Cyclical Indicators for the UK Economy

by Colin Yeend, Office for National Statistics

INTRODUCTION

Interest in cyclical indicators, rather like the economic activity which they attempt to track, appears to rise and fall periodically. Obviously, interest in the figures is at its highest when there is uncertainty about the direction of the economy and it appears to be about to change. However it also often seems to be in part a reaction to the perceived failure of the latest large macro-economic models to pick up the latest changes in the economy. Support for cyclical indicators stems from the need for a simpler predictive tool as well as the belief that series exist which have an inherently stable (and possibly causal) relationship with the state of the economic cycle. Moreover although they are sometimes criticised as merely confirming what is already known, there are also plenty of users who feel this confirmation adds value in itself.

This article takes a look at recent development work on the cyclical indicators originally conducted by the Central Statistical Office (CSO) and complements the article on the Monthly Indicator of GDP also published in this edition of Economic Trends. It presents the conclusions from a research project, carried out for the CSO by a team from the Department of Applied Economics (DAE), University of Cambridge during 1994-95.

The aim of the research project was to examine the existing system of cyclical indicators and to make recommendations for possible replacements. The DAE team arrived at a variety of criticisms of the cyclical indicators and proposed instead a new form of indicator, based on a multivariate regression modelling technique. The Office for National Statistics (ONS) has decided against the adoption of this new technique at least in the way proposed by DAE, largely on the grounds that it would be an explicit forecast of GDP growth.

The article attempts to give an appreciation of the existing cyclical indicators system and some of the criticisms levelled at it: it does not attempt to examine the forecasting record of the existing indicators in any detail. The article then looks briefly at the proposed new indicator and suggests an approach to the problem of improving the identification of turning points and which builds on the DAE proposal.

ONS's EXISTING CYCLICAL INDICATORS

The ONS publishes each month a set of four cyclical indicators of the UK economy: a longer leading index (which looks for turning points around year ahead); the shorter leading index (indicating turning points around half a year ahead); a coincident index; and a lagging index (looking at turning points a year after they occurred). The methodology is based on the traditional approach of the US National Bureau of Economic Research (NBER) developed by Burns and Mitchell[1]. It is very similar to that employed by, amongst others, the US Department of Commerce (now conducted by the Center for International Business Cycle Research, Columbia University) and the OECD.

The composition of the indicators was last reviewed in 1992/93 and the results were published in CSO's Economic Trends, July 1993. However, the CSO had noted growing concern over both the methodology and the results amongst users. Criticism has been on the grounds that the leading indicators generally predicted broad swings in the growth cycle when indicators were chosen after the event, but the performance of the indicators was sometimes less than robust due to data revisions and revisions to trend level in the light of new data. It has also been noted that the implicit assumption of a fixed five year cycle to calculate the trend could be misleading if the latest cycle is atypical. Finally, it is arguable whether the choice of indicators was optimal: there are two monetary aggregates in the longer leader, whereas the shorter leader is weighted towards personal sector indicators.

The cyclical indicators are constructed using a technique which was established in the late 1940s before much of the basis of econometrics had been established. They are intended to anticipate or define only turning points in the economy, rather than provide a quantitative prediction of the growth of the economy. A brief description of the ONS's cyclical indicators methodology follows.

The series are first detrended and then scaled (so that the mean absolute deviation from the trend over a five year window is equal to five) to give cycles of similar amplitude over all the indicators concerned. They are then inverted where appropriate (for example interest rates) and averaged using equal weights to produce an overall index. The underlying cycle is given by a five-year moving average since this is taken to represent the length of cycle. The trend for the initial and terminal values is estimated from a regression which also includes a sinusoidal term. A moving average is then used to smooth the resulting series, with the length of the filter window being the shortest period over which (on the basis of past experience) cyclical movements dominate monthly movements: this is usually a filter length of two or three months. Some quarterly indicators are included with linear interpolation being used to convert them to monthly data.

