FEATURE

Impact of methodological changes to the Index of Production

Andrew Walton, Robin Youll and Chris Hunt
Office for National Statistics

SUMMARY

The Index of Production (IoP) published on 10 March 2008 was based on improved methods, as described in an article published in the January 2008 edition of *Economic & Labour Market Review*. These methodological changes were made primarily in response to concerns in the Office for National Statistics (ONS) about the quality of many of the very detailed published seasonally adjusted estimates. The change was also a response to a wider reprioritisation of ONS's business, which led to a 20 per cent reduction in the number of businesses sampled in the Monthly Production Inquiry, as used in the IoP. This article describes the impact of these methodological changes on the published results.

The Index of Production (IoP) published in March 2008 was based on new methods. **Figures 1** to **4** show the impact of these methodological changes on the seasonally adjusted IoP and its major sub-components over the period from January 2006 to December 2007. This is the period which, in accordance with Office for National Statistics (ONS) National Accounts revisions policy, has been open for revision. It is planned to take on revisions for earlier periods, back to January 1998, when the National Accounts *Blue Book* is published in September 2008. The revisions presented in the figures are, however, indicative of the pattern and scale of the revisions for this earlier period.

The methods changes in more detail

The methodological changes introduced in March 2008 were described in detail in a previous *Economic & Labour Market Review* (ELMR) article (Walton *et al* 2008). In terms of their impact, there are a number of technical reasons why it is not possible to say precisely how each change has contributed to the total revision. For example, one key change was to the level at which aggregate series are compiled and seasonally adjusted. Before the March 2008 release, the aggregate IoP was based on 232 detailed industry series for the value of output, with each series being deflated to remove price effects and seasonally adjusted to remove regular seasonal movements. The new IoP structure is based on just 79 such series. The interaction effects between the impact of this different level of seasonal adjustment, and the changes to the deflators and the turnover methodology, cannot be separately identified.

Given these types of interactions, a detailed change by change decomposition of the impact of each methodological change is not possible. However, it is possible to get an indicative sense of the relative importance of each method's change based on a comparison of the impact each change has when introduced separately. This reveals that the order of importance of the changes is as indicated below.

Seasonal adjustment

This is the single biggest cause of revision. Before March 2008, the IoP was based on 223 seasonally adjusted sub-aggregates, each of which was seasonally adjusted separately and the results weighted together to produce the total IoP. A review of the optimal level at which to undertake seasonal adjustment revealed that many of these series had very high variance and little seasonal pattern. The review recommended aggregation to 103 series before seasonal adjustment. At this level, the seasonality of each series effectively emerges as aggregation reduces the high variance in the detailed series.

Auxiliary variable

This is the second most important change in terms of its impact on revisions. This change entailed aligning the estimation of the IoP with the standard approach used for other ONS sample-based estimates of

Figure 1
Chained volume indices of output for the production industries (total IoP)

