How Cyclical is the PSBR?

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Abstract

This paper examines the methodology of cyclical adjustment of fiscal balances. We find that the crucial assumption underlying any estimates of the cyclically-adjusted balance (CAB) is the measure of the output gap. Estimates for the UK are presented, suggesting that when the economy returns to trend the PSBR should fall by between 3% to 4.5% of GDP from its position at the end of 1992.

I Introduction

The most widely cited justification for cyclically adjusting the PSBR is that the *ex post* budget balance is an unreliable indicator of the stance of policy since it does not distinguish between the impact of discretionary policy cyclical changes on the budget balance and the impact that cyclical changes in national income have on most tax receipts and some expenditure items. The cyclically-adjusted balance (CAB[(1)]) is designed to measure the affect of a government's policies on the budget outcome. A CAB also allows us to gauge what size the deficit (or surplus) might be if we could abstract from cyclical influences.

Although CABs may indicate whether fiscal policy has been loosened or not, or whether the deficit is potentially large, it is important to realise CABs do not in themselves provide estimates of the *absolute* stance of fiscal policy. To measure fiscal stance it is necessary to have a benchmark policy stance with which to compare current cyclically-adjusted policy. The issues relating to the definition of a benchmark - for instance, should it be framed with reference to some macroeconomic variable, or in terms of the deficit itself - are beyond the realms of this paper (see Buiter (1985) for a full discussion).

Many organisations publish estimates of cyclically-adjusted balances, but these vary markedly. For instance, before the UK's 1994/95 Budget (in late-1993), the OECD (1993) estimated the UK CAB to be around 5 1/2% and the IMF (1993) that it was in the range of 2-5% of GDP.[(2)] One difficulty with these estimates is that they are based on a variety of different underlying assumptions, and it is not possible to know *a priori* the relative importance of these assumptions in conditioning the CAB estimate. This paper, in contrast, explicitly explores the sensitivity of the results to different assumptions, which makes it potentially more useful for policy advice.[(3)]

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(1) In the UK context, this is the cyclically-adjusted PSBR.

(2) They gave no specific UK estimate, but stated "the structural deficits of Germany, France, Canada, the US, and the UK are all estimated to be in the range 2-5% of GDP". In the IMF (1992) they provided a specific estimate for the UK of 4%.

(3) Recent work by NIESR (Barrell et al, 1994) provides an excellent summary of the different approaches used by the IMF, OECD and EC. Our work is broadly consistent with their findings.

Two main issues have to be addressed when estimating the cyclicality of taxation and expenditure: (i) how to measure the cycle, and (ii) how best to represent the relationship that links the cycle with tax and expenditure. Considerable uncertainty surrounds both issues. We measure the cycle by single equation output gaps. As these only loosely tie into economic theory, we use four different measures of output gap to test the sensitivity of the results. Total government tax receipts and expenditure are the sum of many disparate elements that have differing relationships with the cycle. Thus there is is no obvious theoretical relationship at the aggregate level, and we are somewhat eclectic in our search for a functional form and allow the data to dictate the preferred version.

For both tax receipts and expenditure, we control as much as possible for non-cyclical influences. In the case of receipts, we make allowance for the impact on revenues of changes to the tax system; that is, we distinguish between cyclicality and policy changes. As we are interested in the present cyclical balance, we adjust the revenue series so that it is *as if* the 1992/3 tax structure had been in place throughout the sample period. In principle, we would like to have undertaken a similar adjustment for expenditure. However, in practice, it is not clear how one would do this; moreover, it is not even clear which elements of expenditure can meaningfully be described as cyclical. Because of this we use three different expenditure aggregates, again to test the sensitivity of the results to the underlying assumptions. The results indicate that the crucial assumption underpinning our CAB estimates is the output gap assumption.

The rest of the paper is organised as follows. Section II discusses measurement of the economic cycle. Section III describes how we have controlled for non-cyclical influences on tax and expenditure. The main body of results are presented in section IV. Section V draws out the implications for the UK in terms of the current fiscal position with general conclusions presented in Section VI.

II Measuring the Cycle

Any cyclical adjustment is dependent on the underlying trend/cycle decomposition upon which it is based. Unfortunately, it is particularly difficult to map precisely the economic concept of the cycle into data, and there is no one technique which is accepted as "best". In view of this, we have used four different measures of the output gap, each of which is based on a different method, and have explored the sensitivity of our cyclicality estimates to the trend/cycle decomposition.

Although cyclical adjustment, and the use of output gaps is widespread (in for example, gauging the strength of inflationary pressures in the economy), there is controversy regarding its statistical and economic validity. Nelson and Plosser (1982) reported that most major US macroeconomic variables show no tendency to revert to trend. That is, the impact of a shock on a variable does not diminish over time: an adverse shock to output will permanently affect it. If that is true, the idea of cyclical adjustment makes little sense. However, Nelson and Plosser's conclusion was based on particularly restrictive tests, and more recent work (for example, Shapiro and Watson (1988), Blanchard and Quah (1989) and Wickens (1995)), which has been based on more sophisticated tests that allow for both permanent and transitory shocks, show that the conclusions Nelson and Plosser drew were unwarranted. More generally, as noted by Quah (1992), any analysis of causes of volatility in economic variables is *conditional* on the assumptions made about the nature of the underlying economic disturbances. In other words, by itself the data cannot tell us what is the predominant source of economic volatility.

Mirroring the statistical debate, real business cycle theorists have suggested that the cycle makes little economic sense. Their arguments are based on models which show that observed economic fluctuations may be consistent with the optimising behaviour of individuals. The implication is that downturns in activity reflect permanent shocks to the economy, and that there is no trend from which output deviates.[4]

An alternative approach, therefore, would have been to analyse year-on-year *changes* in the deficit, as discussed in Blanchard et al (1990) and Ganley (1992). The attraction of this approach is that it does not necessarily rely on

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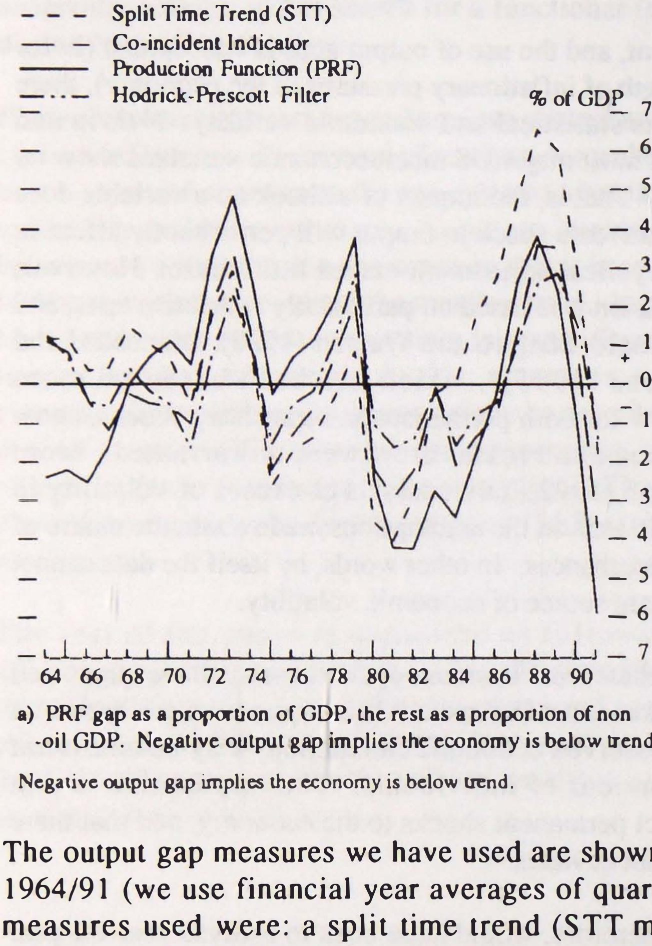
(4) This view is consistent with shocks predominately having a permanent effect on activity: the decomposition of shocks into permanent and transitory elements can be thought as analogous to the decomposition of shocks into supply and demand shocks.

output gap estimates, but an important drawback is that it could not be used to provide estimates of the underlying deficit. Moreover many other models - NAIRU etc - do suggest that output may deviate from trend, and that the distinction between cyclical and trend elements is valid. It is important to appreciate that cyclical adjustment is implicitly based on this latter class of models.

