

FEATURE

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Monitoring the quality of the National Accounts

SUMMARY

The Office for National Statistics (ONS) regularly monitors and publishes indicators of the quality of its statistics. However, when publishing plans for the modernisation of the National Accounts, ONS said in February 2007 that it would monitor closely the quality of quarterly estimates through 2007 and 2008. In its response to the Treasury Committee report on the ONS efficiency programme, the Government noted that 'ONS plans to publish material on the quality of specific National Accounts data sets early next year'. This article proposes an extended quality framework for meeting these two commitments.

The Office for National Statistics (ONS) regularly monitors and publishes indicators of the quality of the National Accounts. However, there is currently concern that there is an increased risk to quality as a result of the transition to modernised systems and methods, as well as aspects of ONS's efficiency programme, including the relocation from London to Newport.

When publishing plans for the modernisation of the National Accounts, ONS said, in February 2007, that carrying forward modernisation would involve some reprioritisation, including reducing the scope of the 2007 *Blue Book*, so that expert resources could be directed to testing and analysis of modernised systems and methods. The scope of the *Blue Book* was reduced in two main respects:

- benchmarking to annual surveys through input-output supply and use balancing of income, output and expenditure was postponed to 2008, and
- certain methodological improvements were also postponed

The effect, in particular of the former, was some additional uncertainty about the path of the economy. ONS said that it would therefore be monitoring closely the quality of quarterly estimates through 2007 and 2008.

In its report on the efficiency programme in the Chancellor's departments, including ONS, the Treasury Committee said that

its task in assessing the overall impact of the efficiency programme in ONS had been rendered more difficult by the absence of measurements of the quality of service provided. It recommended that ONS undertake consultations about the formulation of agreed measurements of quality of outputs. In its response, the Government noted that ONS provides quality analyses of its statistical releases and that it also monitors the internal coherence of the National Accounts estimates, their coherence with other data sets and with external surveys, and planned to publish material on the quality of specific National Accounts data sets early in 2008.

This article summarises existing quality analyses and proposes an extended framework for monitoring the quality of the National Accounts to help meet the commitments made when announcing plans for National Accounts modernisation and to the Treasury Committee. The article is primarily concerned with providing a benchmark for future quality assessments, rather than providing an assessment of the quality of the accounts at present.

The assessment of quality has long been recognised as a complex task. The measures proposed in this article are mostly mechanistic, using published figures on revisions and coherence to make statements about the quality of the data set as a whole. Other measures proposed are novel and based on information that is difficult to extract, and their validity and usefulness will only emerge in time. Before the main analysis, the section 'Quality and the 2007

Blue Book examines specific issues that arise from the restricted exercise conducted for the 2007 *Blue Book*. The next section presents the main material on revisions analysis. The analysis of coherence is split into two parts: in the first part, measures of the internal consistence of the National Accounts data are proposed; in the second part, possible measures of the consistency of National Accounts data with other official and then external measures are examined. The last section looks, in a very preliminary way, at measures of the quality of the survey data that underpin National Accounts aggregates.

Quality analysis

The concept of Summary Quality Reports, published for a range of ONS outputs, was first introduced in Jenkinson (2005). A Summary Quality Report for GDP was published in Robinson (2005) and this provides a very general overview of how the accounts meet certain quality characteristics. The report is based on six dimensions (or 'building blocks') of quality, in line with European recommendations, which are outlined in **Figure 1**. These building blocks are:

- relevance – measures the degree to which the statistical product meets user needs for both coverage and content
- accuracy – measures the closeness an estimated result is to the (unknown) true value
- timeliness and punctuality – timeliness is the lapse of time between publication and the period to which the data refer; punctuality measures the time lag between the actual and planned dates of publication
- accessibility and clarity – accessibility measures the ease with which users are able to access the data, also reflecting the formats in which data are available and the availability of supporting information; clarity measures the

- quality and sufficiency of the metadata, illustrations and accompanying advice
- comparability – measures the degree to which data can be compared over time and domain, and
- coherence – measures the similarity between data from different sources or methods that refer to the same phenomenon

Of the six dimensions, this article will focus on two – accuracy and coherence. These are the two aspects of quality potentially most affected by the reduced scope of the 2007 *Blue Book*.

Accuracy is largely measured through revisions analysis, although it should be noted that revisions analysis measures reliability as a proxy to accuracy. In theory, a reliable estimate (one that it is revised only slightly over time) could be very inaccurate (in its closeness to the underlying 'true' value), and vice versa. Coherence is best measured by analysing how easily the data set is balanced without the need to incorporate adjustments. While these are the approaches taken, they may be distorted by the current risks and issues outlined earlier. It is possible that an apparent improvement to revisions and coherence may be a function of decreasing accuracy. The real position cannot be known until the full benchmarking exercise for the relevant years is done.

In order to measure quality changes in the National Accounts over time, it is important to understand the concept of 'real time'. The world of National Accounts is ever changing, with figures being regularly revised, due to improved data replacing forecasts and methodological improvements, to give just two examples. When analysing quality, it is often the case that presenting a time series at the current time can be misleading, because historical values have had an opportunity to develop and evolve, whereas recent data have not. Therefore a real-time data set should be

built up of values as they were when they were first published. Real-time analysis is particularly relevant for the analysis of coherence.

The most important tools for monitoring the accuracy and coherence of quarterly GDP growth estimates are:

- revisions analysis – the main tool for measuring reliability of estimates
- internal coherence – the analysis of published adjustments (alignment adjustments and statistical discrepancies) as well as unpublished adjustments. These three measures together contribute to understanding coherence within the GDP data set
- wider coherence – measures that indicate the degree of coherence between GDP and other ONS and external sources
- sources – the monitoring of the quality of source data that feed into GDP. While the above three measures concentrate on GDP output, this one looks at the accuracy of ONS surveys and administrative information

Although GDP will be used as the principal data set throughout discussions, the quality will also be looked at through the household saving ratio and other sector accounts measures.

