Building a real-time database for GDP(E)

By Jennifer Castle of Oxford University and Colin Ellis of the Bank's Structural Economic Analysis Division.[1]

The Bank's Monetary Policy Committee analyses a wide variety of data to inform its monetary policy decisions. Some of these data are revised over time, and taking account of possible revisions is an important part of assessing any data release. This article discusses the construction of a database that contains successive releases of data for the expenditure measure of gross domestic product and its components, dating back to 1961. *The database is available to external users on the Bank's Internet site.*

Introduction

One of the main questions raised by new data is how much weight should be placed on initial estimates that are likely to get revised. Economic policy decisions must take account of possible revisions to the data that are used to inform the assessment of the current state of the economy. In attempting to improve our understanding of how data are revised, we have constructed a real-time database that contains successive sets of data for a number of different series. This article discusses the construction of the database for the major components of the expenditure side of gross domestic product (GDP) in the UK National Accounts.[2]

Database construction

The real-time database is a collection of different 'vintages' of data series, where a vintage is defined as a set of data that was the latest estimate at a particular moment in time. As data are revised over time, our interpretation of them could also change (the box on pages 44–45 discusses data revisions in more detail). Chart 1 shows three different vintages of GDP growth published by the Office for National Statistics (ONS) in the past three years.

There are three ways of calculating GDP, namely by measuring expenditure, income or production. In theory all three measures should be equal. This article focuses

Chart 1
Different vintages of GDP growth
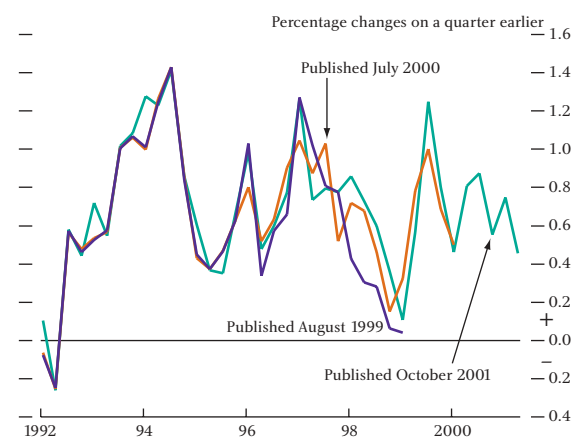
Note: Dates refer to dates of publication in *Economic Trends*.

on the expenditure measure of GDP, GDP(E), and its component series, namely:

- private consumption;
- investment;
- government consumption;
- changes in inventories;
- total exports; and
- total imports.

The database comprises every different vintage of data for the quarterly expenditure components of GDP from 1961 Q1 to 2001 Q4 (the latest available). These data were published by the ONS (formerly the Central

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Statistical Office) in *Economic Trends* and the *Economic Trends Annual Supplement*.[1] All variables are real, ie are measured in constant price terms. This means that users must take care when using the database, as occasionally the base year will change.

In 1961, only one vintage of data was usually published each quarter. This has increased over time so that now three vintages of the latest quarter's GDP growth and two vintages of the expenditure components are published each quarter. Some other real-time databases have collected only one vintage per quarter, such as the database constructed by the Federal Reserve Bank of Philadelphia for the United States.[2] For completeness we have constructed a full back-series of every vintage for each component. However users may wish to focus on one release per quarter.

Some preliminary results

As our database incorporates a complete listing of all successive vintages of the expenditure components, we could potentially look at revisions over any period, eg the average revision over one year, or the average revision between the second and third data releases. Similarly we could look at revisions to either levels or growth rates.[3] Note, however, that we cannot compare levels series across different price bases.[4]

In this article we define a revision as the later vintage minus the earlier vintage. For example, the revision to consumption growth (ΔC) in any period *i* is:

$$\Delta C_i^R = \Delta C_i^L - \Delta C_i^E$$

where *R*, *L* and *E* denote revision, the later vintage and the earlier vintage respectively.