Chart 1

Alternative Output Gaps



a) PRF gap as a proportion of GDP, the rest as a proportion of non -oil GDP. Negative output gap implies the economy is below trend.

Negative output gap implies the economy is below trend.

The output gap measures we have used are shown in Chart 1, plotted over 1964/91 (we use financial year averages of quarterly observations). The measures used were: a split time trend (STT measure);(5) co-incident indicators; a Hodrick-Prescott filter; and a production function measure, (PRF measure), used by the OECD.(6) The first three measure the "non-oil" GDP

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(5) The STT trend is based on real non-oil GDP growth of 0.5% pa in the 1970s, 2.7% pa between 1980/81 and 1989/90 and 2.25% pa growth thereafter.

(6) In the OECD's latest technical paper on cyclical adjustment (Giorno et al, 1995), the authors compare estimates of trend GDP using a split time trend and a production function approach. They preferred the latter since they were better able to take account of structural information.

output gap, the latter measures the GDP output gap which includes North Sea oil. Their derivation is described in detail in Appendix B. *A priori* we remain agnostic between the measures as we believe there are no compelling theoretical grounds for choosing between them.[7]

In general these output gaps exhibit a similar pattern throughout the 1970s and 1980s, although the split time trend measure suggests the rate of growth in the mid to late 1980s was stronger relative to trend than the other measures. The estimates differ most in 1991/92, which is perhaps unsurprising as there was less information with which to decompose output into its trend and cyclical components at the end of the sample. This causes particular problems for the HP and STT decompositions as some assumption needs to be made over the profile of the whole cycle in order to identify the trend and cyclical elements. One approach would be to append actual data with a forecast of output growth. Another, which we adopt, is to assume that the development of the current cycle will follow the same pattern as the most recent complete cycle. This obviates the need to forecast future output growth. For all measures, uncertainty concerning the size of the output gap will always be greatest for the most recent data, which is precisely the data on which policy advice would be based. The measures suggest the output gap was between 2% and 8% of GDP in 1992 Q4.

(7) Barrell and Sefton (1995) provide a discussion of output gap measurement.

III Controlling for Non-Cyclical Influences

The discretionary/cyclical distinction is meaningful only over the short to medium term, because in the long term all revenue/expenditure is ultimately discretionary. To isolate the effect of the cycle on receipts and expenditure we need to strip out the effects of annual budgetary changes (ie base our results on a constant tax regime). We find that it is possible to do so for taxation receipts, but that it is not clear how one could do this for expenditure.

Taxation

In each Budget the government announces a series of measures which change the structure of the tax system and, typically, alter the level of revenues. If the cyclicality of actual tax revenues were calculated it would reflect both the effect of changes in economic activity on revenues, for a given tax system, and the effect of these Budget changes on revenue. When estimating tax cyclicality we are interested only in the first effect, which makes it necessary to adjust tax revenues for changes to the tax system. This section describes the method used to adjust tax revenues and presents our adjusted revenue series.

To adjust actual tax revenue we use Budget estimates of the (direct) revenue impact of tax changes. We derive a series for adjusted tax revenues which estimates what revenues would have been in each year between 1969/70 and 1992/93 had the 1992/93 tax regime been in place. The series is created by using the "Proportional Data Adjustment" method (which is based on the assumption that the proportionate revenue impact of a tax change is constant through time).[8] The adjustment is best explained by way of an example. Imagine revenues in year *t* are 120, of which 20 is estimated to be a direct effect of a change made to the tax system that year. Then the estimated proportionate impact of the tax change is to increase revenues by 0.20 (that is 20/100). Further, assume revenues in year *t*-1 had been 80, then we would estimate revenues would have been 96 in year *t*-1 had the tax change been made a year earlier (1.2*80), and our adjusted revenue series would be (96,120). To create a longer series the proportionate impact of tax changes is cumulated backwards. So had changes in year *t*-1 been introduced that reduced revenues by 10%, then year *t*-2 revenues would have to be increased by 1.08 (0.9*1.2) to create a consistent series. Appendix C gives a more detailed explanation.

(8) The IMF recommends this method for adjusting revenues in its papers on Budget forecasting.

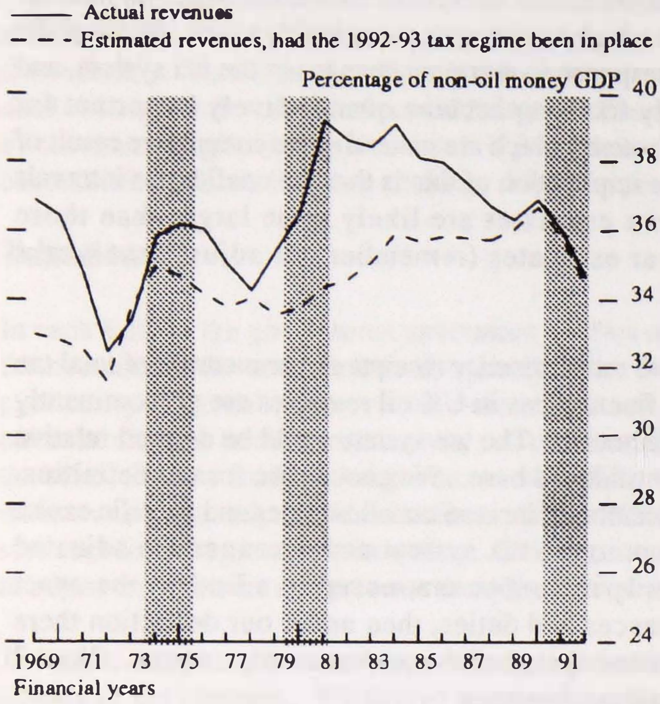
This adjustment does not allow for any private sector reaction to changes in the tax system. It is probable that following a switch in taxation from one area of economic to activity to another, that there will be a shift of private sector activity away from the area which has become more highly taxed. These shifts are unlikely to be large in response to marginal changes in the tax system, and this issue is therefore only likely to become quantitatively important for significant changes to the system (which are generally the cumulative result of a number of Budgets). The implication of this is that the confidence intervals surrounding our early year estimates are likely to be larger than those surrounding our later year estimates (remember our adjustment works backwards).

We take total non-oil tax and social security receipts as our measure of total tax revenues on the basis that fluctuations in UK oil revenues are predominantly the result of non-cyclical factors.(9) The tax system could be defined relative to either an indexed or non-indexed base. We choose the former definition. Thus the over or under indexation of income tax allowances and specific excise duties is taken as a change to the tax system and revenues are adjusted accordingly. Were the only measures announced in a Budget the exact indexation of these allowances and duties, then under our definition there would be no change to the tax system and no revenue adjustment. Chart 2 plots actual and adjusted total tax revenues.

(9) This measure includes both local authority taxation receipts and National Insurance contributions. An argument can be made to exclude both on the basis that it is not possible to control for discretionary changes to their collection. This follows as local authority receipts are influenced by the budgetary decisions of local authorities while National Insurance contributions are designed specifically to fund the National Insurance fund; so both are influenced by factors beyond the remit of the Chancellor when setting the Budget. However, ultimately both local authority and National Insurance payments are determined by central government policy (so, for instance, the decision to index link pensions with prices rather than wages in the early 1980s has influenced the growth in National Insurance payments), and for this reason we include the revenues in our overall measure.

Chart 2

Tax to GDP ratios[1]



(1) Total non-oil tax and social security revenues.
Recessionary periods shaded.

Four features stand out from Chart 2:

(i) We estimate that the cumulative effect of tax changes throughout 1969/70 - 1992/93 has been to reduce tax revenues; that is, we estimate revenues would have been lower over the 1969-91 period if the 1992/93 tax regime had been in place.

(ii) The trend increase in our adjusted revenue series is consistent with the observation that the overall tax system is progressive. Since 1969/70 real GDP has increased and *ceteris paribus* progressivity implies the tax to GDP ratio would increase.

