5	-0.5	-0.6	0.4	0.5	0.5
1982	-0.2	-0.2	-0.1	0.2	0.2	0.2	-0.9	-1.0	-1.2	0.9	1.0	1.1
1983	-0.3	-0.3	-0.2	0.1	0.1	0.1	-0.6	-0.7	0.8	-0.8	0.9	0.9
1984	-0.1	-0.1	-0.1	-0.1	0.0	-0.1	-1.0	-0.9	-1.2	1.2	1.0	1.3
1985	-0.2	-0.2	-0.2	0.4	0.5	0.4	-0.6	-0.6	-0.8	0.4	0.4	0.5
1986	-0.4	-0.4	-0.3	0.5	0.5	0.4	0.1	0.1	0.2	-0.2	-0.2	-0.2
1987	-0.8	-0.8	-0.7	0.5	0.5	0.5	-1.0	-0.9	-1.3	1.3	1.3	1.6
1988	-0.9	-0.9	-0.8	1.1	1.3	1.1	-1.0	-0.9	-1.3	0.8	0.4	1.0
Mean	-0.4	-0.4	-0.3	0.4	0.4	0.3	-0.7	-0.7	-0.9	0.7	0.7	0.8

Table 38: Adjustments to Net Advances on Mortgages by Building Societies and Banks to the Personal Sector
(£ billion)

	LHZJ			LHBJ		
	3MA	3MAC	5MA	3MA	3MAC	5MA
1980	0.0	-0.1	-0.1	0.0	0.0	0.0
1981	0.0	-0.1	-0.1	0.0	0.0	0.0
1982	0.0	-0.1	-0.1	0.0	0.0	0.0
1983	-0.1	-0.1	-0.1	0.0	0.0	0.0
1984	0.0	-0.1	-0.1	0.0	0.0	0.0
1985	0.0	-0.1	-0.1	0.0	0.0	0.0
1986	-0.1	-0.1	-0.1	0.0	-0.1	0.0
1987	-0.1	-0.3	-0.3	-0.1	-0.1	-0.1
1988	-0.1	-0.3	-0.3	-0.1	-0.1	-0.1
Mean	0.0	-0.1	-0.1	0.0	0.0	0.0

Table 39: Adjustments to Domestic Bank Deposits: Persons, ICCs, Banks and OFIs (£ billion)

	DBJ			DBI			DBB			DBV		
	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA
1980	-0.6	-0.8	-0.5	0.5	0.4	0.5	-0.6	-0.6	-0.6	0.7	0.8	0.6
1981	-0.3	-0.3	-0.3	0.4	0.2	0.4	-0.5	-0.5	-0.5	0.4	0.6	0.4
1982	-0.3	-0.3	-0.3	0.3	0.4	0.4	-1.1	-1.2	-1.0	1.1	1.1	0.9
1983	-0.8	-0.8	-0.5	0.3	0.3	0.3	-0.6	-0.7	-0.6	0.9	1.0	0.8
1984	-0.3	-0.3	-0.2	0.0	0.1	0.0	-1.1	-1.0	-0.9	1.3	1.1	1.1
1985	-0.5	-0.5	-0.4	0.7	0.7	0.6	-0.7	-0.7	-0.7	0.5	0.5	0.4
1986	-0.9	-0.9	-0.7	0.7	0.7	0.6	0.3	0.3	0.2	-0.1	-0.1	-0.1
1987	-1.8	-1.8	-1.5	0.9	1.0	0.9	-0.8	-0.7	-0.9	1.7	1.6	1.4
1988	-2.0	-1.9	-1.7	1.7	2.1	1.8	-0.8	-0.8	-1.0	1.1	0.7	0.9
Mean	-0.8	-0.8	-0.7	0.8	0.7	0.6	-0.7	-0.7	-0.7	0.8	0.8	0.7

Table 40: Adjustments to Other Short Debt: Public Sector, Persons, ICCs and OFIs (£ billion)