Because the final indicators show values against a trend it is possible that even historically average values can appear to be above or below trend solely because the surrounding values are comparatively much higher or lower. An illustration of this has occurred recently with the CBI optimism series where the detrended series is showing a large negative value (which might suggest a recession) even though the actual data is around zero. In the previous recession for instance in the late 1980s the optimism showed large negative balances. In this way, both recessions and slowdown can appear the same from the final contribution series.

The assumption of the length of the cycle has not been changed since the series were started, although it is fairly clear that the economy has changed fundamentally since the early 1970s and cycles since then have been growing longer. However, it is only after they occur that the length can be identified so changing this assumption would be far from straightforward.

An illustration of the potential importance of the cycle length assumption can be shown in the mid-1980s. During this period the economy is generally recognised by most analysts as having slowed down, however a trough is located at 1985Q4 in the reference cycle (GDP at factor cost) - albeit a less marked one than others. Even so, if the assumed cycle is lengthened (ie. by lengthening the moving average used to detrend the series) then this 'trough' starts to diminish; it would not have not have been declared as a trough if a seven year cycle was used in the calculations.

EVALUATION OF THE ONS CYCLICAL INDICATOR METHODOLOGY

The DAE research criticised the cyclical indictors technique on two major grounds. Firstly, the impact which pre-filtering of data, in particular using a moving average, has on the identification of the cycle, and secondly, the problem of selection of indicator series solely on the basis of turning points.

Much of recent econometric work on non-stationary series has pointed to the conclusion - which DAE's work supported - that GDP output is close to being a random walk (or in other words, its growth rate this period is largely unrelated to that in previous periods). The ONS practice is to carry out some form of prior smoothing of the detrended data before construction of the indicators. The rationale for this approach is the true cycle may be obscured by short-term volatility in output.

It was found that this detrending and smoothing process affects the statistical properties of the data. The argument, put most simply, is that if a series is a random walk applying the smoothing filter induces an apparent cycle. (In technical terms, the series will exhibit strong positive autocorrelation.) Moreover, the process has undesirable effects on its time series properties, which would make it almost impossible to fit the filtered series satisfactorily in a typical regression equation.

The second main criticism of DAE (concerning mainly the leading indicators) was that the indicators are selected on the basis of goodness of fit compared with only turning points in the reference cycle (ie. GDP filtered and smoothed). Selection on the basis of fit at turning points poses at least two problems. There are relatively few turning points, so it is difficult to make a conventional econometric assessment of performance at turning points. The ONS attempts to take into account variation in leads of turning points using summary statistics but inevitably a great deal of subjective judgment is used. In addition, if the movement of the reference cycle (ie. GDP) is close to a random walk then there is no logic to defining performance with reference only to turning points: all the movements in GDP should have equal importance.

FORECASTING POWER OF THE ONS CYCLICAL INDICATORS

To justify their use in forecasting, it is not enough merely to pick indicators on the basis of their historic fit (ie. ex-post) to be the best linear combination for an in-sample fit. Possible explanations for why such an index may deteriorate in accuracy include regular revisions in the composition of the indices and that the final data in-sample may differ in important ways from provisional numbers at the time forecasts are prepared.

The DAE research concluded that although the leading indicators do indeed have some predictive power it is at best weak. They showed this by using econometric techniques to investigate the extent to which the ONS's leading indicators actually do forecast the variable they are supposed to be leading - the coincident indicator. If the leading indicator had good predictive power the expectation would be a model with coefficients on the leading indicator alone. However when this was attempted it was found that the major variable was a moving average of the coincident indicator, with only a small part being played by the leading indicator. In other words the best forecast of the coincident indicator came from its values in previous periods.

Moreover, as part of the work on finding alternative leading indicators of GDP, DAE found that several of the individual indicators which are used in the ONS's composite leading indicators did indeed have reasonably good predictive power. Not surprisingly, however, they found that some indicators were better at predicting the reference cycle than others, and had a better overall fit: it was concluded that by giving individual indicators in the composite indicator equal weighting the overall predictive power was diminished.