(iii) The effect of the 1981/82 Budget, which increased revenues in a recession is apparent in actual revenues. However, even after allowing for those tax changes we estimate tax revenues would have increased as a proportion of GDP between 1980/81 and 1981/82. This does not accord with the prior that tax revenues decline as a proportion of GDP during recessions.

(iv) Statistical tests suggest that both series are trend non-stationary over our sample. This is a little surprising for the unadjusted revenue series but may reflect a structural break in the series around 1981 (or may just serve to illustrate the low power of the stationarity test over short samples). More fundamentally, all these ratios are bounded [0,1] and so theoretically cannot be trended in the long run.

Expenditure

In principle, to control for non-cyclical influences on expenditure, we should be able to undertake an adjustment for the policy stance similar to that done for taxation. In practice, it is unclear exactly what this means. The main issue on the expenditure side is to decide how much government expenditure is dependent on the cycle. For example, is is cyclical or discretionary if a government regularly chooses to increase capital expenditure during recessionary periods? This could be a deliberate policy response or it could equally be a result of capital expenditure automatically taking up the "slack" when the economy enters recession. Thus, we feel that it is misleading to judge what expenditure should be regarded as cyclical by examining the data: counter-cyclical movement in a spending aggregate may simply reflect a government reaction function. In particular, priorities in government expenditure may vary over the cycle. So, for example, training may assume greater importance during a recession when unemployment rises, prompting a discretionary rebalancing of government resources.

The decision of which expenditures are most likely to be cyclical is judgmental, based on which types of expenditure it seems most reasonable in principle to view as "self-correcting". Social security would appear to be a good candidate for cyclicality since much of it depends directly on the state of the economy (eg unemployment benefits). However, about half of social security expenditure is on pensions which seems unlikely to be cyclical. Hence, we create a separate subset of social security, corresponding to the parts we consider "cyclical", including unemployment benefit, income support and family credit.[10] This measure is our preferred measure and is closest to that used by the OECD and the IMF in their cyclical adjustment.

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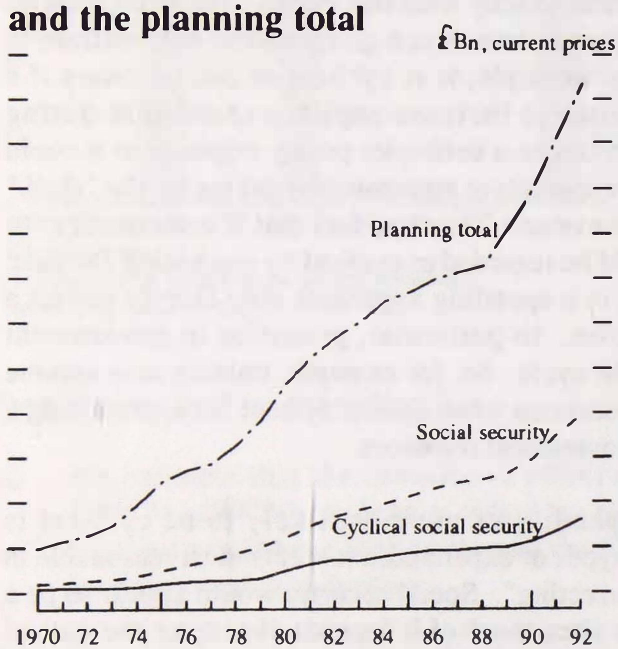
(10) This is a wider definition of cyclical expenditure than that used in the FSBR since it is not possible to construct a consistent time series based on current FSBR definitions.

Because we prefer the narrowest measure,[11] this clearly creates a potential upward bias in our estimates of "structural" expenditure. Our decision, in effect, places an upper bound on the proportion of expenditure which we expect to reduce as the economy recovers. We therefore also choose to test the sensitivity of our results to the choice of expenditure aggregate, and present results for total social security spending and the planning total as well as cyclical social security (see Section IV and Appendix D). The planning total is essentially total general government expenditure (GGE) excluding debt interest.[12] The series are plotted in Charts 3 and 4, both in levels and as a ratio to GDP.

Chart 3

Cyclical and total social security and the planning total



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(11) That is the "cyclical" part of social security.

(12) We want to exclude debt interest on the grounds that it would be influenced by the level of interest rates - a policy variable - the stock of outstanding debt <u>and</u> the level of inflation.

Chart 4

Government expenditure as a % of GDP

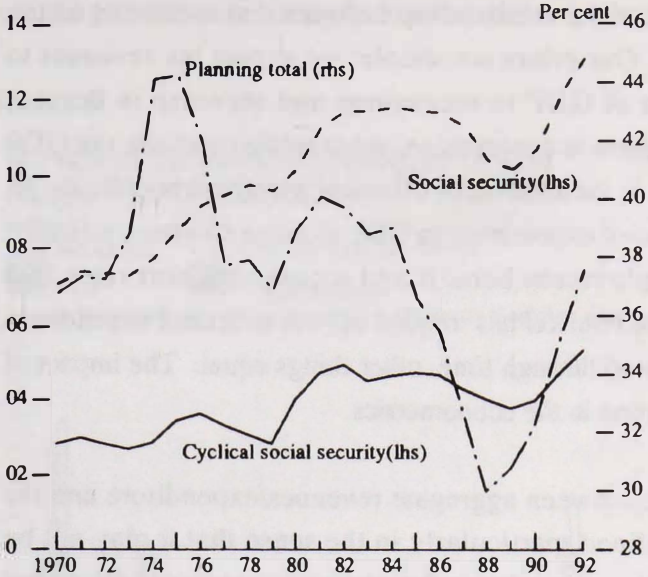

Table A shows the relative magnitudes of these expenditure series.

Table A: Expenditure Aggregates, 1992/3

	£mn	As % of GDP	As % of Planning Total
Planning Total	226,629	38%	100%
Social Security	79,167	13%	35%
"Cyclical" Social Security	32,162	5%	14%

IV Empirical Results

In this section, we examine the relationship between our measures of tax revenue and expenditure. Our priors are simple: we expect tax revenues to decrease as a proportion of GDP in recessions and increase in booms; furthermore, as the tax system is progressive, we would expect the tax:GDP ratio to trend up over time, in the absence of offsetting government policies. In contrast, we expect the ratio of expenditure to GDP to move counter-cyclically, as expenditure on unemployment benefit and income support rises in a recession.(13) Further, if the NAIRU has trended up, the structural expenditure GDP ratio will have increased through time, other things equal. The impact of this is captured by a time trend in the econometrics.

However, the relationship between aggregate revenues/expenditure and the cycle may not be well defined, particularly in the sense that it may not be stable over time. Instability may arise in the aggregate tax/expenditure and output gap relationships because the responsiveness of individual receipts/expenditures to the cycle varies markedly. For example, corporation tax revenues are extremely cyclical (as the amplitude of the profit cycle is large), but other taxes, such as inheritance duties, are largely independent of the cycle.(14) On the expenditure side, instability in the results may occur if *non-cyclical elements* were treated as if they were cyclical.

And further, some reforms to the tax system do not affect overall revenues but change emphasis of tax collection between different areas of the economy. If there is a switch between taxes with differing cyclical sensitivities then the elasticity of overall revenues to the cycle will change. As Chart 5 shows the

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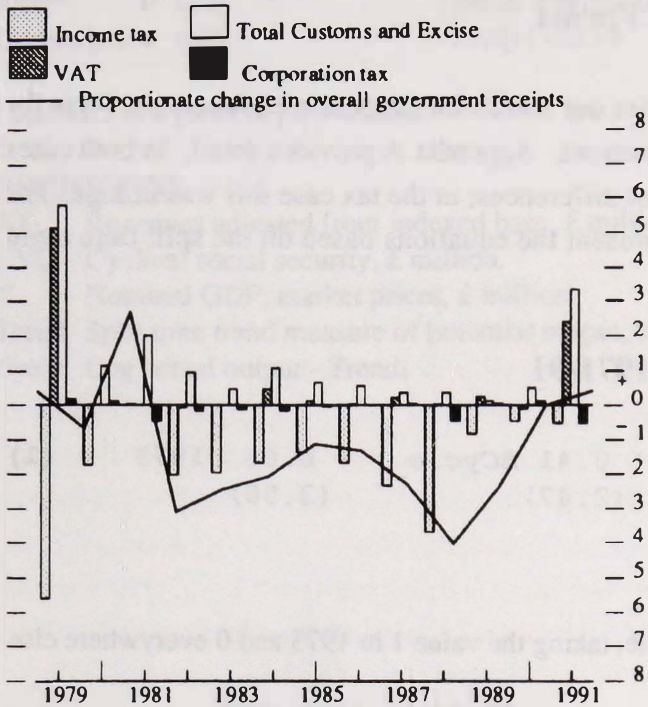
(13) The government may also choose to spend more on certain elements of expenditure at specific points in the cycle, but it is debatable whether this is evidence of cyclicality or a reaction function (see Section III).