	BSGG			BSGJ			BSGI			BSGV		
	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA
1980	0.0	0.0	0.0	-0.3	-0.3	-0.3	0.1	0.0	0.1	0.2	0.2	0.2
1981	0.0	0.0	0.0	-0.2	-0.2	-0.2	0.0	0.0	0.0	0.1	0.1	0.1
1982	-0.2	-0.1	-0.1	-0.2	-0.2	-0.1	0.0	0.0	0.0	0.3	0.3	0.2
1983	0.0	0.1	0.0	-0.3	-0.4	-0.3	0.0	0.0	0.0	0.3	0.2	0.2
1984	0.1	0.0	0.1	-0.3	-0.2	-0.2	0.0	0.0	0.0	0.2	0.2	0.1
1985	0.1	0.1	0.2	-0.3	-0.3	-0.3	0.0	0.0	0.0	0.1	0.1	0.1
1986	0.3	0.4	0.3	-0.5	-0.5	-0.5	0.1	0.1	0.1	0.1	0.1	0.1
1987	0.3	0.3	0.3	-1.0	-1.0	-1.0	0.1	0.1	0.1	0.6	0.8	0.5
1988	0.6	0.3	0.7	-1.1	-1.0	-1.2	0.1	0.2	0.1	0.5	0.8	0.4
Mean	0.1	0.1	0.2	-0.5	-0.5	-0.5	0.0	0.0	0.1	0.3	0.3	0.2

Table 41: Adjustments to Long Debt: Public Sector, Persons, ICCs and OFIs (£ billion)

	BLGG			BLGJ			BLGI			BLGV		
	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA
1980	0.4	0.5	0.3	-0.9	-1.0	-0.7	0.0	0.0	0.0	0.4	0.4	0.4
1981	0.2	0.3	0.1	-0.5	-0.6	-0.4	0.0	0.0	0.0	0.2	0.2	0.2
1982	-0.1	0.0	-0.2	-0.4	-0.5	-0.3	0.0	0.0	0.0	0.4	0.4	0.4
1983	0.5	0.8	0.3	-1.0	-1.3	-0.8	0.0	0.0	0.0	0.5	0.4	0.4
1984	0.5	0.3	0.4	-0.9	-0.6	-0.6	0.0	0.0	0.0	0.3	0.3	0.2
1985	0.7	0.7	0.5	-1.0	-1.0	-0.8	0.0	0.0	0.0	0.3	0.3	0.2
1986	1.4	1.6	1.0	-1.7	-1.9	-1.3	0.0	0.0	0.0	0.3	0.2	0.2
1987	2.2	2.2	1.4	-3.4	-3.3	-2.4	0.1	0.1	0.1	1.2	1.1	1.0
1988	2.9	2.1	2.3	-3.9	-3.3	-3.1	0.1	0.1	0.1	1.0	1.1	0.7
Mean	1.0	0.9	0.7	-1.5	-1.5	-1.1	0.0	0.0	0.0	0.5	0.5	0.4

Table 42: Adjustments to Miscellaneous Financial Flows: Public Sector, Overseas, Persons, ICCs, Banks and OFIs (£ billion)

	PUBM			OUSM			PERM		
	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA
1980	-0.8	-0.3	-0.4	1.3	1.3	1.5	-3.5	-3.4	-4.2
1981	-0.5	0.0	-0.4	1.3	1.0	1.6	-1.9	-1.8	-2.5
1982	-0.7	-0.3	-0.7	-2.8	-3.6	-2.5	-1.5	-1.5	-1.7
1983	-0.2	0.9	-0.1	0.3	-1.8	0.6	-3.5	-3.5	-4.1
1984	0.5	-0.5	0.8	4.8	6.5	4.4	-2.3	-2.5	-2.4
1985	-0.1	-0.2	0.2	5.3	5.2	5.2	-3.8	-3.8	-4.2
1986	-0.7	-0.2	-0.2	12.8	12.8	12.8	-7.4	-7.5	-8.1
1987	-1.2	-1.2	-0.5	11.2	11.8	11.0	-12.9	-12.9	-14.3
1988	0.1	-2.9	1.5	11.8	14.4	11.0	-14.3	-14.3	-16.4
Mean	-0.4	-0.5	0.0	5.1	5.3	5.1	-5.7	-5.7	-6.4

	ICCM			BANM			OFIM		
	3MA	3MAC	5MA	3MA	3MAC	5MA	3MA	3MAC	5MA
1980	3.0	2.5	3.0	-0.1	-0.1	0.1	0.9	1.0	1.1
1981	1.7	1.1	1.7	-1.0	-0.9	-0.8	0.5	0.7	0.6
1982	3.3	3.8	3.2	-0.2	-0.1	0.0	1.6	1.7	1.8
1983	2.2	2.7	2.1	0.0	0.2	0.2	1.2	1.4	1.4
1984	-0.8	-0.9	-0.7	-3.2	-3.4	-3.2	1.1	0.8	1.2
1985	1.4	1.7	1.5	-3.0	-3.0	-2.9	0.2	0.1	0.3
1986	-0.6	-0.7	-0.4	-3.1	-3.2	-3.1	-1.0	-1.1	-1.0
1987	3.4	3.2	3.5	-2.1	-2.3	-1.7	1.6	1.4	1.9
1988	5.4	6.4	6.0	-3.8	-3.7	-3.1	0.6	0.1	1.0
Mean	2.1	2.2	2.2	-1.8	-1.8	-1.6	0.7	0.7	0.9