There is no rigorous statistical test for assessing the leading indicators performance at identifying turning points, largely because of the lack of observations. One indication can be gained from the range of leads (shown in table B of the monthly first release): of the fourteen turning points in GDP identified since 1960, the longer leader has correctly anticipated only four of them (even with allowing a three month window either side of the median lead). The shorter leader has performed better, anticipating nine out of the last twelve turning points.

Another indication of the predictive strength is illustrated by the probability that the leading indicator anticipates the correct change in direction of the reference cycle. For both the leading indicators this is around 65 per cent, with a sample period of close to forty years. This is statistically significant (against the null hypothesis of a 50:50 chance of getting the direction right), but nonetheless means that the leading indicator will get the change in the reference cycle wrong one in every three times.

DAE's PROPOSED NEW LEADING INDICATOR

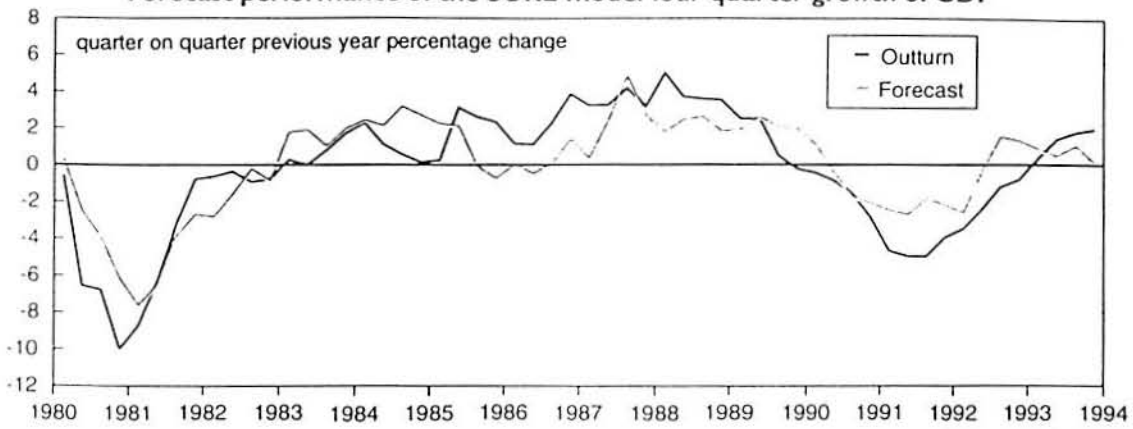
Before estimating any equations for GDP the DAE team first had to decide which version of GDP to use and then which leading indicators could be useful. The measure of activity of the economy used was GDP excluding North Sea oil and the Non-Trading Public Sector. The logic of this choice was two-fold. First of all the battery of indicators which are available, with the possible exception of oil price, are not likely to predict the vagaries of the oil industry. The indicators are all intended to represent private sector activity: unless some policy response function were to be embedded in the reduced form of the model, they would also fail to anticipate the activity of the non-traded public sector. Secondly, it was felt that users were more likely to be interested in this narrower definition of GDP.

In order to sift-out which indicators to examine further the obvious econometric technique of "Granger-Causality" was used. This is a bivariate technique to test whether there is a significant link between variables. It is not a true test of causality but rather it examines whether movements in one variable regularly precede those in another variable. A simple example is the purchase of

Assessing the Performance of the Proposed SURE Model

The DAE tested the performance of the SURE model by selecting the model over the period 1971Q1 to 1989Q4 and then forecasting over the period 1990Q1 to 1994Q3. The performance over the latter period represents a genuine forecast test: the values in the chart below represent within-sample values while those for 1990 and beyond are out-of-sample projections.

Forecast performance of the SURE model four quarter growth of GDP



Another way of presenting the forecasts is by looking at the ability of the model to predict correctly whether growth will be above or below average. In order to judge better how much value the model is adding, it is also useful to present benchmark statistics for a naive model which uses past year-on-year growth rates of quarterly GDP to predict the growth in GDP over the subsequent four quarters. The R^2 between the predicted and actual values are also shown.