(14) As the share of cyclically-sensitive tax receipts in total receipts will increase in booms and decrease in recessions, the elasticity of total tax revenues with respect to the cycle, which is a weighted sum of the elasticity of the individual taxes, will be positively related to the output gap.

1979/80 (income tax-VAT switch) and 1991/92 (community charge-VAT switch) are examples of such reforms. As VAT is less progressive than income tax the 1979/80 switch may have reduced the cyclicality of overall tax receipts.

Chart 5

Revenue impact of changes to the Major Tax catagories



These considerations suggest overall tax/expenditure cyclicality might be best derived by estimating the cyclicality of individual taxes/expenditures separately, and then combining these estimates. This is the approach adopted by the OECD, at least on the tax side.[15] But, of course, even individual tax categories are aggregate measures and may not exhibit stable cyclical relationships. For example, the distribution of personal income has changed over the last twenty years and the cycle-income tax relationship may have

(15) Given that we (and the OECD) believe that only a small subset of expenditure can be meaningfully described as "cyclical", this issue is less pressing on the spending side.

changed. If this is the case, if the changes in individual taxes cyclically offset each other, then total revenue estimates are empirically unimportant, total tax estimates may provide better cyclicality estimates. This issue can only be resolved empirically. We estimated the cyclicality of both individual and total tax revenues, but found that the results were similar, and so we report only the aggregate results in the text.(16)

Preferred Functional Forms

In this section we summarise our search for the preferred functional form for our tax and expenditure equations. Appendix A provides detail. In both cases we opt for equations in first differences; in the tax case this was in logs. For illustrative purposes we present the equations based on the split time trend measure of trend output.

Non-oil tax revenue, 1971-91

$$\Delta log(AT/Y) = \underset{(2.47)}{0.00} + \underset{(2.47)}{0.41}\ \Delta Cycle_{-1} + \underset{(3.50)}{0.06}\ D1973 \qquad \textbf{(1)}$$

where

D1973 = Dummy variable, taking the value 1 in 1973 and 0 everywhere else

$Radj^2$ = 0.51	SE of Regression = 0.02
DW = 1.68	LM(1) = 0.39

(16) In general, it proved harder to explain movements in (adjusted) individual taxes than total taxes. Our preferred results, based on total revenue, therefore estimate the *average* sensitivity of total revenues to the cycle over our sample period.

Cyclical social security expenditure, 1971-91

$$\Delta(CYC/Y) = \underset{(1.41)}{0.001} + \underset{(2.42)}{0.33}\ \Delta(CYC/Y)_{-1} - \underset{(-1.05)}{0.05}\ \Delta trend$$

$$- \underset{(-6.81)}{0.16}\ \Delta Cycle \qquad (2)$$

$Radj^2$ = 0.73		SE of Regression = 0.002
Durbin's h = 0.88		LM(1) = 0.94

t statistics are given in parentheses.

DEFINITIONS

AT	Revenues adjusted from indexed base, £ million.
CYC	Cyclical social security, £ million.
Y	Nominal GDP, market prices, £ million.
Trend	Split time trend measure of potential output, logged.
Cycle	Log actual output - Trend.

Interpretation

The two equations identify the cyclical response parameters, which are the crucial element when wishing to work out the implications for the PSBR *as the economy returns to trend.* The equations imply:

(i) $\Delta log\ (T/Y) = +\ 0.41 * \Delta Output\ Gap$

(ii) $\Delta (G/Y) = -\ 0.24 * \Delta Output\ Gap$

So (i) implies that a percentage point reduction in the output gap would lead to a rise in the tax:GDP ratio of 0.41 *percent*; equation (ii) implies that a percentage point reduction in the output gap would lead to a fall in the ratio of cyclical social securtiy to GDP of 0.24 *percentage points*.[17]

Although not directly comparable, these results imply lower tax cyclicality than the results in Davies (1990), where it is reported that a one percent rise in GDP increases the tax:GDP ratio by 0.3 percentage points.[18] He also found that a one percent rise in GDP decreases the expenditure:GDP ratio by 0.4 percentage points for two years in succession. But because he used a different expenditure aggregate,[19] this is not directly comparable in terms of the implications for the change in the level of expenditure as the economy returns to trend.

(17) The tax side is in terms of a percentage (rather than percentage points) fall because it is expressed in logs.

(18) For example, consider a tax:GDP ratio of 35%, with GDP at £600 billion. An increase in the Tax:GDP ratio of one percentage point would mean taxation revenue had risen around £6 billion. On the other hand, an increase in the tax:GDP ratio of one percent implies a rise of 0.01 * (0.35*600) = £2.1 billion. Hence, in our example, a percentage point translates into a larger difference in tax revenue than a percent.

(19) They use general government expenditure which is a wider aggregate than the planning total.

Treasury Results: the effects of a 1 percent rise in GDP

	First Year	Second Year
Effect on Tax:GDP	-0.07	0.3
Effect on expenditure:GDP	-0.4	-0.4

Sensitivity Analysis

In this section we analyse the sensitivity of the results to various assumptions employed: (i) the output gap measure, (ii) the expenditure aggregate and (iii) the sample period.

(i) Sensitivity analysis: output gap measure

Table B reports the sensitivity of our preferred receipts and expenditure equations to the different output gap measures. Two features stand out from these results. First, for both tax and expenditure, there is an inverse relationship between the estimated size of the output gap in 1992 Q4 and the coefficient on the cycle term. This implies a degree of convergence among the different measures in the amount that taxes (expenditure) will rise (fall) once output returns to trend. Second, comparing fit, for the tax equations, the PRF (production function) output gap measure underperforms the other three output gaps, which are virtually indistinguishable in terms of fit. As noted in Section II, the PRF measure is defined in terms of total GDP, and the other output gaps in terms of non-oil GDP, so this result is not surprising given the sharp changes in oil output over this period. On the expenditure side, there is little to distinguish the different output gap measures in terms of fit for a given expenditure aggregate.

We tested for asymmetric cyclical effects in both equations but found there were insufficient data to discriminate adequately.

TABLE B: Sensitivity of results to output gaps

(i) Non-Oil Tax Revenue

Equation	Dep Var	Output Gap	$\Delta(\text{Cycle})_{-1}$ β_0	Constant γ_0	Dum 73 κ_0	DW	LM(1)	$\bar{R}^2$	SE Equation	Memo Item Output Gap 1992 Q4
5	Δlog(AT/Y)	FILTER	0.48 (2.07)	0.00 (0.03)	0.06 (3.19)	1.56	0.74 [0.38]	0.48	0.01	- 2.4
5	Δlog(AT/Y)	STT	0.42 (2.47)	0.00 (0.01)	0.06 (3.50)	1.68	0.37 [0.54]	0.51	0.02	- 4.3
5	Δlog(AT/Y)	COINC.IND	0.40 (2.31)	0.00 (0.06)	0.06 (3.19)	1.57	0.83 [0.36]	0.51	0.02	- 6.1
5	Δlog(AT/Y)	PRF	0.24 (1.43)	0.00 (0.03)	0.06 (3.31)	1.49	1.11 [0.29]	0.42	0.02	- 8.1