The 'later' vintage refers to the data published in *UK Output, Income and Expenditure—fourth quarter 2001* released on 27 February 2002. All 'earlier'

vintages are defined as the estimate of growth published at the time.[5] All revisions are to quarterly growth rates and were calculated over the entire sample period (1961 Q1–2001 Q3) unless otherwise stated. Data published only recently may not yet have been substantially revised, and these observations could bias our results. However, when we ended the sample at 1997 Q4 to exclude these most recent data, our results were broadly unaffected.

Chart 2 presents the average (mean) revision to quarterly growth of selected GDP components, calculated over the entire sample period. The average revision to quarterly GDP growth is +0.2 percentage points, on an average quarterly growth rate of 0.6%. Average revisions to different expenditure components vary. Growth of private consumption and government consumption are revised relatively little. In contrast, investment and, to a lesser extent, exports tend to be revised by more. Statistical tests[6] show that the revisions to GDP(E), investment and export growth are biased upwards at the 5% significance level. Revisions to private consumption and import growth are biased upwards at the 10% and 15% significance levels respectively, but revisions to government consumption

Chart 2
Average revisions to GDP(E) components

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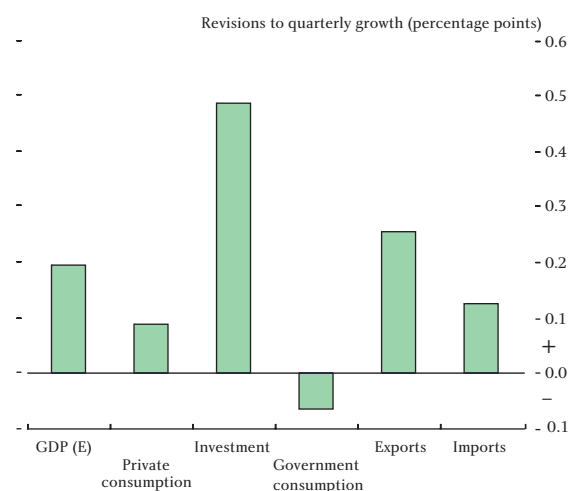
(1) Our thanks go to Carmen Birbeck, Danielle Palumbo, Rachel Pigram and Alison Schomberg for their assistance in collecting, inputting and checking these data.
(2) See Croushore and Stark (1999). The Philadelphia database includes a wider range of variables, eg unemployment and the money stock.
(3) Note, however, that the latest vintage of data will suffer from 'non-additivity', ie the components of GDP will not sum to the level of GDP prior to the 'link year'. This is a statistical feature of real GDP data in the United Kingdom. The 'link year' (currently 1994) is the year from which the most recent sectoral/component weights are used to calculate the aggregate level and growth rate of GDP. Different sets of weights are used prior to the link year. For example, in the latest vintage of data, the real levels of private consumption, investment and government consumption do not sum to the real level of final domestic demand pre-1994. For more on additivity and how growth is calculated, see Lynch (1996).
(4) We could re-base the series so that the levels appeared to be the same, but we would implicitly be assuming that the 'real' level was the same in the re-basing period.
(5) When more than one vintage were published per quarter, we have taken the final vintage published in that quarter for the analysis in this article.
(6) Testing for one-sided bias, calculated as in Symons (2001).

Background on ONS data and revisions

Why are data revised?

The Office for National Statistics (ONS) compiles quarterly National Accounts for the United Kingdom. These data are subject to revision in subsequent releases. In general, revisions are made due to:

1   The receipt of additional and/or more comprehensive data.
2   The replacement of judgmental adjustments and model-based estimates with source data.
3   Changes in methodology.
4   Re-basing.

The first two types of revision are closely linked. The National Accounts are based largely on returns from ONS sample surveys, but also on other source data, eg tax data from the Inland Revenue. Over time the ONS receives more comprehensive data (eg as more survey returns come in), and the new information contained in those data is incorporated into the National Accounts estimates.