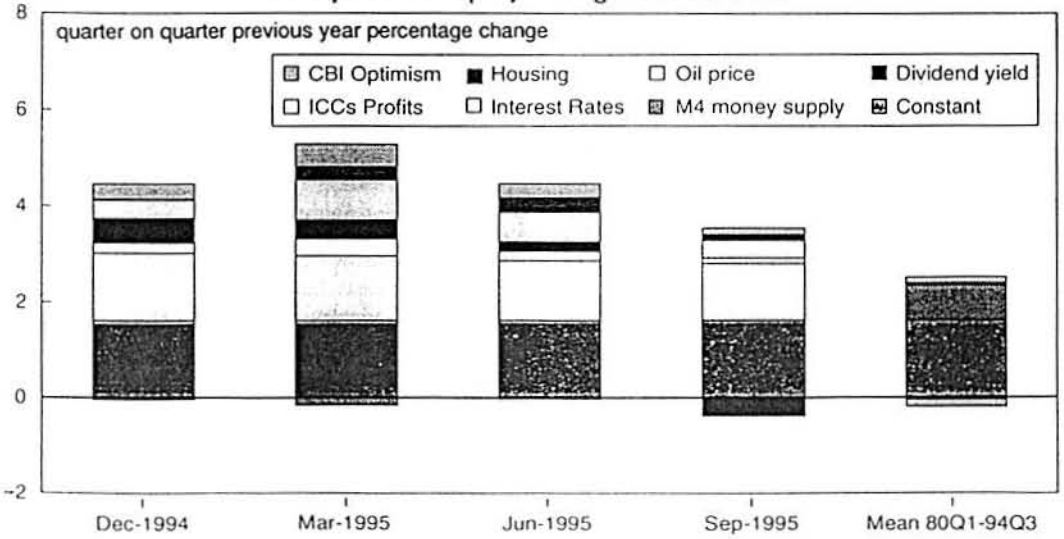
		DAE-SURE model		Naive model	
Outturn\Forecast		+	-	+	-
1980Q1-1984Q4	+	8	0	4	6
	-	1	11	7	3
1985Q1-1989Q4	+	17	3	16	2
	-	0	0	2	0
1990Q1-1994Q3†	+	7	0	0	3
	-	3	9	2	11

	R^2	R^2
1980Q1-1984Q4	0.77	0.005
1985Q1-1989Q4	0.09	0.03
1990Q1-1994Q3†	0.66	0.04
Whole sample	0.71	0.14

† Results shown for naive model are for 1990Q1-1993Q4

An example of a forecast is shown in the chart below. It gives the projections for the total growth rate in the four quarters ending in the period 1994Q4 to 1995Q3. It indicates the contribution to the projection made by each variable. The last column shows the predicted value when the components take their mean values for the period Q to 1994Q3, allowing us to identify the sources of the projected high rates of growth. For instance it can be seen that while the money stock has shifted from being an expansionary to a contractionary force, the interest rate is an important factor in the projected expansion.

Components of projected growth for 1995



antifreeze in the months leading up to winter: it is clear that winter causes antifreeze purchase but a typical Granger Causality test would suggest reverse causation, since the antifreeze purchases come first. However in the context of the search for leading indicators this problem does not arise: in this example, anti-freeze purchases are a good leading indicator of winter. The DAE applied this technique to a variety of indicators to see which were potentially good candidates as leading indicators of the modified GDP, and also to give an indication of the appropriate lag-length to apply, before being combined in a multi-variate estimation procedure[2].

The estimation approach which DAE applied was Seemingly Unrelated Regression Estimation (SURE) first developed by Arnold Zellner[3]. In this context it is an example of the Vector AutoRegression (VAR) class of forecasting techniques. Using SURE, equations for GDP quarterly growth one, two, three and four quarters ahead are first modelled individually (using normal linear regression). The second stage it to estimate the equations simultaneously as a system, by taking account of the entire matrix of correlations of all of the equations: the system estimator minimises the covariance matrix. At this point cross equation restrictions are also imposed using the considerable degree of similarity between the four equations ie the same coefficients of one equation are imposed on one more of the other equations for each variable. This last part is only possible if all the equations are estimated jointly.