Quality and the 2007 *Blue Book*

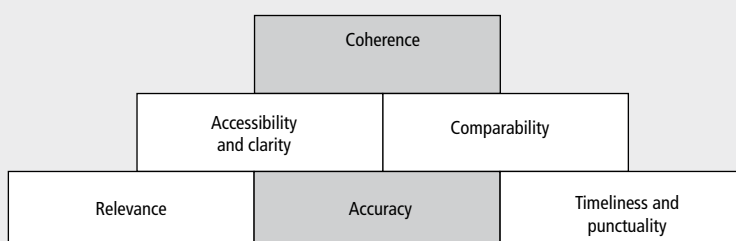
The aim of modernising National Accounts systems and methods is to improve the quality of the estimates, in particular by reducing the size of revisions. However, the 2007 *Blue Book* (BB07) was reduced in scope so that resources could be redirected towards the modernisation of the National Accounts. The reduction in scope meant some temporary additional uncertainty about the path of the economy; the rest of the article attempts to assess whether this is evident in a deterioration of the quality of the estimates. The reduced scope of BB07 impacted in several ways, as indicated below.

Previously planned methodological improvements were postponed

The only methodological improvements were the incorporation of new methodology for calculating private sector own-account software and some improvement of indicators used for service sector output estimates.

The major postponement was that the implementation of the improved method for measuring banking sector output

Figure 1
'Building blocks' of quality



through Financial Intermediation Services Indirectly Measured (FISIM) will not be included until 2008. However, GDP figures incorporating the improved FISIM estimates are presently being published as experimental statistics and extensive analysis has been carried out, showing potential effects of taking on FISIM. For instance, there are small differences in the quarterly growth rate, although these never exceed 0.2 percentage points in either direction. Incorporating FISIM would also raise the level of GDP by an average of 1.7 per cent. Further analysis is provided in Akritidis (2007). A number of other changes, such as the incorporation of the reclassification of London and Continental Railways, were also postponed.

Annual supply and use balancing was not carried out

Each year, annual estimates of production, expenditure and income are balanced through the input-output supply and use framework (see **Box 1**) and annual benchmark sources incorporated. With the suspension of this process for BB07, the estimate of GDP for 2004 was not rebalanced through the supply and use framework, the estimate for 2005 was not balanced for the first time, and the detail not confronted at industry and product level. Instead, the output measure has continued to determine the estimate of GDP for 2005.

Annual benchmarking was not carried out fully

For the production measure, no benchmarking was incorporated, except data from retail sales. The most important source used in the benchmarking process is the ABI, which was not incorporated. Some benchmark sources were included within expenditure and income, specifically contributing to trade in services,

compensation of employees and non-financial company profits. These results are provisional, because any benchmarking carried out for expenditure and income components was constrained to the unbenchmarked production measure, and full benchmarking relies on the supply and use process. While benchmarked data have helped to improve some components of GDP, they have had little impact on the aggregate total.

Analysis of revisions in previous *Blue Books* may be used to give an indication of the size of revisions that have been postponed. Table 1 in Beadle (2007) calculates that the average revision to the level of current price GDP is an addition of £5.2 billion and the average revision to annual volume growth is 0.15 per cent (at its first *Blue Book* rather than in total). However, since historical figures are so variable, it is impossible to make future predictions with any certainty.

A base year of 2003 has continued to be used for recent volume estimates

Since the implementation of annual chain-linking, price base years have been updated annually for the most recent years. The justification for chain-linking is that updating the price base each year permits volume measures to respond more quickly to structural change. This was not done in 2007, with 2003 continuing to be used as the base year. Moreover, volume measurement for the latest quarters depends on approximating movements in value added with deflated output indicators. The validity of this depends on the ratios of value added to output being constant. Not reweighting also involves extending the period for which the output approximation is used, which might impact if intermediate consumption is taking an increasing or reducing share of economic activity.

Revisions analysis

A range of factors needs to be considered when analysing revisions. The size of revisions is clearly important. Large revisions over time raise concerns over the reliability of a particular estimate. In addition to the scale of revisions, the direction is also important. If estimates on average tend to be revised up, it needs to be established whether this is indicative of a statistically significant bias. Historically, GDP estimates are revised up on average.

Much work has routinely been carried out to record and analyse the nature of revisions within National Accounts output. Detailed revisions analysis of GDP and its components have been discussed in regular annual articles since Barklem (2000). The latest update relates to data from 1996 to 2004. See Meader (2007) for the latest assessment.

As explained in an article in the March 2004 edition of *Economic Trends*, each First Release now contains a section analysing revisions. This analysis records the average revision and the average absolute revision to quarters. It also shows whether the average revision is significant, according to a statistical significance test. If the test is not significant, then the observed revisions might have occurred by chance. More details about this test can be found in Jenkinson and Stuttard (2004). Average revisions are calculated over the latest 20 quarters.

Table 1 of each GDP First Release provides this information for short-term revisions. These summarise revisions made between month one (M1), month two (M2) and month three (M3). Table 2 of each First Release gives this information for longer-term revisions (M3 to the published value three years later). Analysis of longer-term revisions is also shown for the household saving ratio.