Moreover, some source data may be unavailable at the time of publication, meaning that the ONS must 'fill the gap' with a mixture of model-based estimates and judgmental adjustments. When these missing data become available, they replace the adjustments that had been incorporated.

An example of where judgmental adjustments are incorporated is in the 'preliminary estimate' of GDP. For instance, the main ONS press release[1] explicitly states that the ONS has 'limited information' on the output of some sectors at the time of publication:

'This preliminary estimate for gross domestic product is based on the estimate of the index of output of the production industries for the first two months of the quarter, as published on 6 July 2001, and the retail sales estimates for

the three months to end-June, as published on 20 July 2001, together with limited information on the output of the rest of the economy. At this stage, estimates for the latest quarter for most individual industry series are not sufficiently reliable for publication.'

Similarly, the published briefing notes[2] for the release also explicitly state that many service sector components are not based on final data:

'A final reminder: many of the service industry components include large proportions based on estimates rather than final data, and so even the qualitative commentary should be treated with caution.'

For example, Reed (2000) notes that for the 1999 Q3 preliminary release of GDP, 16% of the data used were internal ONS estimates.

Revisions may also occur because of changes in how the ONS calculates the National Accounts. In principle, methodology changes could cause time series to be revised all the way back to 1948. Some recent examples of substantial changes are:[3]

● Pickford Report (Cabinet Office (1989)).
● Chancellor's initiatives (ONS (1991), and Caplan and Daniel (1992)).
● Reporting of GDP (Wroe (1993)).
● European System of Accounts 1995 (*Blue Book* (1998)).
● New capital stock estimates (*Blue Book* (2000)).
● Inclusion of alcohol and tobacco smuggling (*Blue Book* (2001)).

The fourth reason for revisions, re-basing, could also have significant effects on the real series. The effective weights in the base year become less representative over time as the latest observation for different series moves further away from the base year. This could result in

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(1) Taken from ONS (2001a). For more on the preliminary estimate of GDP, see Reed (2000).
(2) Taken from ONS (2001b).
(3) For more information about changes to economic statistics in the past ten years, see Jenkinson and Brand (2000).

real growth estimates being different from their 'true' values, as the estimates are distorted by the unrepresentative weights. In essence re-basing brings forward the weights used, and changes growth rates after the last link year. A re-based measure would more accurately reflect the relative contributions of the different economic sectors.

For example, measuring real investment in 1996 at 1990 prices is likely to use unrepresentative weights. Re-basing to 1995 prices would be likely to result in different real growth estimates for 1996 than using a 1990 price base.

Important caveats

Before analysing the behaviour of revisions, three important points must be borne in mind.

First, without detailed (but unpublished) information about the raw data and the methodology changes, we are unable to determine whether revisions are the result of new information or a change in methodology. In principle, we could examine revisions before and after methodology changes to see if they were different. But we would be unable to say exactly how much of any change in the behaviour of revisions was due to the methodology change. As such, we can only calculate the total revision to a given variable.[4]

Second, although the database allows us to calculate the past behaviour of revisions, this does *not* mean that future revisions will necessarily follow the same pattern.

Third, prior to the introduction of alignment adjustments in 1989, the quarterly paths of the separate GDP measures were very different. Alignment adjustments are statistical series that the ONS includes in the expenditure and income measures of GDP, so that quarterly growth in these two series matches quarterly growth in the production measure. As such, comparing the

expenditure-based measure of GDP (or changes in inventories, where the alignment adjustment is included) before and after 1989 could be misleading, because GDP(E) is smoother after 1989.[5]

In addition, the scope for revisions in any given release will be limited by the ONS revisions policy at that time. A good example of this is the different revisions policies for successive *Blue Books*.

The *Blue Book*

The *Blue Book* is an annual ONS National Accounts publication, and normally incorporates the first complete balancing of the three measures of GDP (expenditure, income and production). Although the three different measures should in theory all be equal, in practice they will often be different. The ONS includes a statistical discrepancy in each of the three measures, which ensures that all three levels are the same.