Essentially the SURE method works by exploiting the fact that the equation for, say, two quarters ahead is similar to the one for one quarter ahead with a lag applied. By modelling each quarter separately it also avoids the problems of serial-correlation experienced by other models which attempt to model growth one year ahead directly. The approach also allowed the DAE team to exploit the superior range of data available in forecasting over shorter horizons, but combining this information with longer-dated information which could be used to forecast over longer horizons. It is the power of the cross-equation restrictions, adding up the models one by one, which enables the four quarters ahead prediction to be much more powerful than the single equation for a year ahead.

One practical advantage of such a system would be its timeliness. The application of the lags in the models actually allows an indicator for one year ahead to be constructed for the same quarter as the current year's GDP estimate, simultaneously. It also has the added advantage of versatility in presenting forecast periods: it would be possible in principle to produce a leading indicator up to any of the four periods. (Thus shorter and longer leading indicators could still be maintained).

PREDICTIVE PERFORMANCE OF THE NEW LEADING INDICATOR

The predictive performance of the SURE equation was tested in two ways by the DAE team. First they estimated the model over the period 1971-1989 and ran the model on for the next four years. Thus the data for 1990-1993 would be a genuine test. In this pure forecast the R^2 between the forecast data and the outturn was 0.66 which is a good performance for a pure forecast. Perhaps more importantly in this context, the model also correctly predicted whether growth would be above or below average 16 out of 19 times. The variable selection was not affected in the light of this performance either.

A second test was to look at recursive forecasts by taking the final model structure but estimating recursively over the period 1980-1993. Here the forecasts were on the correct side of the mean 36/40 times. Over the whole period 1980-1993 the fit between the forecasts and outturn was R^2=0.71. This performance generally exceeded that of two similar rival models[4] examined. In common with the two other models the SURE model did better in the periods of recession (1980-1984 and 1990-1993) than in the periods of steady growth.

Regardless of the good performance in tests done it would need to be recognised that the projections would not fit the outturn exactly and there may on occasion be large errors. Similarly, it must also be recognised that no econometric model can be expected to be stable for ever and indeed the SURE model showed some signs of parameter instability. If the model or a similar one were to be used, constant monitoring would be needed to assess its performance and substantial revision may be necessary on occasions.

There have been precedents for such failure to predict. Most notably recently was in the United States where a new approach developed by Stock and Watson (using a VAR model), after generating much interest in its test performance failed to anticipate the 1990 recession and thus reduced its credibility. Of the possible explanations examined for this failure the significant one was the set of leading indicators behaved differently compared to previous recessions. On the other hand the failure to predict the 1990 recession was common with standard econometric models and the consensus of the business forecasters.

POSSIBLE FUTURE DEVELOPMENT

So far, the ONS has not taken the development or testing of the new leading indicators any further. Before any further development of the project the ONS would first need to establish more precisely the extent of demand for leading indicators which have traditionally focused on identifying "turning points", whereas the DAE methodology is more akin to forecasting levels of GDP.

Typical cyclical indicators are essentially "deviations from trend" which require two elements:

(i) a lagged and weighted combination of monthly/quarterly indicators (which historically have a good relationship with the reference cycle you are trying to predict); and
(ii) a trend estimate of either individual indicators (or their composite) from which turning points are selected as the largest deviation from that trend.

The new DAE indicators (both the Monthly Indicator of GDP and the leading indicator) could be considered to be an improved version of the first of these. In both cases the weighting is dynamic, using econometric models which are re-estimated with additional data. In the case of the leading indicator the lags are also dynamic, though to a lesser extent, according to the significance of individual variables in any of the four quarterly equations. The leading indicator could reasonably be considered as a "future realisation" of the reference cycle (GDP) and therefore an extension of the quarterly path (rather just a composite of individual indicators as currently used in the cyclical

indicators), and so detrending the leading indicator would in essence be the same process as estimating the reference cycle as currently done but in the future as well.