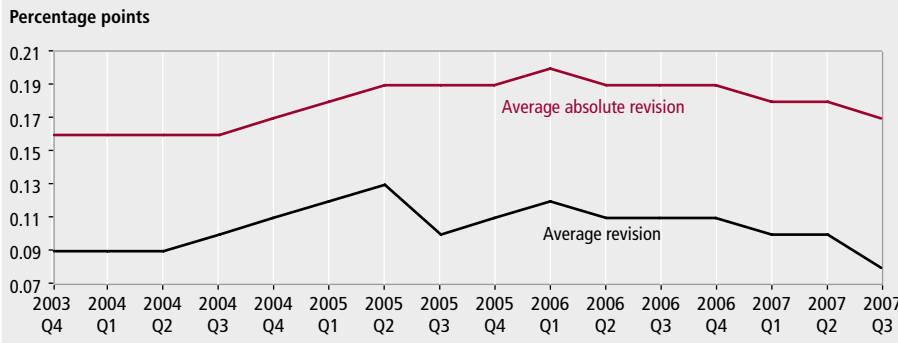
Box 1

Constructing timely and benchmarked annual data

GDP is published on a quarterly basis. In the short term, the principal aim is to provide a timely indicator of growth. The UK publishes a preliminary estimate of GDP about 25 days after the end of the quarter (month one), which is one of the fastest estimates of GDP in the world. At seven (month two) and 12 (month three) weeks after the end of the quarter, more detailed and complete data are published, culminating in the Quarterly National Accounts. The headline measure of growth is based on the output measure of GDP, with the expenditure and income estimates constrained to that measure.

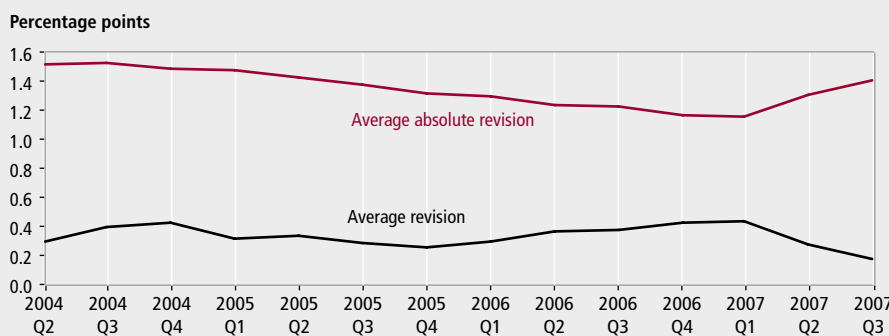
GDP estimates remain based on the output measure until the input-output supply and use process. This process permits the confronting of industry and product detail underpinning the three measures of GDP, and builds an estimate of GDP from bottom up, with growth no longer constrained to the production measure. At the same time, annual sources for a number of components are introduced, in particular the Annual Business Inquiry (ABI) for production and some expenditure components, and HM Revenue and Customs administrative sources for income data. This process takes place around two years after first publication, so that benchmark data for 2004 were incorporated into the accounts in 2006. The supply and use balancing is normally revised in the following year. After that, historic estimates are only revised following methodological change.

Figure 2
Quarterly revisions to GDP growth (M3 to three years later) in real time¹



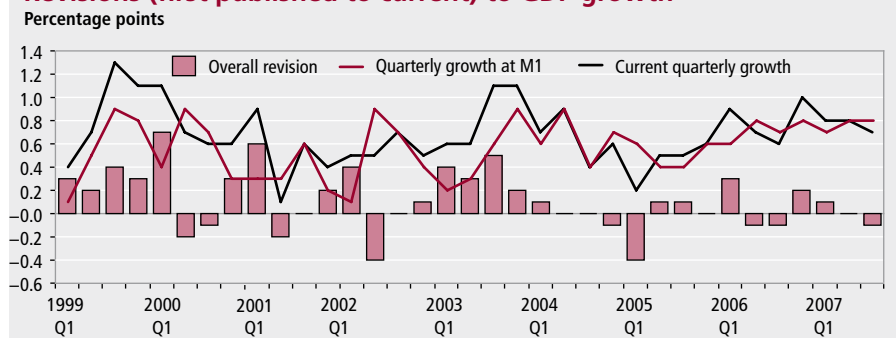
Note:
 1 X-axis labels represent date of publication.

Figure 3
Quarterly revisions to household saving ratio (M3 to three years later) in real time¹



Note:
 1 X-axis labels represent date of publication.

Figure 4
Revisions (first published to current) to GDP growth



The average revisions and absolute average revisions published in First Releases (from M3 to the published value three years later) have been plotted in **Figure 2** and **Figure 3**. As a result, these are moving averages taken over 20 successive quarters. Note that the data published in First Releases are always one month in arrears. The household saving ratio (see **Figure 3**) was first included in First Releases from 2004Q4 and is published every quarter (with data corresponding to the previous quarter).

The results show that average revisions

to GDP growth over the period have ranged from 0.09 to 0.13 percentage points. Notably, GDP growth is revised up on average but, since 2006Q1, revisions have been falling both in terms of the average and the absolute average. However, this may be a consequence of not taking on benchmarked data.

The average revision to the household saving ratio over the period ranged from 0.18 to 0.44 percentage points and was therefore also revised up on average. Recently, the average revision has sharply fallen and the average absolute revision has

risen due to large downward revisions to the saving ratio in recent quarters.