The balancing process ensures that the three measures all give the same estimate of GDP without any statistical discrepancy in the two years prior to publication (denoted '*t*–2'). For example, the 2001 *Blue Book* was the first time that the three measures of GDP in 1999 were balanced.

Blue Books often also incorporate methodology changes, but the scope for back-revisions is limited by the revisions policy in any given year. For recent *Blue Books*, the revisions policy (for annual data) has been:

1999 Restricted to *t*–2 (1997) onwards.
2000 Mainly restricted to *t*–2 (1998) onwards.
2001 Open policy (in principle back to the start of the series).

So a comparison of the revisions in the 2000 and 2001 *Blue Books* would be affected by their different revision policies.[6]

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(4) The 1998 *Blue Book* calculates the revisions to annual GDP growth (both nominal and real) due to the implementation of the 1995 European System of Accounts (ESA95), and the revisions due to other factors. The ONS does try to provide estimates of the impact of methodology changes, but such estimates are not published on a regular basis.
(5) For more information on alignment adjustments, see Snowdon (1997).
(6) For more information on *Blue Books* and recent revisions policy, see ONS (2001c).

growth are unbiased even at the 20% significance level. This suggests that initial estimates of growth in most of the series are on average too low (biased downwards).

But Chart 2 does not tell us anything about the relative impact of these revisions on GDP(E) growth itself. This can be examined by calculating the revisions to the contributions of components, shown in Chart 3.[1] We have split the data into five-year blocks to show whether the pattern of revisions has changed over time.

Chart 3 shows that, in terms of contributions, investment is the only component of GDP(E) to be consistently revised up. Revisions to the contribution of private consumption are generally small, as are revisions to the contribution from government consumption. Most of the impact on GDP tends to come from investment, stockbuilding and net trade, although the last two have tended to be revised in opposite directions.
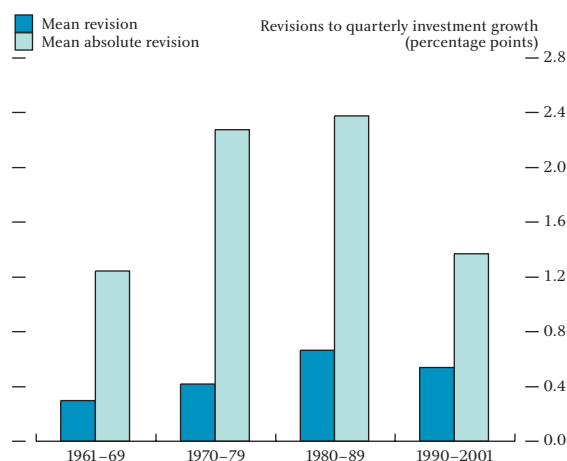
Chart 3
**Average revisions to the contributions of GDP(E) components**
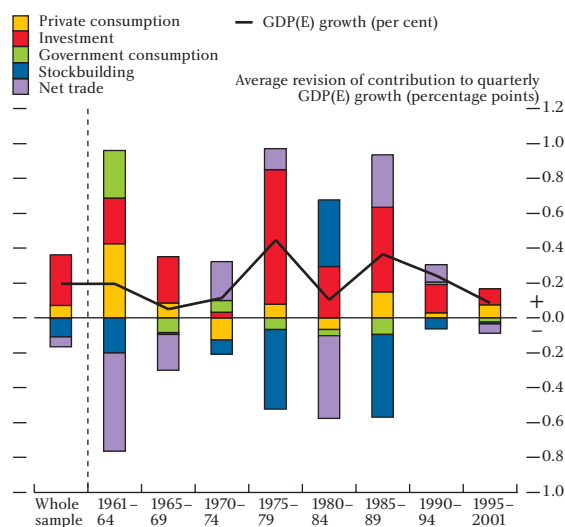
Another way to analyse the revisions is to look at the mean absolute revision alongside the mean revision. The former can give an indication of the uncertainty surrounding an estimate, while the latter gives an indication of the average bias in initial estimates.