The second part, and hence the viability of the approach for developing replacement cyclical indicators by building on DAE's work, depends on finding a sensible and improved method of detrending. Traditional filtering techniques which are model-free (such as moving averages) have been found to have undesirable effects on the statistical qualities of the time series. Obvious alternatives include univariate models such as ARIMA and Kalman filters and multivariate models such as VARs, however such techniques are not uncontroversial: essentially the choice of trend extraction method depends as much on its purpose as any statistical property. Finally, it is not clear at the outset what the implications of building an additional model on top of the DAE models would have on the resulting series.

CONCLUSION

Modern theories of business cycles are based on the notion that cycles are inherently unpredictable - although they may show persistence over time, the changes in direction should, in principle, be random shocks. The research presented by DAE can be thought of then as representing a process of testing the null hypothesis that the cycle is not predictable. The alternative hypothesis - which is effectively accepted - is essentially that the cycle is predictable but without any rigid view of the mechanism by which it becomes so. In other words, indicators have been found which empirically have a good relationship (with GDP) and whose coefficients in an econometric model are broadly those expected in a modern Keynesian model.

One possible criticism of any leading indicators approach is that since there are no cause-effect relationships identified, they do not explain anything and there is no guarantee of stability. The approach relies on observed relationships between GDP and the economic indicators used to be able to predict the path of GDP. This is the logic of critics of data-mining, whereby if enough variables are considered some are bound to apparently explain the desired variable. Although the DAE attempted to avoid this problem by extensive use of out-of-sample testing, to see whether the model structure changed, it still has to be recognised that hindsight played a large role in model selection.

The methodology also assumes a stable relationship so where behaviour in indicators suddenly changes the indicators may fail to predict well. One example is the recent behaviour in unemployment in the UK, usually assumed to be a lagging indicator but which started to respond far earlier in the latest recovery phase of the cycle. A structural model would seek to account for such changes when the econometric equations experienced predictive failure. To overcome this, leading indicators would have to find stable relationships between economic variables so that it could accurately predict turning points in GDP.

Many observers think that what is more likely is that after each cycle a new batch of variables would be thrown into a simple statistical analysis, with the resulting indictors each time being the best to coincide with the latest turning point. Simple models of this sort (in econometric terms) are unlikely to sufficiently track the very complex phenomenon of economic cycles. However the same could be said of larger models such as those HM Treasury uses. One possibility may be to use simpler models in order to check if there are any changes occurring to established relationships.

Clearly it is very difficult to maintain useful leading indicators. It requires a lot of research to ensure that the indicators are maintaining their relationship with GDP, and it requires continuous investigation of the alternatives. Changes in the indicators adopted should be related to changes in the way the economy works. Essentially these are changes in the structure of the economy - increased reliance on services, a more open economy, more flexible labour markets etc. It requires skill to assess these changes and ensure that the indicators reflect the important changes (especially when these statistics may be unavailable or difficult to obtain).

The ONS believes the research carried out for it in this area has indicated some promising alternatives to the traditional cyclical indicators methodology. In the meantime the ONS will continue producing the cyclical indicators. Comments and views are invited on both the approach adopted in the work so far, as well as the value and use of cyclical indicators in general.

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1 Burns,A. & Mitchell,W. (1946) 'Measuring Business Cycles', NBER, New York

2 The indicators which were used in the final model were: CBI optimism, housing starts, (real) oil price, FT dividend yield, profit of Industrial and Commercial Companies, 3-month interest rate and M4 money supply.

3 Zellner,A. (1962) 'An efficient method of estimating seemingly unrelated regressions and tests for aggregations bias', Journal of the American Statistical Association 57, 348-368

4 The models examined were from:

The National Institute of Economic and Social Research, Britton,A. & Pain,N. (1992) 'Economic forecasting in Britain', NIESR Report No.4, Pain,N. 'The UK economy', National Institute Review 149 p8-29;and

Goldman Sachs, Davies,G. & Shah,M. (1992), 'New methods for forecasting GDP growth in the UK'

Both used single equation econometric approaches: the NIESR equation forecasts output one half-year ahead, Goldman Sachs modelled four-quarter growth rate.