More detailed information on revisions can also be obtained from revisions triangles available on the ONS website. These spreadsheets show the evolution of a time series over time and also include an analysis of whether revisions are significant. Revisions triangles are available for GDP and key components at www.statistics.gov.uk/statbase/product.asp?vlnk=13560

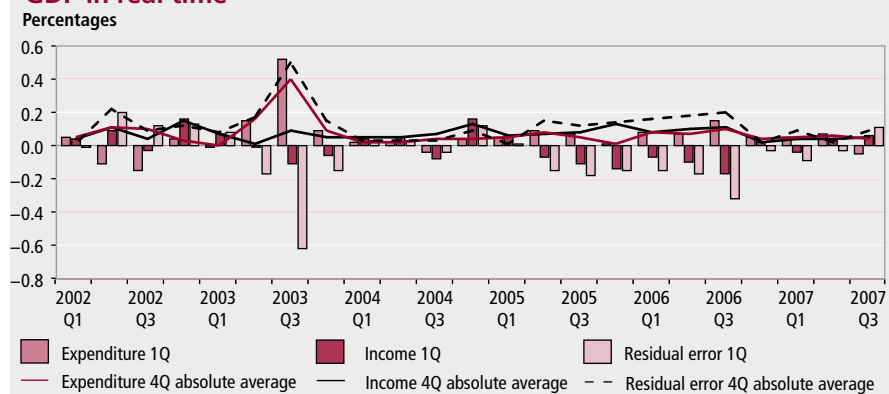
Figure 4 shows revisions to GDP growth for each quarter, from the preliminary estimate first published in month one to the latest published figure for that quarter (taken from the Quarterly National Accounts, published in December 2007). This uses information contained in the revisions triangle for GDP. The start date used here is 1999, although published revisions triangles are available back to 1992 for the aggregate series.

Although the average revision is upward, driven by the 20 upward revisions since 1999, downward revisions are also possible for any given quarter. The 2000Q1 estimate has been revised up by 0.7 percentage points since it was first published, while both the 2002Q2 and 2005Q1 estimates have been revised down by 0.4 percentage points. There have been fewer revisions to figures first published in the last three years. This is because data had not been subject to at least two *Blue Books* and therefore future revisions are likely.

It is possible for the current estimate to show little revision compared with the initial estimate, when in fact there have been large offsetting revisions in intervening time periods. Therefore, the choice of the time period analysed becomes important. Broadly, revisions fall into three areas of interest:

- stability of early estimates – the preliminary estimate published at M1 is based on early source data and is subject to revision as later data become available. The revision from M1 to M3 therefore reflects the reliability of the early estimate
- impact of benchmarking – over time, more reliable data from annual sources become available and data are revised as the quarterly path is benchmarked to the annual totals. This occurs during *Blue Book One* (BB1) and to a lesser extent during *Blue Book Two* (BB2),

Figure 5
Size of statistical discrepancies and residual errors as a percentage of GDP in real time



Note:

Alignment adjustments are calculated at current prices.

and

- impact of methodological improvements – after BB2, the majority of revisions are due to methodological improvements, some of which can have a large effect, such as the introduction of annual chain-linking in 2003

The size and nature of revisions from one year to the next are routinely presented as part of the annual publication of the National Accounts. Specific details about these revisions were presented in the 2007 *Blue Book* (pages 28 to 31). For instance, Table B of the *Blue Book* details revisions made to GDP between 1998 and 2005, since the 2006 edition. The level of GDP was revised upwards by nearly £9.3 billion in 2005, due to a range of improvements. Revisions to previous years were slightly smaller and exclusively due to a better method of estimating own-account

Box 2

Achieving a coherent quarterly data set

In the process of producing early estimates, a balance is achieved for recent quarters by using three different mechanisms.

Statistical discrepancies

Prior to supply and use balancing, there are small discrepancies in the levels of the three measures of GDP. The expenditure 'statistical discrepancy' measures the extent to which the production measure exceeds the expenditure measure and the income statistical discrepancy corresponds likewise. The term 'residual error' is sometimes used to describe the extent to which income exceeds expenditure. Statistical discrepancies are published in Tables C and D of the Quarterly National Accounts.

Alignment adjustments

The first way of adjusting the data is solely mechanical and consequently there is only some degree of control over alignment adjustments. These are used to bring the quarterly path of expenditure and income into line with production (which is the most reliable estimate of GDP in the short term). Alignment adjustments only affect the quarterly path, because over the year they sum to zero.

Expenditure alignment adjustments are always incorporated into the changes in inventories (stocks) component. Similarly, on the income side, alignment adjustments are added to the gross operating surplus of non-financial corporations (company profits). These areas of the accounts have been chosen specifically because they are the most difficult to estimate and therefore the most unreliable. Nevertheless, the true discrepancy could be within other expenditure and income components.

Quarterly alignment adjustments are published in Table M of the Quarterly National Accounts and are explained further in Snowdon (1997).

Quarterly coherence adjustments

Coherence adjustments are unpublished adjustments, applied to different areas of the accounts on a more judgemental basis. They are added to the data for two reasons:

- adjustments are inserted at component level by data compilers when there are concerns that low-quality data are distorting a component of GDP. They can be thought of as predicting the value the component should take if the quality were satisfactory. They are commonly used to adjust a component when the response rate of a survey is lower than anticipated and consequently results are different from what were expected. If these adjustments are working well, they will gradually be taken out over time as the quality of the data increases and the adjustments are replaced by actual values
- other adjustments are agreed during balancing, in order to help align the three measures. Where alignment adjustments are a mechanical method of alignment, coherence adjustments require judgement. This is particularly necessary for deciding to which area of the accounts to apply adjustments. In practice, this is done through consultation with compilers and coherence adjustments are applied to areas where there is data uncertainty. The adjustments are based in part on the projection of adjustments constructed during the most recent annual *Blue Book* process. For instance, if the supply and use tables show expenditure data on household consumption of services weak relative to the production of household services, a positive adjustment to the consumption of services will be applied and projected forward

software.