Appendix 1

A Simple Example

The following example may help clarify the algebra of the basic Stone balancing formula, and give a better feel for how the adjustment process works. Suppose $x_{1,t}$ and $x_{2,t}$ are two observations, each from different sources and made with error, at time t of an economic time series. The income and expenditure measures of GDP for example. So that, dropping the t subscript,

$$x_1 = x + \varepsilon_1$$

$$x_2 = x + \varepsilon_2$$

In the previous notation

$$x = \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$$

$$A = (1 \ \ {-1})$$

and

$$V = \begin{pmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{12} & \sigma_2^2 \end{pmatrix}$$

where σ_1^2 is the variance of ε_1, σ_2^2 the variance of ε_2 and σ_{12} is their covariance.

Note

$$Ax^* = (1 \ \ {-1}) \begin{pmatrix} x \\ x \end{pmatrix} = 0$$

$$VA^T = \begin{pmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{12} & \sigma_2^2 \end{pmatrix} \begin{pmatrix} 1 \\ -1 \end{pmatrix} = \begin{pmatrix} \sigma_1^2 - \sigma_{12} \\ \sigma_{12} - \sigma_2^2 \end{pmatrix}$$

and

$$AVA^T = (1 \ \ {-1}) \begin{pmatrix} \sigma_1^2 - \sigma_{12} \\ \sigma_{12} - \sigma_2^2 \end{pmatrix} = \sigma_1^2 - 2\sigma_{12} + \sigma_2^2$$

[Note: AVA^T is a scalar because A contains only one restriction. In general AVA^T will be a $K \times K$ matrix where K is the number of restrictions.]

$$\therefore (AVA^T)^{-1} = \frac{1}{\sigma_1^2 - 2\sigma_{12} + \sigma_2^2}$$

$$Ax = (1 \ \ {-1}) \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} = x_1 - x_2$$

$$\therefore x^* = x - VA^T (AVA^T)^{-1} Ax$$

$$= \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} - \begin{pmatrix} \sigma_1^2 - \sigma_{12} \\ \sigma_{12} - \sigma_2^2 \end{pmatrix} \frac{1}{\sigma_1^2 - 2\sigma_{12} + \sigma_2^2} (x_1 - x_2)$$

$$\text{ie } x_1^* = x_1 - \frac{\left(\sigma_1^2 - \sigma_{12}\right)}{\sigma_1^2 - 2\sigma_{12} + \sigma_2^2} (x_1 - x_2)$$

$$= \frac{\sigma_2^2 x_1 - \sigma_{12}(x_1 + x_2) + \sigma_1^2 x_2}{\sigma_1^2 - 2\sigma_{12} + \sigma_2^2} = x_2^*$$

Hence the balanced estimates of x_1 and x_2 are equal and are a weighted average of the two observations with the weights depending on the variances and covariances of the observation error ε_1 and ε_2. Note, in particular, that if $x_1 = x_2$ then $x_1^* = x_2^* = x$ and if $\sigma_{12} = 0$, ie the observation errors are independent, then

$$x_1^* = x_2^* = \frac{\sigma_2^2 x_1 + \sigma_1^2 x_2}{\sigma_1^2 + \sigma_2^2}$$

Note also, and the importance of this will become clearer later, that $x_1 > x^*$ iff

$$x_1 > \frac{\sigma_2^2 x_1 - \sigma_{12}(x_1 + x_2) + \sigma_1^2 x_2}{\sigma_1^2 - 2\sigma_{12} + \sigma_2^2}$$

$$\Rightarrow \sigma_1^2 x_1 - 2\sigma_{12} x_1 + \sigma_2^2 x_1 > \sigma_2^2 x_1 - \sigma_{12}(x_1 + x_2) + \sigma_1^2 x_2$$

$$\Rightarrow \sigma_1^2 x_1 - \sigma_{12} x_1 > \sigma_1^2 x_2 - \sigma_{12} x_2$$

$$\Rightarrow \left(\sigma_1^2 - \sigma_{12}\right) x_1 > \left(\sigma_1^2 - \sigma_{12}\right) x_2$$