(ii) Cyclical Social Security

Equation	Dep Var Gap	Output	LDV α_1	ΔTrend β_0	Δ(Cycle) γ_0	Constant κ_0	Durbin's h	LM(1)	$\bar{R}^2$	SE Equation	Memo Item Output Gap 1992 Q4
4	Δ(CYC/Y)	FILTER	0.32 (2.81)	-0.02 (-0.69)	-0.20 (-7.20)	0.001 (1.39)	0.29 [0.77]	0.01 [0.91]	0.79	0.002	-2.4
4	Δ(CYC/Y)	STT	0.32 (2.42)	-0.05 (-1.05)	-0.16 (-6.81)	0.001 (1.41)	0.88 [0.37]	0.85 [0.36]	0.73	0.002	- 4.3
4	Δ(CYC/Y)	COINC.IND	0.35 (2.80)	-0.03 (-0.77)	-0.16 (-7.71)	0.001 (1.10)	0.49 [0.62]	0.09 [0.77]	0.77	0.002	- 6.1
4	Δ(CYC/Y)	PRF	0.32 (2.66)	-0.11 (-0.97)	-0.15 (-7.37)	0.002 (1.02)	0.73 [0.47]	0.45 [0.50]	0.77	0.002	- 8.1

(ii) Sensitivity analysis: expenditure aggregate

Although we have argued for the narrowest expenditure aggregate, we felt it would be interesting to test how sensitive our results were to this decision. Appendix D gives the econometric results. Table C shows the sensitivity of the results to expenditure total, showing how much expenditure is estimated to fall as output returns to trend, based on the four different output gaps. The results show that - as you would expect given the similarity in coefficients on the output gaps - the level of expenditure expected to fall as the output gap is closed rises with the size of the output gap. The reduction in expenditure per percentage point of the output gap is in the range of between £1.1 billion and £2.4 billion across all output gap and expenditure measures.

Table C: The fall in expenditure when output returns to trend

Output Gap Measure	Output Gap in 1992 Q4	Δ in Expenditure: £ billion (% GDP) CYC	SS	PLAN
Filter	- 2.4	3.7 (0.6)	3.4 (0.6)	5.7 (0.9)
STT	- 4.3	5.1 (0.8)	9.7 (1.6)	8.4 (1.4)
Co-incident Indicator	- 6.1	7.5 (1.2)	9.9 (1.6)	11.9 (2.0)
PRF	- 8.1	9.0 (1.5)	16.9 (2.8)	13.3 (2.2)

The overall margin of error is sizeable (£3.6 billion - £16.9 billion), but this is more a reflection of the uncertainty about the size of the output gap than the choice of expenditure aggregate. The results underline the importance of getting the output gap measure right, rather than worrying about how much of expenditure is potentially cyclical. It would be possible to narrow the range by arguing in favour of a particular aggregate or by conditioning on a given output gap. For example, taking the STT output gap as the central case, with cyclical social security, we should expect expenditure to fall about £5 billion when the economy returns to trend. However, this would be arbitrary in the absence of a macroeconomic consensus concerning the appropriate cycle measurement.

(iii) Sensitivity analysis: sample period

Finally, we examine the sensitivity of our findings to the sample period. As we found that this was only a significant problem on the tax side, we only report these results. As Table D shows, the cycle coefficient is very sensitive to the sample period. The estimated coefficient is much greater when the tax equation is calculated over the full sample (1971/72-1992/93), than when it is estimated over sub-samples.

Table D: The sensitivity of tax cyclicality over different sample periods

	Coefficient on Output Gap Measure			
Estimation End Point	**Filter**	**STT Indicator**	**Co-incident**	**PRF**
1990/91	0.25	0.20	0.19	0.01
1991/92	0.31	0.28	0.27	0.1
1992/93	0.48	0.41	0.39	0.24

The importance of the 1991/92 and 1992/93 data points reflect the fact that the whole sample period only covers three recessionary periods, and that the tax to GDP rates actually increased in one of these periods. Nevertheless, given the heightened uncertainty surrounding the output gap estimates in 1991/92 and 1992/93 - the end point problem discussed in Section II - this finding is worrying. It shows our estimates of tax cyclicality rely strongly on those data points in which we have least faith. We suspect that this type of sensitivty could be a common feature of CAB analyses, highlighting a potential danger of using these estimates for policy advice.[20]

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(20) Barrell et al (1994) also found end point biases with their HP filter measure.

V How Big is the Cyclically Adjusted PSBR?

Table E combines the expenditure and tax results (for the full sample) to show the implications for the PSBR.

Table E: The change in the PSBR when output returns to trend

Output Gap Measure	% in 1992 Q4	£ billion (% GDP) Δ in Revenue	Δ in Expenditure[(a)]	Δ in PSBR
Filter	- 2.4	8.4 (1.4)	3.7 (0.6)	12.1 (2.0)
STT	- 4.3	13.5 (2.3)	5.1 (0.8)	18.6 (3.1)
Co-incident Indicator	- 6.1	19.7 (3.3)	7.5 (1.2)	27.2 (4.5)
PRF	- 8.1	23.1 (3.9)	9.0 (1.5)	32.1 (5.4)

(a) Using cyclical social security.

Combining the tax and expenditure results suggests that the PSBR will automatically decrease by between about £12 billion to £32 billion when the economy returns to trend from its position in 1992 Q4. One can only obtain a narrower range of estimates by conditioning on a particular output gap: if one rules out the two extreme output gaps, the PSBR should reduce by between about 3% (£19 billion) and 4.5% (£27 billion) of GDP.

This improvement is in addition to the pre-announced Budget measures of the 1993/94 and 1994/95 Budgets which aimed at a structural reduction of the deficit of about £12.5 billion in 1994/95, £17 billion the year after and £21 billion in 1996/97.[(21)] Hence, by 1996/97 the PSBR (neglecting cyclical improvement) would be about £26 billion (about 3% GDP[(22)]); when added to our estimate of a £19-27 billion cyclical improvement indicates that the fiscal position should be broadly in balance as the economy returns to trend.

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(21) The 1995/96 Budget was broadly neutral in its impact.

(22) That is, 3% of Money GDP forecast for 1996/7 in the November FSBR.

VI Conclusions

This paper analyses the methodology of cyclical adjustment, focusing on the UK's position, although many of the issues are of international significance. We focus particularly on the sensitivity of the estimates to the underlying assumptions. Unlike previous published work on this area, our research is explicit about the importance of alternative assumptions.

The cyclically-adjusted PSBR (CAB) estimates depend crucially on the underlying output gap assumption, on the sample period and, to a lesser extent, on the definition of cyclical expenditure. In particular, using the tax equation, we also show how reliant the estimates of cyclicality are on the latest data points, which are precisely the ones in which we have least faith. This highlights the danger of interpreting these estimates too precisely.

The other assumptions, for example whether to adopt total revenue or individual tax revenue based estimation are far less important than the output gap assumptions. In general, the results confirm how tentative any estimates of the CAB must be and explain the reasons why various published estimates of CABs can differ significantly.

Appendix A: Search for Preferred Functional Form

This appendix sets out the search for a preferred functional form for tax and expenditure. As we noted in the introduction, we are somewhat ecletic in this search, relying on essentially statistical guidance since there seems no obvious theoretical relationship at the aggregate level. Because of the essentially atheoretic approach, these results are best interpreted as being illustrative rather than necessarily "true". In both cases we opted for equations in first differences; in the tax case this was in logs.

(i) Tax

Table A1 presents our preliminary search for a preferred functional form. To limit the number of equations that we estimate at this stage, all these equations based on the STT measure of trend output and the output gap. The trend term is I(1), and the output gap I(0). We take taxes adjusted from an indexed base as our measure of tax revenues under the 1992/3 policy regime.

Given that theory gives little guidance on the precise form of the cycle/tax receipts relationship, we start with a general specification (equation 1) which regresses the tax to GDP ratio against lags of the output gap, trend output (in log terms), a constant and a lagged dependent variable. There appears to be no theoretical reason why one might prefer to measure the elasticity of revenue (or expenditure) to the cycle, as opposed to or the sensitivity of the ratio of revenue (or expenditure) to GDP to the cycle. Indeed, both approaches should produce virtually the same result. However, using ratios does have the advantage that it is easier to see the impact of different assumptions about the output gap on the structural budget balance. The coefficients are more easily comparable across countries (when using levels, the budget elasticities have to be weighted by country-specific revenue and expenditure ratios to make valid comparisons). Also, it is likely that the concept of a neutral spending policy would be one where the *ratio* of revenue/GDP or expenditure/GDP remained constant rather than the *level*. On the basis of these arguments, we prefer to express the dependent variable as a ratio to GDP.