Methods of coherence

There are three different ways of producing GDP estimates, through production, expenditure or income. In theory all three estimates are equal, but due to the complexities involved in producing estimates from surveys and other source data, and differences in measuring many aspects of economic activity, equality will never occur in practice. The UK National

Accounts are based on a single measure of GDP, but adjustments are applied to each of the measures to achieve this coherence through the supply and use balancing process. As explained in **Box 2**, the following three mechanisms are used to produce a coherent data set for the most recent quarters:

- statistical discrepancies
- alignment adjustments, and

- quarterly coherence adjustments

They do this essentially by bringing the expenditure and income estimates in line with production.

By recording real-time movements in the statistical discrepancies, alignment adjustments and quarterly coherence adjustments, the output, expenditure and income measures looked at together can give a broad indication of coherence.

Statistical discrepancies

A small unallocated divergence between the three measures of GDP is published. On the face of it, it would seem sensible to simply plot the differences between the three measures, as a way of monitoring coherence. This is done through 'statistical discrepancies' and the 'residual error'.

They are plotted in real time in **Figure 5**, as a percentage of GDP. The bars represent values for the latest quarter, while the lines are an average of the last four quarters, within the publication shown.

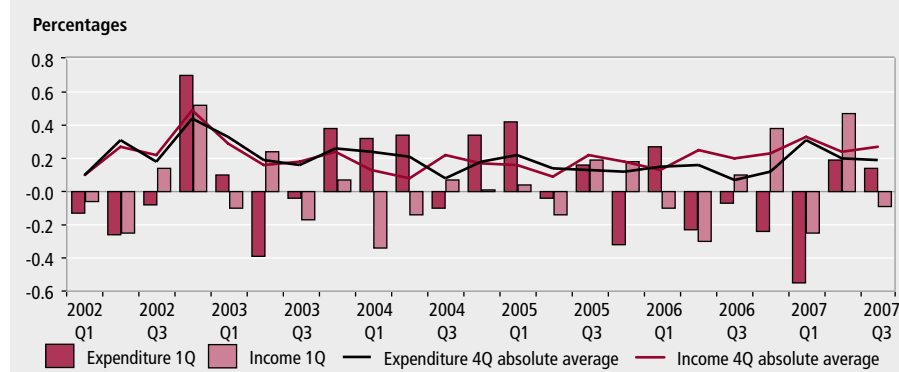
An exceptional discrepancy was published in 2003Q3. This was due to a one-off stripping out of internal buffers. In normal circumstances, an absolute residual error above 0.2 per cent of GDP is considered large and anything approaching this indicates possible difficulties in aligning the three measures for that quarter. In recent quarters, 2006Q3 shows a negative residual error of over 0.3 per cent, although subsequent quarters have delivered an improvement in this measure. Typically, the expenditure estimate comes in below the production measure and the discrepancy reflects this. Similarly, the income estimates have fairly regularly come in above production.

While in the longer term a full balance is reached through the input-output supply and use framework (where there are no discrepancies), in the shorter term, discrepancies exist, but are kept small by the use of other adjustments. Therefore, although discrepancies are helpful in adding to the picture of coherence, they are not enough on their own. Two methods of adjustments are used – alignment adjustments and quarterly coherence adjustments.

Alignment adjustments

Alignment adjustments only improve coherence by adjusting quarters within the year and do not alter the annual totals. Expenditure and income alignment adjustments are plotted in real time in **Figure 6**, as a percentage of GDP. Like the statistical discrepancy, bars represent

Figure 6
Size of alignment adjustments and residual errors as a percentage of GDP in real time



Note:

Alignment adjustments are calculated at current prices

Table 1

Annual current price coherence adjustments

	£ million	
	2003	2004
Financial corporations' profits	1,380	950
Private non-financial corporations' profits	1,884	-1,686
Compensation of employees	2,992	2,361
Rental income	-	-
Self-employment income	2,682	1,910
Total income	8,938	3,535
Households final consumption (HHFCE)	1,409	5,711
NPISH	520	802
Central government	-	-
Local government	-	-
Gross fixed capital formation	505	3,535
Changes in inventories	-	-
Exports of services	3,010	3,265
Imports of services	2,740	2,055
Total expenditure	8,184	15,368
Agriculture, forestry and fishing	35	0
Mining and quarrying	2,815	1,570
Manufacturing	179	-1,385
Electricity, gas and water supply	660	413
Construction	-366	240
Distribution and hotels	-1,857	-3,356
Transport and communication	-1,339	-685
Finance and business services	-4,194	-4,248
Public administration and defence	-	-
Education, health and social work	181	114
Other services	-794	-224
Total production	-4,680	-7,561

Source: United Kingdom Input-Output Analyses (2006 Edition)

values for the latest quarter, and lines are an average of the last four quarters, within the publication shown.

Alignment adjustments are considered large when their absolute value approaches 0.4 per cent of GDP. In 2002Q4, both the income and alignment adjustment were above this level. Recent quarters contain large, but not unprecedented, alignment adjustments, on the expenditure side in 2007Q1 and on the income side in 2007Q2, although there were relatively small alignment adjustments in the latest quarter.

Quarterly coherence adjustments

The third mechanism achieves a balance in the accounts by the use of coherence adjustments. These are applied to components of expenditure and income, as described in Box 2.

Annual coherence adjustments, shown in **Table 1**, are routinely published in Table B5 of the *United Kingdom Input-Output Analyses*. A full explanation of these adjustments is given in Mahajan and Penneck (1999).

The table shows that annual adjustments reduce the production measure, while raising the expenditure and income levels. In 2004, £15 billion (about 1.3 per cent of GDP) was added to the expenditure measure, over one-third of which was to the household final consumption expenditure (HHFCE) component. On the income side, compensation of employees is the largest and most dominant component. In 2004, the total income adjustment was offset by a downwards adjustment to private non-financial corporations' profits. Two production components (finance and business services, and distribution and hotels) are responsible for much of the negative adjustment to production in 2003 and 2004. While these annual coherence adjustments are applied to current price data in order to balance the input-output supply and use tables, they are also projected forward to assist with balancing of quarterly data in subsequent years. The size of the annual adjustments in 2004 and 2005 were by no means unusual. Adjustments of this order are always needed to balance the accounts.