Chart 4 shows that the uncertainty and bias around estimates of investment growth have varied over time. Though the revisions are reported in decades for simplicity, this choice is arbitrary and the results might be sensitive to different time periods. An alternative
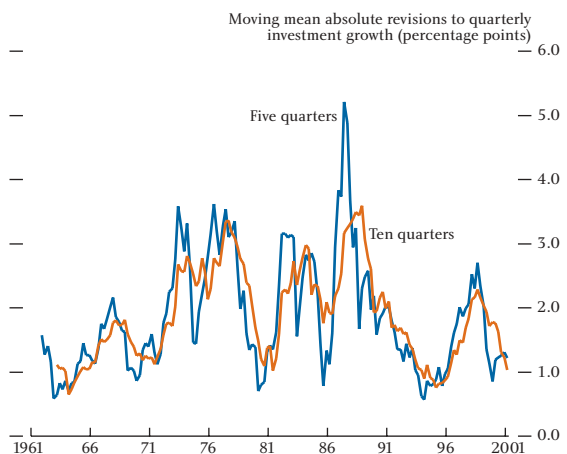
Chart 4
Revisions to quarterly investment growth

Chart 5
Moving mean revisions to investment growth
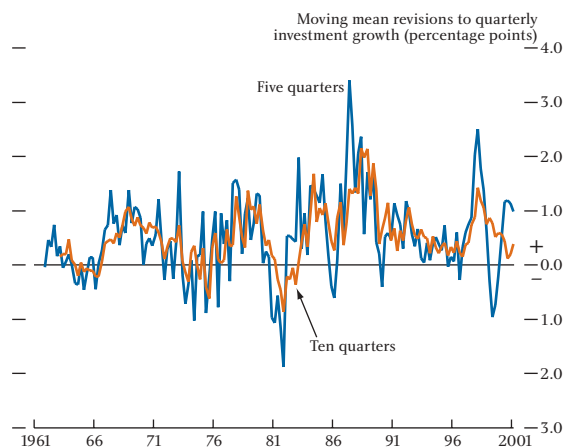
Chart 6
**Moving mean absolute revisions to investment growth**

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(1) Note that we cannot imply anything about causality. In calculating Chart 3 the latest vintage of contributions pre-1994 has to be adjusted to sum to GDP(E) growth because of non-additivity, but the relative proportions of different components' contributions are unchanged.

would be to take moving mean and mean absolute revisions, as shown in Charts 5 and 6, which also demonstrate how the behaviour of revisions has varied over time.

Pattern of revisions

We can also use the database to ask specific questions about the pattern of revisions. For example, is there any pattern to revisions for 'strong' or 'weak' initial estimates? Chart 7 examines this for private consumption, defining strong and weak as first estimates lying outside the average first estimate of growth, plus or minus one standard deviation respectively.[1] It shows that on average strong estimates are revised down and weak estimates are revised up, ie strong and weak initial estimates tend to get revised back towards average growth.

Chart 7
Revisions to strong and weak private consumption growth
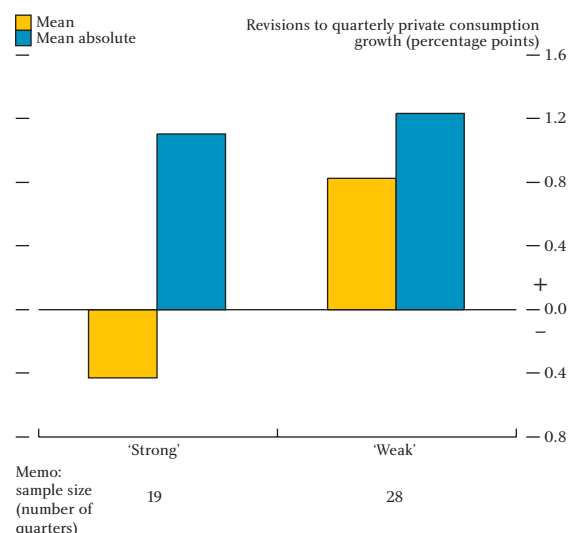
Similarly we could examine whether there is any cyclical pattern to revisions. For example, does growth tend to get revised down in what are subsequently known to be recessions? If so, this might suggest that contemporaneous estimates of growth may not be a good indicator of turning points in the economic cycle. Chart 8 looks at this for GDP(E) growth. Here we define recessions as peak-to-trough in the level of GDP where GDP fell in at least two consecutive quarters,[2] but we could have used alternative definitions (for example, defining a recession as negative annual growth). The chart shows that estimates of GDP(E) growth tend to get revised down slightly in (what are subsequently known to