Therefore $x_1 > x^*$ iff $\sigma_1^2 > \sigma_{12}$ and $x_1 > x_2$

or $\sigma_1^2 < \sigma_{12}$ and $x_1 < x_2$

Similarly $x_2 > x^*$ iff $\sigma_2^2 > \sigma_{12}$ and $x_2 > x_1$

or $\sigma_2^2 < \sigma_{12}$ and $x_2 < x_1$

Hence x_1 <u>and</u> $x_2 > x^*$

iff $\sigma_1^2 > \sigma_{12} > \sigma_2^2$ and $x_1 > x_2$

or $\sigma_1^2 < \sigma_{12} < \sigma_2^2$ and $x_1 < x_2$

Similarly $\qquad x_1$ <u>and</u> $x_2 < x^*$ iff $\sigma_1^2 > \sigma_{12} > \sigma_2^2$ and $x_1 < x_2$

or $\qquad \sigma_1^2 < \sigma_{12} < \sigma_2^2$ and $x_1 > x_2$

However, providing $\sigma_{12} < \sigma_1^2$ <u>and</u> $\sigma_{12} < \sigma_2^2$

then $\qquad x_1 > x^* > x_2$ iff $x_1 > x_2$

and $\qquad x_1 < x^* < x_2$ iff $x_1 < x_2$

That is, the balanced data lies between the two observations providing the covariance between the two measurement errors are less than both of the variances. The covariance can never exceed both the variances, but when it exceeds one of them the balanced series will not lie between the two unbalanced observations.

Appendix 2

Assumption and Propositions Underlying the Weale Regression Approach

Assumption One

x_t, x_t^* and ε_t are vectors of dimension ρ, with $x_t = x_t^* + \varepsilon_t$ and $E(x_t^* \varepsilon_t^T) = 0$

This assumption is certainly not unreasonable and is typical of the sort of assumptions commonly required in econometric and time-series work. It would seem reasonable, for example, where data are collected by means of surveys, the results of these surveys are liable to reporting and sampling errors. When the error is of this type the data variance about its time-series mean will exceed the true variance. As Weale goes on to point out, however, citing Maravall and Pierce [1], the structure could be of the form

$$x_t^* = x_t + \varepsilon_t$$

Actually, of course, this can still be written as $x_t = x_t^* + V_t$ where $V_t = -\varepsilon_t$. The real point is that the measurement error cannot necessarily be assumed independent of the true data. In particular, if there is an element of 'guesstimating' in the raw data then the measurement error will be negatively correlated with the true data and the observed data may have lower variance than the true data. Weale points out the possibility of an extreme case where a volatile series could exist but for recent periods the national accountant has no information and so uses an assumed constant value instead. The measurement error will then be fully correlated with the true data and independent of the 'observed'.

The Weale asymptotically maximum likelihood estimator, then, is only valid when the data is actually observed, and when the measurement error is independent of the true data. The assumption can be challenged but is not unreasonable.

Assumption Two

$\varepsilon_t \sim N(\beta Z_t, V)$ where $\varepsilon_t, \beta, Z_t$ and V have been defined earlier. Normality is usually assumed for maximum likelihood estimators.

Assumption Three

$$E\left(\varepsilon_{t-1}\, \varepsilon_t^T\right) = 0$$

That is the errors are not serially correlated. Weale indicates that with further work it may be possible to drop this assumption. It does not prevent the balancing adjustments that are finally produced being serially correlated, indeed they are. To the extent that

(1) Maravall, A and Pierce, D A (1986), 'The Transmission of Data Noise in US Monetary Control', *Econometrica*, Vol 54, pp 961-980

the assumption is false, however, the estimators of bias, and more importantly of V, are not maximum likelihood and are inefficient. This, of course, in turn implies the balancing adjustments are, themselves, not maximum likelihood.

Assumption Four

The true data, x_t^*, satisfy the k accounting constraints $Ax^* = 0$.

The log likelihood function for the data is given by : -

$$\log L = C - \frac{\left(T(\log|V|)\right)}{2} - \sum_{t=1}^{T} \frac{\left(x_t - \beta Z_t - x_t^*\right)^T V^{-1}\left(x_t - \beta Z_t - x_t^*\right)}{2}$$

where C is a constant. Weale maximises this subject to the restrictions

$$\sum_{t=1}^{T} A\hat{x}_t = 0$$

where $\hat{x}_t$, $\hat{V}$ and $\hat{\beta}$ are used to denote the ML estimators of x_t, V and β. The estimators are derived via a series of propositions.

Proposition One

Taking $\hat{V}$ and $\hat{\beta}$ as given,

$$\hat{x}_t = (I - \hat{V}A^T(A\hat{V}A^T)^{-1}A)(x_t - \hat{\beta}Z_t)$$

This is the same as the least squares estimator derived earlier except that the initial data are adjusted for the bias before balancing is carried out.