Testing suggests the trend and tax to GDP ratio terms co-integrate, so equation (1) can be viewed as an unrestricted error correction mechanism (ECM). The three trend terms are collinear and are individually insignificant.

The contemporaneous cycle term is insignificant and incorrectly signed. Equation (3) is our preferred specific form. The (lagged) trend term is correctly signed - picking up progressivity - but still insignificant. Thus on grounds of fit the trend term could be dropped; however as its inclusion maintains the ECM interpretation we retain it.[23] The two cycle terms (one and two lags) are oppositely signed and of similar magnitude, suggesting it is the change in the cycle that effects the tax GDP ratio rather than the level itself. Durbin's h suggests there may be residual autocorrelation, but beyond this the equation diagnostics are satisfactory. The joint restriction that the cycle enters as a (lagged) difference and that the LDV has a unit coefficient is accepted, and equation (4) is the restricted version of equation (3). The trend term in equation (4) is wrongly signed, implying unsatisfactory long run properties. Equation (4) should therefore only be used for short run projections (say, 2 to 3 years); longer out it implies the tax to GDP ratio would decline as trend GDP increased.

That the contemporaneous cycle terms are persistently insignificant and wrongly signed may reflect simultaneity between taxes and GDP. Although we have adjusted for the impact of tax changes on revenue, the Budget estimates which we (and HMT) use for adjustment only measure the direct impact of changes on revenue. If there are significant indirect effects - or if the estimates of the direct effects are understated - GDP in year *t*, and therefore the output gap, may be a function of year *t* taxes. In this case the coefficient on the contemporaneous output gap will be biased and the lagged output gap may be viewed as an instrument for the contemporaneous output gap. As such, the coefficient on the lagged change in the output gap in equation (4) may be viewed as representing the impact of the contemporaneous change in the output gap.

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(23) Furthermore, the qualitative implications from the equation are little changed if the time trend is dropped.

TABLE A1: NON-OIL TAX REVENUE CYCLICALITY, 1971-91

Equ	Dep Var	LDV	Trend	$Trend_{-1}$	$Trend_{-2}$	Cycle	$Cycle_{-1}$	$Cycle_{-2}$	Constant	Tests	DW/ Durbin's h	LM(1)	$\bar{R}^2$	SE Equation
		α_1	β_0	β_1	β_2	γ_0	γ_1	γ_2	κ_0					
(1)	$\frac{AT}{Y}$	0.50 (1.80)	0.27 (0.63)	-0.42 (-0.57)	0.19 (0.47)	-0.07 (-0.57)	0.18 (1.30)	-0.15 (-1.01)	-0.47 (-0.93)	-.-	1.72 [0.40]	0.70	0.70	0.007
(2)	$\frac{AT}{Y}$	-.-	0.11 (5.62)	-.-	-.-	0.02 (0.26)	-0.01 (-0.15)	-.-	-0.99 (-4.17)	-.-	1.09	4.40 [0.04]	0.67	0.008
(3)	$\frac{AT}{Y}$	0.67 (3.23)	-.-	0.02 (0.64)	-.-	-.-	0.20 (2.75)	-0.16 (-2.04)	-0.11 (-0.37)	$\alpha_1=1;\gamma_1=-\gamma_2$ [0.25]	3.54 [0.00]	0.86 [0.35]	0.72	0.007
(4)	$\Delta\left(\frac{AT}{Y}\right)$	-.-	-.-	-0.013 (-0.91)	-.-	-.-		0.18 (2.58)	0.17 (0.91)	-.-	1.87	0.39 [0.84]	0.24	0.007
(5)	$\Delta\log\left(\frac{AT}{Y}\right)$	-.-	-.-	-0.04 (-0.87)	-.-	-.-		0.52 (2.50)	0.47 (0.87)	-.-	1.89	0.02 [0.89]	0.23	0.02

Pref Equ	Dep Var	$\Delta(Cycle)_{-1}$	Constant	Dum 73	DW	LM(1)	$\bar{R}^2$	SE Equation
		β_0	γ_0	κ_0				
(5a)	$\Delta\log(AT/Y)$	0.41 (2.47)	0.00 (0.01)	0.06 (3.5)	1.68	0.39 [0.53]	0.51	0.02

DEFINITIONS

- AT — Revenues adjusted from indexed based, £ million.
- Y — Nominal GDP, market prices, £ million.
- Trend — STT measure of potential output, logged.
- Cycle — Log actual output - Trend.
- LDV — Lagged Dependent Variable

(t-statistics)
[probabilities]
Sample period: 1971-1991 (financial years)

As noted above the form of the relationship between taxes and the cycle is not tightly specified. Therefore we also estimated a log specification that allows the coefficients to be interpreted as elasticities. Testing down from a general lag structure (and imposing the same prior on the trend term) resulted in equation (5), which is the log equivalent of equation (4). In common with equation (4) this has unsatisfactory long-run properties. Although non-nested tests of the functional form were unable to significantly distinguish between the ratio and log specifications they did give weak support for the log form. On this basis, we prefer the log specification, even though it is less directly interpretable in terms of CABs (which is always referenced in terms of the PSBR to GDP ratio). Empirically this decision is trivial: taking the tax to GDP ratio as 0.34 in 1992/93 the coefficients in equations (4) and (5) have identical implications for the change in the tax to GDP ratio were output to return to trend.

We examine the sensitivity of the estimated cycle-tax relationship to the inclusion of dummies for years which might be considered outliers. The 1973/74 observation in particular appears to be an outlier.[24] We find that inclusion of the 1973/74 dummy improves the performance of the equation greatly and we drop the trend term which was insignificant. Our overall preferred tax equation is equation (5) augmented with a 1973 dummy [equation (5a)].

(ii) Expenditure

Table A2 presents the preliminary search for a preferred functional form for the narrowest measure of expenditure, which is our favoured expenditure aggregate. To limit the number of equations we estimate, the equations were again based on the STT measure of trend output and the output gap.

Equation (1) is a general specification which regresses the ratio of cyclical social security to GDP against lags of the output gap, trend output (in log terms), a constant and a lagged dependent variable. (The second lag of the cycle was insignificant). The cycle terms are oppositely signed and of similar

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(24) Appendix B shows the 1973/74 General Government Expenditure forecast error was unusually large, and that this has created a spike in our tax adjustment series.

magnitude, suggesting it is the change in the cycle that affects the expenditure/GDP ratio rather than the level itself. This was tested and accepted in all the different functional forms. The three trend terms tended to be insignificant. However, the unit coefficient on the lagged dependent variable suggests that a differenced specification would be more appropriate [equations (3) and (4)]. In equation (4) the trend is restricted to two lags and the coefficients suggest that it is the change in the trend which matters. As it makes little or no difference to the rest of the coefficients so is not reported. Equation (5) is the log equivalent of equation (4), but as the diagnostics are not quite as good we chose equation (4) as the preferred functional form.

On the basis of equation (4), with the STT output gap, the results suggest that, were the output gap to close, the ratio of cyclical social security to GDP would fall by about 1.03% points (from around 5% to 4% of GDP).