These quarterly coherence adjustments are added and subtracted to low-level GDP component series of quarterly expenditure and income. In the same way as their annual counterparts, they help to achieve a balance but, as explained in Box 2, help align expenditure and income as well. Over the year, the quarterly adjustments diverge from the annual adjustments,

until annual balancing takes place again. With the suspension of annual supply and use balancing in 2007, annual coherence adjustments were last calculated in 2006, which means that quarterly adjustments have continued to be projected forward from the last balanced year (2004). Until annual balancing is again carried out, it is impossible to know whether these adjustments are correctly anticipating levels of GDP components.

While it is possible to identify annual adjustments, quarterly adjustments are harder to analyse and interpret. A real-time analysis is currently carried out within ONS, although it is not easy to separate quality from coherence adjustments (the latter being more useful for judging coherence, see Box 2). The time series produced is also short, due to the lack of an available and reliable back series.

Although Table 1 gives adjustments made to the annual levels of GDP components, growth rates interest users more in quarterly publications. While quarterly coherence adjustments are increasing in terms of the level, they have no impact on the headline GDP growth rate which, as always, is still being driven by the more reliable short-term output measure.

Only a broad indication of the impact of quarterly coherence adjustments is possible. In growth terms, there is typically a need to add to the growth of the expenditure measure, in order for coherence with the production measure. Methods for doing this can vary. For instance, there were large inventories adjustments through 2006. However, following a downward revision to imports due to a reassessment of the impact of VAT Missing Trader Intra-Community (MTIC) fraud, inventories adjustments were lowered.

It should be emphasised that no adjustment, or even combination of adjustments, can give a complete picture of coherence. It should be looked at through discrepancies, alignment adjustments and coherence adjustments, because these are the tools available to National Accounts, and can be utilised to achieve a coherent data set. It is similarly the case in the sector accounts, where the identity between net lending/borrowing on the income and capital account and on the financial account is ensured through a (published) statistical discrepancy and (unpublished) adjustments to component series. It should also be noted that even a perfectly coherent data set is not necessarily an accurate one.

New quarterly quality/coherence assessment

The National Accounts process to achieve a single balanced and therefore fully coherent measure of GDP is complex. As above, there are various mechanisms that play distinct roles, and some adjustments are published, but it is not possible to combine all adjustments into a single indication of coherence. However, it is possible to make a qualitative judgement and assessment about the overall coherence of the data. Starting in March 2008, a coherence assessment will be included as part of the quality discussion in the background notes of the Quarterly National Accounts.

To illustrate the nature of this assessment, an example has been produced retrospectively for the 2007Q3 data set, published in December.

At present, the coherence between the three measures is broadly in line with historical experience. As is common, output growth is higher than both expenditure and income growth, according to the underlying information. The upward adjustment to expenditure growth has mainly been applied to HHFCE. The upward adjustment to the income measure has been allocated between the gross operating surplus of corporations and mixed income. Other adjustments to balance the accounts, the published statistical discrepancies and alignment adjustments, are also in line with historical experience.

Wider coherence

In addition to coherence within the National Accounts, the relationship between various official measures of economic activity (in particular labour market) is closely monitored by users. There is also some interest in the relationship with other official sources of information.

Coherence with labour market employment estimates

One measure of this sort is the relationship between GDP and either the Labour Force Survey (LFS) estimate of employment or workforce jobs.

Figure 7 plots the path of the four-quarterly growth rates for these three measures. Four-quarterly growth rates have been chosen because they are more stable than their quarterly counterparts. When comparing measures in this way, it is important to look at the movements in the series and check for divergence. Particular points of interest or concern are when one series moves in the opposite direction to another for a given period. For instance,

Figure 7
Four-quarterly growth rates of GDP, LFS (employment) and workforce jobs

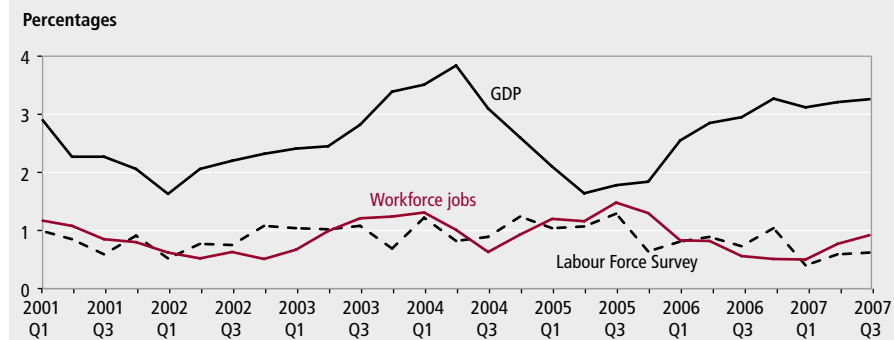
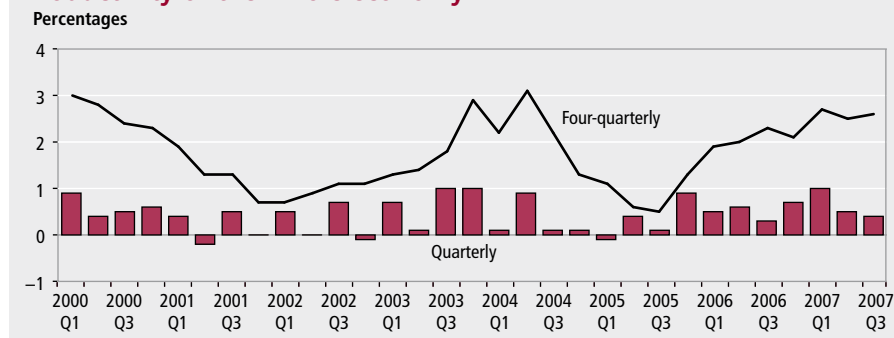