Proposition Two

Taking $\hat{V}$ as given

$$\hat{\beta} = (k\hat{V}A^T(A\hat{V}A^T)^{-1}A^T + (1-k))\left(\sum_{t=1}^{T} x_t z_t^T\right)\left(\sum_{t=1}^{T} z_t z_t^T\right)^{-1}$$

where k is any scalar constant.

The arbitrary constant k comes about because it emerges that the estimator is the solution of the equation ;

$$\hat{V}A^T(A\hat{V}A^T)^{-1}A\hat{\beta} = \hat{V}A^T(A\hat{V}A^T)^{-1}A\left(\sum_{t=1}^{T} x_t z_t^T\right)\left(\sum_{t=1}^{T} z_t z_t^T\right)^{-1}$$

$$\hat{\beta} = \left(\sum_{t=1}^{T} x_t z_t^T\right)\left(\sum_{t=1}^{T} z_t z_t^T\right)^{-1}$$

is clearly one solution to this. However, because $\hat{V}A^T(A\hat{V}A^T)^{-1}A$ is idempotent

$$\hat{\beta} = \hat{V}A^T(A\hat{V}A^T)^{-1}A\left(\sum_{t=1}^{T} x_t z_t^T\right)\left(\sum_{t=1}^{T} z_t z_t^T\right)^{-1}$$

is another solution and any linear combination of the two is also a solution.

Weale argues that it is not surprising that maximum likelihood does not give a unique solution because there are no prior restrictions or penalties on the bias. He points out, however, that of the range of solutions only one has the property that $\hat{\beta} = 0$ if $Ax_t = 0$ for all t, ie that the estimated bias is zero when all the data vectors satisfy the accounting constraints *a priori*. That solution is ;

$$\hat{\beta} = \hat{V}A^T\left(A\hat{V}A^T\right)^{-1}A\left(\sum_{t=1}^{T} x_t z_t^T\right)\left(\sum_{t=1}^{T} z_t z_t^T\right)^{-1}$$

which is obtained by setting $k = 1$. Weale argues, reasonably, that this condition is a desirable one to impose on the bias and so adopts this solution.

Weale offers the following interpretation. The bias is estimated by an ordinary least squares regression on the accounting residuals, Ax_t, in order to produce an explained component of these residuals. Since there is no other information on how this explained component should be allocated across the x_t, it is allocated in the same way as the unexplained components of the accounting residuals (ie proposition one).

Substituting the preferred solution for $\hat{\beta}$ into the ML estimator given for x_t in proposition one yields:

$$\hat{x}_t = \left(I - \hat{V}A^T\left[A\hat{V}A^T\right]^{-1}A\right)x_t$$

That is, since the explained bias is allocated in the same proportion as the unexplained, the result is the same as balancing the data in one go, without bias adjustment.

Proposition Three

$$\hat{V} = \frac{1}{T}\sum_{t=1}^{T} \hat{\varepsilon}_t \hat{\varepsilon}_t^T \text{ is the ML estimate for } V \text{ where :}$$

$$\hat{\varepsilon}_t = x_t - \hat{x}_t - \beta Z_t = \hat{V}A^T\left(A\hat{V}A^T\right)^{-1}A\left(x_t - \beta Z_t\right)$$

and hence $\hat{V} = WA^T(AWA^T)^{-1}AW$

where

$$W = \sum_{t=1}^{T} \frac{\left(x_t - \beta Z_t\right)\left(x_t - \beta Z_t\right)^T}{T}$$

That is W is the covariance matrix of the data, x_t, corrected for bias. It follows that $\hat{V}A^T = WA^T$ and $A\hat{V}A^T = AWA^T$.

Proposition Four

$$Plim\ WA^T(AWA^T)^{-1} = VA^T(AVA^T)^{-1}$$

Weale points out that WA^T can only be calculated once β is known, and the estimator β requires knowledge of $\hat{V}A^T = WA^T$.

The solution is supplied by proposition five.

Proposition Five

$WA^T = \hat{W}A^T$ where $\hat{W}$ is the covariance matrix of the ordinary least squares residuals found after regressing x_t on Z_t,

$$\hat{W} = \sum_{t=1}^{T} \frac{(x_t - \beta Z_t)(x_t - \beta Z_t)^T}{T}$$

This implies that the covariance matrix of the regression residuals, $\hat{W}$, may be used in place of W for the calculation of $\hat{V}$, and that $\hat{W}A^T(A\hat{W}A^T)^{-1}$ can be used in place of $WA^T(AWA^T)^{-1}$ for the calculation of the balanced data. Weale offers an intuitive explanation for this. The regression of x_t on Z_t 'explains' both the true data, x_t^*, and the bias, βZ_t. However, the explained components of the true data satisfy the accounting constraints and are filtered out on post-multiplying by A^T. Only the bias remains and so $WA^T = \hat{W}A^T$.