TABLE A2: EXPENDITURE CYCLICALITY, 1971-91

Equ	Dep Var	LDV	Trend	$Trend_{-1}$	$Trend_{-2}$	Cycle	$Cycle_{-1}$	Constant	Durbin's h	LM(1)	$\bar{R}^2$	SE Equ
		α_1	β_0	β_1	β_2	γ_0	γ_1	κ_0				
(1)	$\frac{CYC}{Y}$	1.03 (5.74)	0.11 (0.68)	-0.15 (-0.57)	0.04 (0.32)	-0.20 (-5.74)	0.11 (1.67)	0.03 (0.16)	1.3 [0.19]	0.54 [0.46]	0.91	0.002
(2)	$\Delta\left(\frac{CYC}{Y}\right)$	0.23 (0.97)	0.12 (0.95)	-0.21 (-1.03)	0.10 (0.85)	-0.18 (-5.80)	0.13 (2.61)	0.02 (0.15)	n/a	0.05 [0.82]	0.73	0.002
(3)	$\Delta\left(\frac{CYC}{Y}\right)$	0.36 (2.58)	0.08 (0.73)	-0.21 (-1.04)	0.13 (1.26)	-0.17 (-6.74)		0.06 (0.82)	-0.34 [0.74]	0.13 [0.72]	0.74	0.002
(4)	$\Delta\left(\frac{CYC}{Y}\right)$	0.33 (2.36)	-0.04 (-0.74)	0.03 (0.62)		-0.16 (-6.62)		0.06 (0.80)	0.89 [0.37]	0.94 [0.33]	0.73	0.002
(5)	$\Delta\log\left(\frac{CYC}{Y}\right)$	0.28 (2.00)	-0.95 (-0.64)	0.77 (0.49)		-4.46 (-6.56)		2.30 (1.02)	1.12 [0.26]	1.54 [0.22]	0.71	0.06

Pref Eqn	Dep Var	LDV	ΔTrend	ΔCycle	Constant	Durbin's h	LM(1)	$\bar{R}^2$	SE Equ
(4a)	$\Delta\log\left(\frac{CYC}{Y}\right)$	0.33 (2.42)	-0.05 (-1.05)	-0.16 (-6.81)	0.001 (1.41)	0.88 [0.37]	0.94	0.73	0.002

DEFINITIONS

CYC Cyclical Social Security, £ million.
Y Nominal GDP, market prices, £ million.
Trend STT measure of potential output, logged.
Cycle Log actual output - Trend.
LDV Lagged Dependent Variable

(t statistics) [probabilities]
Sample period: 1971-1991 (financial years)

Appendix B: Derivation of Output Gaps

Previous work at the Bank has identified four techniques as the most common ways of deriving reduced form output gaps. The output gaps that we use each represent one of these methods. Their derivations are summarised below. We remain agnostic between each approach, and our ordering is not a ranking. See Barrell and Sefton (1995) for a fuller discussion of the different output gap measures and their potential benefits and drawbacks.

1 Hodrick-Prescott Filter

The Hodrick-Prescott filter (HP) decomposes the variables into cycle and trend elements. It allows the trend to be stochastic. Taking y_t as *log(GDP)*, g_t as the trend component and c_t as the cycle component the HP identifies the components according to the following condition:

$$\min_{g_t} \left[\Sigma\, [y_t - g_t]^2 + \alpha\, \Sigma\, [g_{t+1} - 2g_t + g_{t-1}]^2 \right]$$

That is, it minimises the variance of the cycle subject to a penalty term in the second difference of the trend. α is a smoothing factor; the variability of the trend is inversely related to α. We chose $\alpha = 1600$ which is widely used (see Wickens, 1995).

The HP filter is popular as it easy to apply, more sophisticated than split time trends (see below) and imposes the exact structure on the data that trend/cycle decomposition assumes. Of course, the validity of the approach depends on the validity of that underlying assumption.

2 Split Time Trends (STT)

Potential output is modelled by a split (deterministic) time trend, and the output gap is taken as the residual between that and actual GDP. They may be interpreted as approximations to HP's. For historic periods the growth rate is derived from picking a linear trend between two peaks and taking the average growth. For current periods the growth rate assumption is more subjective, as peak-to-peak fitting is not possible. The STT trend is based on real non-oil growth of 0.5% pa in the 1970s, 2.7% pa between 1980/81 and 1989/90 and 2.25% pa growth thereafter.

3 Co-incident Indicators

The co-incident indicator method is effectively a peak to peak method. However, rather than fitting a trend between peak GDP periods it fits a trend between points where the CSO co-incident indicator series equalled 100. As with the split time trend approach, the most recent estimates of trend growth depend on the forecast of future output growth.

In so much as co-incident indicators provide a reliable indicator of the state of the economy, trends derived from them may be more attractive than split time trends as they are more broadly based, and are not conditioned on the path of just one variable.

4 Production function based approaches (PRF)

These measures derive productive potential estimates from estimates of the equilibrium supply of factor inputs and total factor productivity. The output gap is then derived as the difference between productive potential and GDP. Of the four methodologies we have used this has the strongest economic basis.

In order to use this method (as with the other methods), various assuumptions have to be made. Typically, total factor productivity estimates are based on the assumption that total technical progress is disembodied and returns to scale are constant. Equilibrium factor supplies are normally inferred from "long run" trends. Among other things, this process requires estimation of the capital stock, which, in particular, is difficult as allowance has to be made for capital depreciation and scrapping, both of which are hard to model.

The OECD measure we have used is based on "efficiency" labour units, with labour productivity augmented by technical progress and capital scrapping modelled as an endogeneously. Dhar, Fisher and Henry (1992) provide a detailed discussion.

Appendix C: Controlling for Changes to the Tax System

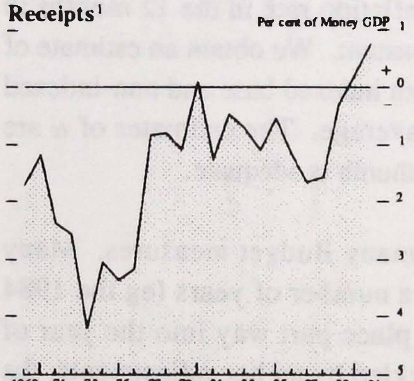
As described in Section III we control for the revenue impact of changes to the tax system with the Proportional Data Adjustment (PDA) method. Although simple in theory several practical problems complicated its application. This appendix discusses them.

First, PDA requires a consistent time series of the revenue impact of tax changes exists. However, the Budget data which we use are actually *forecasts* of the expected *direct* revenue impact of Budget changes, and further, has not been calculated on a consistent basis throughout our sample period. This created three immediate concerns: are the forecasts accurate, are "indirect" effects quantitatively important and does it matter the series has not been calculated on consistent basis? We address these concerns in the following way.

Forecast accuracy could not be directly checked as outturn data for the direct revenue impact does not exist. However, the Budget also contains forecasts of general government receipts (GGR) and we calculate the forecast errors associated with them as an indirect check on the accuracy of direct revenue forecasts. As Chart C1 shows the (generally negative) GGR forecast errors tend to be small relative to GDP. Thus we infer that we could treat the Budget forecasts of the direct effects as if they were outturns without introducing serious measurement error problems.

Chart C1

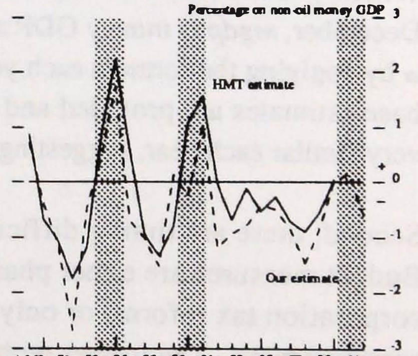
Forecast Error in General Government Receipts[1]



1 Difference between Red Book Estimate and Outcome

Chart C2

Alternative estimates of the impact on tax revenues of discretionary policy changes



Financial years

+ indicates increase in government revenues

This conclusion is generally supported by Chart C2 which compares our estimate of the revenue impact of tax changes with the Treasury's (see Davies 1990). The Treasury series allows for forecast errors, but with the exception of 1972/73 and 1973/74 (when the largest GGR forecast errors were made), the two series are very similar. The 1973/74 divergence provides a measurement error rationale for the dummy we introduced for that year in our empirical work.

The Budget estimates are only forecasts of the "direct" revenue effect of tax changes. That is, the estimates are designed to take account of the income and substitution effects that a tax change induces but take no account of any second round interactions, or multiplier effects, following on from that change. As we have no way of estimating these effects we have to accept the accuracy of our adjustment is inversely related to the size of these effects.