Chart 8
Revisions to GDP(E) growth in recessions and non-recessions
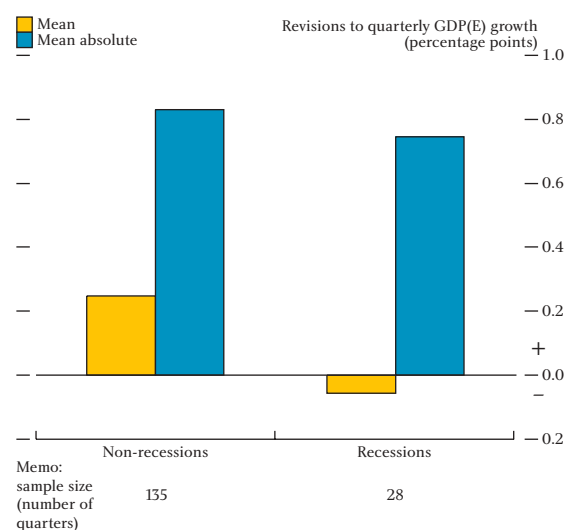
be) recessions, although these revisions are not significantly different from zero at the 10% significance level. So although growth appears to get revised down in recessions, there is little statistical evidence that the initial estimates are too high. Revisions in non-recessions are biased upwards at the 5% significance level. Note however that the usual small sample caveats apply to Charts 7 and 8.

What next?

There is a potentially inexhaustible list of questions that users could try to address using this database. For example, Egginton, Pick and Vahey (2002) use their own real-time UK database to analyse how data revisions affect recursive models. Orphanides *et al* (2000) examine the implications of real-time US output gaps for monetary policy, and Nelson and Nikolov (2001) conduct a similar exercise for the United Kingdom. As well as considering policy implications, the data could be examined for rationality (see, for example, Swanson and van Dijk (2001)) or for bias in initial estimates; considerable work has already been done on this by the ONS (eg Symons (2001)). Further work on revisions analysis is currently ongoing at the ONS. Real-time data could also be used to see if other variables are helpful in refining current estimates of output (see, for example, Svensson and Woodford (2001)), or to revisit previous work but using real-time data instead of a single (particular) vintage (see, for example, Croushore and Stark (1999)). In addition, information about the

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(1) Strong and weak estimates are calculated over the whole sample using the latest vintage of GDP data at the time of writing (published on 27 February 2002). Note that only three of the (weak) estimates in Chart 6 were from the 1990s.
(2) Based on the vintage of GDP data published on 27 February 2002. We have included the period 1974 Q3–1975 Q2, despite a small rise in GDP in 1975 Q1.

distribution of revisions could be incorporated directly into model formulation; this could be done by using a specific form of weighted least squares estimation, which places a lower weight on more recent data that have yet to be revised. Finally, there are ongoing plans at the Bank of England to extend the database to include other variables, for example nominal series and deflators.

The above examples are by no means a complete list. But they do serve to show that the results presented in this article are but a few simple examples of what the database can be used for. We encourage users to follow their own avenues of research using the data that we have made available.

Conclusion

This article has discussed why revisions to official data occur, and some of the issues that data users face when examining data revisions. It has documented how we have constructed a real-time database for the expenditure components of GDP, and presented some simple results from the database.

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