Proposition five only holds providing $E(x_t^* \varepsilon_t^T) = 0$. Even then, it does not matter particularly to what extent the regressors explain true x_t as well. Indeed it is not necessary for the regressors to explain x_t^* at all since its contribution to $\hat{W}$ will be purged on post multiplying by A^T. The point is that the bias has to be removed by regression, because it does not satisfy the accounting identities, and it does not matter if the regression explains x_t^* to some extent as well.

Weale points out, and it is worth emphasising here, that $\hat{V}$ only has the same rank as the number of restrictions while V is of full rank. They cannot, therefore, be equal and $\hat{V}$ does not approach V in large samples. Fortunately this is not a requirement.

APPENDIX 3 - List of Restrictions used to Produce Balanced Data

I1 0=GDP9-GDPY9

I2 0=GDPE-GDPO

I3 0=GDPO-GDPY

I4 0=LHZJ+LZNA

I5 0=LHBJ+LHBB

I6 0=BSGO+BGSO

I7 0=LZG+LZO+LZJ+LZI+LZB+LZV

I8 0=NCI+NCG+NCJ+NCV

I9 0=PUBM+OUSM+PERM+ICCM+BANM+OFIM

I10 0=LDJ+LDI+LDB+LDV

I11 0=DBJ+DBI+DBB+DBV

I12 0=FTKG+FTKO+FTKJ+FTKI+FTKF

I13 0=-G9-IFG9-IIG9-ESAB+YGC-YSAG-YJG-EDBT-PUBM+FTKG-EGTA-LZG-LVG-BSGO-BSGG-BLGG-NCG

I14 0=-X9+M9-BIPD+EJTA-OUSM+FTKO+EGTA-LZO-BGSO

I15 0=-IFJ9-IIJ9-C9+YD-YSAJ-PERM-LDJ-DBJ+FTKJ-LZJ-LVJ-LHZJ-LHBJ-BSGJ-BLGJ-NCJ

I16 0=-IFI9-III9+SCI-YSAI-ICCM-LDI-DBI+FTKI-LZI-BSGI-BLGI-NCI

I17 0=-BANM-LDB-DBB-LZB-LHBB

I18 0=LVV+LVG+LVJ

I19 0=BSGG+BSGJ+BSGI+BSGV

I20 0=BLGG+BLGJ+BLGI+BLGV

See Appendix 4 for a guide to the notation

APPENDIX 4 - Notation

BANM	-RESB-LDB-DBB-LZB-LHBB
BGSO	OVERSEAS TAKE-UP OF GILTS: OVERSEAS
BIPD	INTEREST, PROFITS AND DIVIDENDS (NET)
BLGG	LONG DEBT: PUBLIC SECTOR
BLGI	LONG DEBT: ICCS
BLGJ	LONG DEBT: PERSONS
BLGV	LONG DEBT: OFIS
BSGG	OTHER SHORT DEBT: PUBLIC SECTOR
BSGI	OTHER SHORT DEBT: ICCS
BSGJ	OTHER SHORT DEBT: PERSONS
BSGO	BGSO WITH THE SIGN REVERSED
BSGV	OTHER SHORT DEBT: OFIS
C9	NOMINAL TOTAL CONSUMERS' EXPENDITURE
CONS	TOTAL CONSUMERS' EXPENDITURE
DBB	DOMESTIC BANK DEPOSITS (STERLING AND FOREIGN CURRENCY): BANKS
DBI	DOMESTIC BANK DEPOSITS (STERLING AND FOREIGN CURRENCY): ICCS
DBJ	DOMESTIC BANK DEPOSITS (STERLING AND FOREIGN CURRENCY): PERSONS
DBV	DOMESTIC BANK DEPOSITS (STERLING AND FOREIGN CURRENCY): OFIS
ECMM	EMPLOYMENT COSTS PER EMPLOYEE IN MANUFACTURING [DEFINED AS (YWS+YEC+YECS)*2.9717*EMAN/YWS]
EDBT	PUBLIC SECTOR DEBT INTEREST PAYMENTS
EGTA	NET PUBLIC SECTOR TRANSFERS ABROAD
EJTA	PERSONAL SECTOR NET TRANSFERS ABROAD
EMAN	INDEX OF AVERAGE EARNINGS IN MANUFACTURING, 2.9717 CONVERTS THE INDEX TO POUNDS PER QUARTER
ENIH	NATIONAL INSURANCE PAYMENTS
ESAB	SUBSIDIES
FCA	FACTOR COST ADJUSTMENT
FCA9	NOMINAL FACTOR COST ADJUSTMENT
FFI	NET ACQUISITION OF FINANCIAL ASSETS: ICCS
FG	NET ACQUISITION OF FINANCIAL ASSETS: PUBLIC SECTOR
FJ	NET ACQUISITION OF FINANCIAL ASSETS: PERSONS
FO	NET ACQUISITION OF FINANCIAL ASSETS: OVERSEAS
FTKF	NET CAPITAL TRANSFERS: FINANCIAL COMPANIES