The basis upon which the estimates have been calculated has changed since 1969/70. Until 1982/83, the revenue impact was calculated relative to a non-indexed base, between 1982/83 and 1987/88 the impact relative to both an indexed and non-indexed base was calculated; since then the impact has only been calculated relative to an indexed base. Therefore to create consistent series indexation costs have to be estimated. For this we use the following rule of thumb to create indexed based estimates for each year that they were not calculated:

$$\imath = \alpha.\pi.mgdp$$

Where $\imath$ is the cost of indexation, π is the inflation rate in the 12 months to December, *mgdp* is money GDP and α is a constant. We obtain an estimate of α by applying the formula each year when both indexed base and non-indexed base estimates are provided and taking the average. The estimates of α are very similar each year, suggesting our rule of thumb is adequate.

Second, there are timing difficulties with many Budget measures. Many Budget measures are either phased in over a number of years (eg the 1984 corporation tax reform) or only come into place part way into the year of announcement. The former problem was tackled by ad hoc adjustments, the latter by assuming tax receipts are not seasonal. Thus, if a measure was introduced one-third of a way through a year, the proportionality factor would be calculated as follows:

$$\rho = (de*3)/\lambda$$

with $\lambda = (ar + (2*de))$

where ρ is the proportionality factor; *de* the estimated direct revenue effect in the year of implementation and *ar* actual revenues in the year of implementation. The adjusted series is derived by applying the cumulative ρ factors to the λ series.

Appendix D: Sensitivity of econometric results to expenditure aggregate

Table D1 presents the econometric results for different expenditure aggregates. For completeness, we also present how the coefficients differ over the four output gaps. The results show that there is more uniformity in the coefficients on the four cyclical social security equations than for the other two aggregates. The difference between the cyclical social security and social security equations reflects the behaviour of the extra elements within social security - the largest being pension expenditure. One difference is that the coefficient on the lagged dependent variables (LDVs) are larger for social security than for cyclical social security, suggesting that there is more persistence within the larger aggregate. More generally, the equation for social security is not as good as that for cyclical social security, with evidence of autocorrelated disturbances. Both factors suggest that the additional components of social security behave differently from the cyclical elements over the cycle. This gives some further support for our preference of the narrowest expenditure aggregate.

Table D1: Sensitivity of results to expenditure aggregate for different output gaps

Equation	Dep Var	Output Gap	LDV α_1	Trend β_0	Trend (-1) β_1	Δ(Cycle) γ_0	Constant κ_0	Durbin's h	LM(1)	$\bar{R}^2$	SE	Memo Item Output Gap 1992 Q4
(1a)	Δ(CYC/Y)	FILTER	0.30 (2.58)	-0.02 (-0.41)	0.01 (0.31)	-0.21 (-7.02)	0.05 (0.87)	0.06 [0.95]	0.002 [0.96]	0.79	0.002	-2.4
(1b)		STT	0.33 (2.37)	-0.04 (-0.74)	0.03 (0.62)	-0.16 (-6.62)	0.06 (0.80)	0.89 [0.37]	0.94 [0.33]	0.73	0.002	-4.3
(1c)		COINC.IND	0.34 (2.71)	-0.02 (-0.41)	0.01 (0.30)	-0.16 (-7.66)	0.06 (0.92)	0.34 [0.74]	0.06 [0.81]	0.77	0.002	-6.1
(1d)		PRF	0.32 (2.59)	-0.05 (-0.37)	0.05 (0.34)	-0.15 (-7.22)	0.04 (0.77)	0.78 [0.44]	0.63 [0.43]	0.77	0.002	-8.1
(2a)	Δ(SS/Y)	FILTER	0.50 (3.26)	-0.10 (-1.82)	-0.11 (1.82)	-0.18 (-4.8)	-0.01 (-0.17)	-0.70 [0.48]	0.71 [0.40]	0.75	0.003	-2.4
(2b)		STT	0.65 (4.25)	-0.02 (-0.27)	0.02 (0.24)	-0.18 (-7.46)	0.02 (0.31)	-2.56 [0.10]	5.47 [0.02]	0.80	0.002	-4.3
(2c)		COINC.IND	0.55 (3.81)	-0.06 (-0.98)	0.06 (0.93)	-0.17 (-6.93)	0.02 (0.28)	-1.11 [0.27]	1.50 [0.22]	0.78	0.002	-6.1
(2d)		PRF	0.66 (4.29)	0.06 (0.28)	-0.06 (-0.29)	-0.15 (-6.07)	0.05 (0.80)	-1.52 [0.13]	2.53 [0.11]	0.76	0.003	-8.1
(3a)	Δ(PLAN/Y)	FILTER	0.13 (0.55)	-0.18 (-0.49)	0.17 (0.44)	-0.63 (-2.06)	0.18 (0.32)	n/a	3.20 [0.07]	0.22	0.02	-2.4
(3b)		STT	0.04 (0.15)	0.15 (0.41)	-0.20 (-0.52)	-0.67 (-3.13)	0.61 (1.04)	n/a	0.77 [0.38]	0.34	0.02	-4.3
(3c)		COINC.IND	0.02 (0.08)	0.13 (0.33)	-0.18 (-0.43)	-0.65 -2.99	0.60 (1.07)	n/a	2.61 [0.11]	0.31	0.02	-6.1
(3d)		PRF	0.16 (0.73)	1.38 (1.20)	-1.44 (-1.23)	-0.47 (-2.48)	0.65 (1.51)	1.88 [0.06]	0.10 [0.75]	0.40	0.02	-8.1

where
CYC = cyclical social security
SS = social security
PLAN = planning total

References

Barrell, R, Morgan, J, Sefton, J and in't Veld, J (1994), "The Cyclical Adjustment of Budget Balances", *NIESR Report Series Number 8.*

Barrell, R J and Sefton, J (1995), "Output Gaps. Some Evidence from the UK, France and Germany", *National Institute Economic Review* (February).

Blanchard, O J (1990), "Suggestions for a New Set of Fiscal Indicators", *OECD Economics and Statistics Department*, Working Paper No.79.

Blanchard, O J,Chouraqui, J-C, Hagemann, R P and Sartor, N (1990) "The sustainability of fiscal policy: New answers to old questions", *OECD Economic Studies*, No.15.

Blanchard, O J and Quah, D (1989), "The Dynamic Effects of Demand and Supply Disturbances", *American Economic Review*, 79, pages 655-673.

Buiter, W H (1985), "Government Deficits reinterpreted" in *"Principles of Budgetary and Financial Policy"* MIT Press (1990).

Davies, S (1990), "Fiscal Developments and the Role of the Cycle", *Treasury Bulletin* Vol 2 (1), pages 13-24.

Dhar, S K, Fisher, P G and Henry, S G B (1992), "Productive Potential and Inflation", *Bank of England mimeo.*

Ganley, J A (1992), "Blanchard's Indicator of Discretionary Fiscal Change", *Bank of England mimeo.*

Giorno, C P, Richardson, P, Rosemare, D and van den Noord, P (1995), "Estimating Potential Output, Output Gaps and Structural Budget Balances", *OECD Working Paper No 152.*

Hibberd, J (1993), "Trends in Public Expenditure: 1978-79 to 1992-93", *Treasury Bulletin*, vol 4(2), pages 20-32.

IMF (1992), "World Economic Outlook", December 1992.

IMF (1993), "World Economic Outlook", May 1993.

Nelson, C R and Plosser, C I (1982), "Trends and Random Walks in Macroeconomic Time Series", *Journal of Monetary Economics*, 10, pages 129-162.

OECD (1993), "Automatic Stabilisers: Their Extent and Role", *OECD June 1993 Economic Outlook*, pages 37-48.

Quah, D (1992), "The Relative Importance of Permanent and Transitory Components: Identification and some Theoretical Bounds", *Econometrica*, Vol 60 (1), pages 107-118.

Shapiro, M D and Watson, M W (1988), "Sources of Business Cycle Fluctuations", in *Maroeconomics Annual*, ed, by S Fisher, MIT Press, pages 111-148.

Wickens, M R (1995), "Trend Extraction: A Practioners Guide", *Government Economic Service Working Paper No 125*.

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