Figure 8
Productivity of the whole economy



between 2004Q2 and 2005Q2, GDP growth halved, but the growth in workforce jobs and LFS stayed fairly constant. Over the next few quarters, GDP increased, while LFS and workforce jobs fell slightly. One possible explanation is labour hoarding. In the short term, firms keep on staff and so there is a lag effect. Since growth in GDP fell and then grew over a relatively short period of time, this had little effect on labour market statistics.

Output and employment estimates are also encapsulated in estimates of labour productivity. However, the relationship between employment and output is not very well determined, and these coherence tests are very loose ones. They can only be suggestive, perhaps indicating the need for future analysis of the quality. Moreover, they could be pointing to quality issues with labour market estimates as much as issues surrounding the quality of the National Accounts.

Productivity is shown in **Figure 8** and in this context it is defined as output per worker. Divergence between GDP and labour market figures will be reflected as weak or strong estimates of productivity. Between 2004Q2 and 2005Q3, productivity growth slowed abruptly, as a consequence of GDP growth slowing and employment growth increasing. Similarly, the opposite effect has been evident since 2005Q3.

Productivity growth is now just above the long-run average and not pointing to any immediate concerns.

Coherence with external sources

Although ONS is the official supplier of data on the UK economy, a number of other organisations and trade associations conduct surveys of economic activity. These tend to be more qualitative and based on smaller samples, but are still regarded by many as useful indicators. The most prominent and widely used is Purchasing Managers' Index (PMI) data. These are surveys of the UK private sector manufacturing, construction and services industries administered by NTC Economics on behalf of the Chartered Institute of Purchasing and Supply (CIPS). Further details of PMI data can be found at www.ntceconomics.com

External sources are not used to compile the National Accounts, but are a useful additional coherence check when finalising the estimates. ONS has developed a measure to assess the coherence of measures by calculating the degree of correlation between the CIPS estimate and the ONS estimate. This process is described in the Appendix to this article.

Sources

The discussion until now has been concentrated on outputs, but it is also worth considering the quality of the source and input data. GDP uses a wide range of source data. Surveys by ONS can be carried out over different periods and play an important role. Examples include the Monthly Inquiry into Distribution Services Sector, the Quarterly Stocks Inquiry or the ABI. These surveys are used alongside other survey or administrative data delivered by other government departments or external bodies.

Standard errors

The most obvious way of assessing quality is through the use of standard error statistics. The estimate produced from a sample survey will rarely be identical to the population value, but statistical theory allows us to estimate the precision associated with any survey result. Standard errors are an estimate of the sampling error which arises because an estimate is based on a survey rather than a population census. It is a measure of the precision of the estimate. A low standard error therefore indicates a precise estimate.

However, the prospect of producing a standard error for a measure such as GDP is fraught with problems, given the complexity of calculating estimates from multiple data sources. Instead, standard errors are produced for some component survey sources. **Table 2** gives a list of the most important surveys and sources that contribute to GDP.

The most common way of presenting standard errors is through confidence intervals. In most circumstances, a confidence interval can be instructed by taking the estimate plus or minus two standard errors – then the statement can be made that the true value lies within this range with 95 per cent confidence. For example, International Trade in Services 2005 estimates 2005 total exports at £51,710 million, with a standard error of £777 million. This can be interpreted as saying there is a probability of approximately 95 per cent that the true value lies between £50,156 and £53,264.

For comparing standard errors, a better measure is the coefficient of variation (sometimes also known as the relative standard error), which calculates the standard error as a percentage of the estimate. In the above example, the coefficient of variation is 1.5 per cent. However, for the purposes of assessing the quality of National Accounts outputs, time

Table 2
Main surveys and sources feeding into GDP

Surveys	National Accounts area	Coefficient of variation (%)
Monthly Inquiry into Distribution Services Sector (MIDSS)	Production	0.4
Monthly Production Inquiry (MPI)	Production	0.5
Annual Business Inquiry (ABI) ¹	Production	n/a
Expenditure and Food Survey (EFS)	Household expenditure	1.3
Retail Sales	Household expenditure and production	0.6
International Passenger Survey (IPS)	Household expenditure and trade in services	1.6 (earnings); 1.0 expenditure
Capital Expenditure Survey (CAPEX)	Gross fixed capital formation	1.0
Quarterly Stocks Inquiry	Inventories	0.8
International Trade in Services (ITIS)	Trade in services	1.5 (exports); 1.7 (imports)
Workforce Jobs	Compensation of employees	1.0
Quarterly Profits Inquiry ²	Profits of private non-financial corporations	n/a
Labour Force Survey (LFS)	Mixed Income	0.3 (employees)

Notes:

- 1 ABI standard errors are comprehensively available at component level, but are not available at aggregate level. These are published at www.statistics.gov.uk/abi/quality_measures.asp
- 2 Standard errors are being developed for the Quarterly Profits Inquiry.