FTKG NET CAPITAL TRANSFERS: PUBLIC

FTKI NET CAPITAL TRANSFERS: ICCS

FTKJ NET CAPITAL TRANSFERS: PERSONS

FTKO NET CAPITAL TRANSFERS: OVERSEAS

G PUBLIC AUTHORITIES' CURRENT EXPENDITURE ON GOODS AND SERVICES

G9 NOMINAL PUBLIC AUTHORITIES' CURRENT EXPENDITURE ON GOODS AND SERVICES

GDPA AVERAGE MEASURE OF GDP

GDP9 NOMINAL GROSS DOMESTIC PRODUCT (EXPENDITURE ESTIMATE)

GDPE REAL GROSS DOMESTIC PRODUCT (EXPENDITURE ESTIMATE)

GDPO REAL GROSS DOMESTIC PRODUCT (OUTPUT ESTIMATE)

GDPY REAL GROSS DOMESTIC PRODUCT (INCOME ESTIMATE)

GDPY9 NOMINAL GROSS DOMESTIC PRODUCT (INCOME ESTIMATE)

GO OUTPUT OF GENERAL GOVERNMENT ESTIMATED AS 0.6*G

ICCM FFI-RESI-LDI-DBI-LZI-BSGI-BLGI-NCI

IF TOTAL FIXED INVESTMENT

IF9 NOMINAL GROSS FIXED INVESTMENT

IFF9 NOMINAL FINANCIAL COMPANIES FIXED INVESTMENT

IFG9 NOMINAL PUBLIC SECTOR FIXED INVESTMENT

IFI9 NOMINAL ICCS FIXED INVESTMENT

IFJ9 NOMINAL PERSONAL SECTOR FIXED INVESTMENT

II TOTAL STOCKBUILDING

II9 NOMINAL TOTAL STOCKBUILDING

IIF9 NOMINAL FINANCIAL COMPANIES STOCKBUILDING

IIG9 NOMINAL PUBLIC SECTOR STOCKBUILDING

III9 NOMINAL ICCS STOCKBUILDING

IIJ9 NOMINAL PERSONAL SECTOR STOCKBUILDING

LC9 LOG OF C9

LCONS LOG OF CONS

LDB BANK LENDING TO UK PRIVATE SECTOR: BANKS

LDI BANK LENDING TO UK PRIVATE SECTOR: ICCS

LDJ BANK LENDING TO UK PRIVATE SECTOR: PERSONS

LDV BANK LENDING TO UK PRIVATE SECTOR: OFIS

LFCA LOG OF FCA

LFCA9 LOG OF FCA9

LG LOG OF G

LG9 LOG OF G9

LGDPE	LOG OF GDPE
LGDP9	LOG OF GDP9
LHBB	LOANS FOR HOUSE PURCHASE BY BANKS: BANKS
LHBJ	LOANS FOR HOUSE PURCHASE BY BANKS: PERSONS
LHZJ	NET BORROWING ON MORTGAGES BY BUILDING SOCIETIES: PERSONS
LIF	LOG OF IF
LIF9	LOG OF IF9
LM	LOG OF M
LM9	LOG OF M9
LPC	LOG OF THE DEFLATOR FOR CONSUMERS' EXPENDITURE
LPFCA	LOG OF THE DEFLATOR FOR FACTOR COST ADJUSTMENT
LPG	LOG OF THE DEFLATOR FOR PUBLIC AUTHORITIES' CURRENT EXPENDITURE ON GOODS AND SERVICES
LPGDP	LOG OF PGDP
LPIF	LOG OF THE DEFLATOR FOR TOTAL FIXED INVESTMENT
LPM	LOG OF THE DEFLATOR FOR IMPORTS OF GOODS AND SERVICES
LPX	LOG OF THE DEFLATOR FOR EXPORTS OF GOODS AND SERVICES
LVG	LIFE ASSURANCE AND PENSION FUND RECEIPTS: PUBLIC
LVJ	LIFE ASSURANCE AND PENSION FUND RECEIPTS: PERSONS
LVV	LIFE ASSURANCE AND PENSION FUND RECEIPTS: OFIS
LZB	DEPOSITS WITH BUILDING SOCIETIES: BANKS
LZG	FLOW OF PUBLIC SECTOR DEPOSITS WITH BUILDING SOCIETIES
LZI	DEPOSITS WITH BUILDING SOCIETIES: ICCS
LZJ	FLOW OF PERSONS DEPOSITS WITH BUILDING SOCIETIES
LZNA	NET ADVANCES ON MORTGAGES BY BUILDING SOCIETIES: OFIS
LZO	FLOW OF OVERSEAS DEPOSITS WITH BUILDING SOCIETIES
LZV	DEPOSITS WITH BUILDING SOCIETIES EXCLUDING THOSE FROM OTHER OFIS
LX	LOG OF X
LX9	LOG OF X9
M	IMPORTS OF GOODS AND SERVICES
M9	NOMINAL IMPORTS OF GOODS AND SERVICES
MPRO	MANUFACTURING PRODUCTION
NCG	NOTES AND COIN: PUBLIC
NCI	NOTES AND COIN: ICCS
NCJ	NOTES AND COIN: PERSONS
NCV	NOTES AND COIN: OFIS
OFIM	FFV-RESV-LDV-DBV+LZV-LVV-LZNA-BSGV-BLGV-NCV