Table 3
Other data sources of GDP

Other data sources	National Accounts area
BERR (construction) ¹	Production and gross fixed capital formation
DEFRA (agriculture)	Production and inventories
HMRC (alcohol, tobacco and betting)	Household expenditure
Treasury (Combined Online Information System – COINS)	Government expenditure
HMRC (customs data and intrastat survey)	Trade in goods
Bank of England (financial activities)	Trade in services and profits of financial corporations
Chamber of shipping	Trade in services
HMRC (wages and salaries)	Compensation of employees
Treasury (pensions)	Compensation of employees
HMRC (corporation tax profits)	Profits of private non-financial corporations
Communities and Local government and devolved administrations (including trading services)	Compensation of employees, government expenditure, gross fixed capital formation, taxes less subsidies and public corporations

Note:

- 1 In March 2008, construction statistics transfer from BERR to ONS.

series are necessary. The figures displayed in Table 2 are primarily intended as a baseline for future comparisons, but these are within magnitudes that can be expected from these kinds of surveys. Future articles will update Table 2, so that progress over time can be monitored.

External sources

ONS surveys only form part of the information used to build a picture of the economy. Surveys and administrative sources from external bodies are also used during the compilation of GDP. The most important of these are given in Table 3.

Conclusions

The absence of benchmarking and balancing in the 2007 *Blue Book* inevitably means that there is additional uncertainty about the path of the economy for recent years. This article brings together a number of quality measures concentrating on

reliability (revisions) and coherence. While it is difficult to construct unambiguous measures of coherence because individual measures are noisy and cannot be combined into a single indicator, the article has looked to the publication of a qualitative assessment.

There is no obvious change in quality from the measures studied. Nevertheless it is likely that revisions will be larger than usual when balancing is reintroduced. While there is therefore no way of quantifying at this stage the degree of extra uncertainty, the material above should help inform users about aspects of quality in the National Accounts.

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REFERENCES

- Akritidis L (2007) 'Improving the measurement of banking services in the UK National Accounts', *Economic & Labour Market Review* 1(5), pp 29–37 and at www.statistics.gov.uk/cci/article.asp?id=1761
- Barklem A (2000) 'Revisions analysis of initial estimates of key economics indicators and GDP components', *Economic Trends* 556, pp 31–52 and at www.statistics.gov.uk/cci/article.asp?id=75
- Beadle J (2007) 'Modernising the UK's National Accounts', *Economic & Labour Market Review* 1(4), pp 32–8 and at www.statistics.gov.uk/cci/article.asp?id=1737
- Butler J (2005) 'GDP doubts. What evidence?' HSBC Global Research.
- Jenkinson G and Stuttard N (2004) 'Revisions information in ONS First Releases', *Economic Trends* 604, pp 70–2 and at www.statistics.gov.uk/article.asp?id=793
- Jenkinson G (2005) 'Publishing Quality Information for National Accounts Outputs' at www.statistics.gov.uk/article.asp?id=1141
- Mahajan S and Penneck S (1999) 'Annual Coherence Adjustments in the National Accounts' *Economic Trends* 551, pp 27–32 and at www.statistics.gov.uk/article.asp?id=51
- Meador R (2007) 'Revisions to quarterly GDP growth and its components', *Economic & Labour Market Review* 1(10), pp 36–43 and at www.statistics.gov.uk/article.asp?id=1888
- Office for National Statistics (2005) *International Trade in Services* at www.statistics.gov.uk/statbase/product.asp?vlnk=14407
- Office for National Statistics (2007) *United Kingdom National Accounts: The Blue Book 2007* at www.statistics.gov.uk/statbase/product.asp?vlnk=1143
- Robinson H (2005) *Summary Quality Report for Gross Domestic Product (GDP) data releases* at www.statistics.gov.uk/article.asp?id=1180
- Snowdon T (1997) 'Quarterly alignment adjustments in the UK National Accounts', *Economic Trends* 528, pp 23–7 and at www.statistics.gov.uk/statbase/product.asp?vlnk=1341

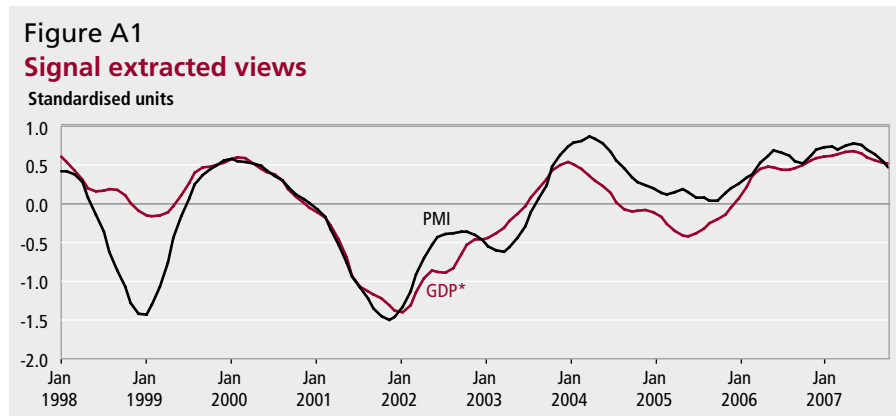
APPENDIX

Coherence of ONS and PMI data

Monitoring the coherence between ONS and PMI data is a three-part problem:

- adjust ONS data so that its coverage is the same as the sectors covered in the PMI. Butler (2005) describes this as GDP*, noting that the PMI does not include the distribution and public sectors, and neither does it make an adjustment for the intermediate consumption of financial services
- standardise the data so it is expressed in a common metric, and
- extract and compare the signals from the standardised data using a Kalman filter

The outcome of these three steps for the latest available monthly is plotted in **Figure A1**.



A final step is to test when these signal extracted views have moved apart in a statistically significant way. This can be achieved by conducting a simple t-test on the differenced time series. Periods of significant divergence are shown in **Figure A2**, where the data move outside a 95 per cent confidence interval.