ONSO NORTH SEA NET OUTPUT

OOTH OUTPUT OF 'OTHER' SECTOR (NATIONALISED INDUSTRIES AND PRIVATE SERVICES)

OUSM FO-RESO-LZO-BGSO

PERM FJ-RESJ-LDJ-DBJ-LZJ-LVJ-LHZJ-LHBJ-BSGJ-BLGJ-NCJ

PRDMAN OUTPUT PER HEAD IN MANUFACTURING

PRDOTH OUTPUT PER HEAD IN "OTHER" SECTOR

PRDWH OUTPUT PER HEAD IN WHOLE ECONOMY

PUBM FG-RESG-LZG-LVG-BSGO-BSGG-BLGG-NCG

RESB UNIDENTIFIED FINANCIAL TRANSACTIONS: BANKS

RESE RESIDUAL ERROR IN NATIONAL INCOME ACCOUNTS

RESG UNIDENTIFIED FINANCIAL TRANSACTIONS: PUBLIC

RESI UNIDENTIFIED FINANCIAL TRANSACTIONS: ICCS

RESJ UNIDENTIFIED FINANCIAL TRANSACTIONS: PERSONS

RESO UNIDENTIFIED FINANCIAL TRANSACTIONS: OVERSEAS

RESV UNIDENTIFIED FINANCIAL TRANSACTIONS: OFIS

SCF FINANCIAL COMPANIES SAVING

SCI INDUSTRIAL AND COMMERCIAL COMPANIES SAVING

TE RECEIPTS BY GOVERNMENT OF TAXES ON EXPENDITURE

TYJ PERSONAL SECTOR PAYMENTS OF UK INCOME TAX

ULC NON-NORTH SEA UNIT LABOUR COSTS [DEFINED AS (YWS+YEC+YECS)/(GDPO-ONSO)]

X EXPORTS OF GOODS AND SERVICES

X9 NOMINAL EXPORTS OF GOODS AND SERVICES

YD PERSONAL DISPOSABLE INCOME

YDIJ PERSONAL INCOME FROM DIVIDENDS AND NET INTEREST

YEC EMPLOYERS' CONTRIBUTIONS

YECS ACCRUALS OF NATIONAL INSURANCE SURCHARGE

YGC PUBLIC SECTOR TOTAL CURRENT RECEIPTS

YJG CURRENT GRANTS TO PERSONS FROM PUBLIC SECTOR

YRJ PERSONAL SECTOR INCOME FROM RENT AND NON-TRADING CAPITAL

YSAG PUBLIC SECTOR STOCK APPRECIATION

YSAI INDUSTRIAL AND COMMERCIAL COMPANIES STOCK APPRECIATION

YSAJ PERSONAL SECTOR STOCK APPRECIATION

YSE INCOME FROM SELF-EMPLOYMENT

YWS INCOME FROM WAGES AND SALARIES

The notation is consistent with that used in the Bank's macro-economic model.

Bank of England Discussion Papers

	Title	Author
1-5,8, 11-14, 16-17, 20-22, 31	*These papers are now out of print, but photocopies can be obtained from University Microfilms International* [a]	
6	*'Real' national saving and its sectoral composition*	*C T Taylor* *A R Threadgold*
7	The direction of causality between the exchange rate, prices and money	C A Enoch
9	The sterling/dollar rate in the floating rate period: the role of money, prices and intervention	I D Saville
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