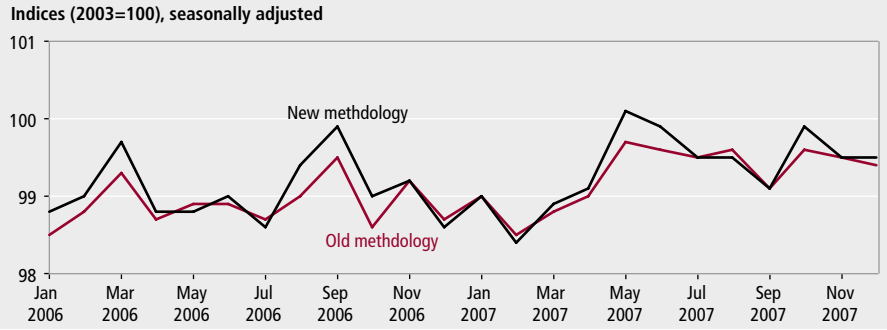


Figure 2
Chained volume indices of output for the mining and quarrying sector

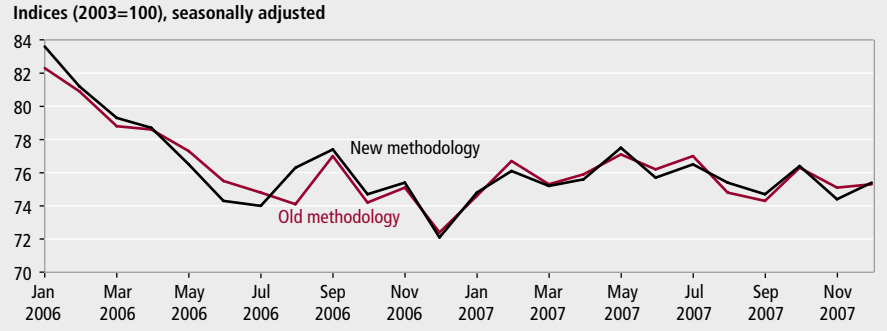


Figure 3
Chained volume indices of output for the manufacturing sector

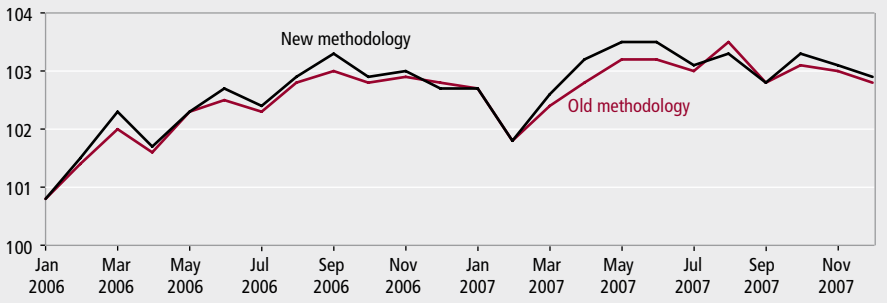
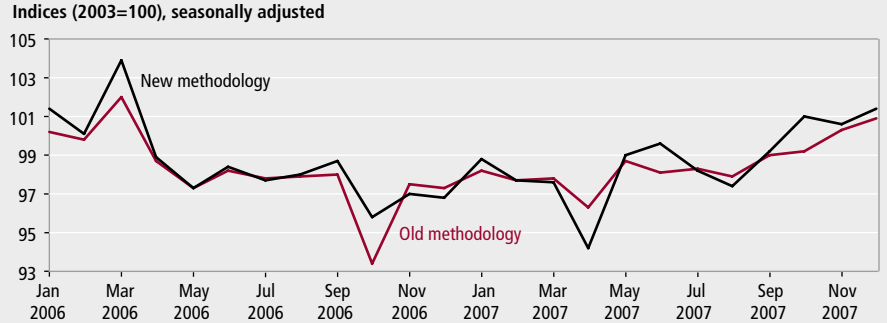


Figure 4
Chained volume indices of output for the electricity, gas and water supply sector



turnover. The auxiliary variable used for the IoP before March 2008 was employment. By this it is meant that employment data from the ONS business register was used to weight monthly sample data on turnover from the Monthly Production Inquiry to estimate turnover for the population of businesses. The new series uses register turnover data, rather than employment, which is better correlated with the returned data and so can be shown to improve considerably the accuracy of the sample based estimates.

Deflation

Changes to the approach to deflation had the next largest impact. The pre-March 2008 IoP deflated the output cash value of each detailed industry component series using the arithmetic mean of up to five of the main products sold by the relevant industry. This method was considered deficient for two reasons: first, that many industries sell more than five products, and second that, according to index number theory, arithmetic means will tend to overstate the rate of price increases. Since March 2008, deflators are based on up to 20 products per industry and use harmonic weighting, consistent with best practice. Investigations showed that having a set of up to 20 products ensured that all industry deflators contained every relevant product.

Other changes

Many other improvements were introduced to the IoP compilation in March 2008, all of which are described in detail in Walton *et al* (2008). Taken together, these are judged to have had only a small impact on the aggregate revision to the IoP, although it should be noted that, at a detailed level, some may be more important in particular periods.

Improvements to the IoP

The methodological changes described here and in Walton *et al* (2008) provide an improved basis for estimation of the IoP. This section describes why the changes are an improvement, and sets out some evidence for this.

Improved accuracy in aggregate estimates

The change in the auxiliary variable used in estimation described earlier has led to a significant improvement in the accuracy of the published estimates, as measured by the estimated standard error of estimated turnover. **Box 1** describes in more detail the concept of a standard error, but in

broad terms it provides a measure of how close an estimate is likely to be to the true population value. **Table 1** compares the percentage standard error of the estimates of industry turnover for each subsection of the IoP and for the total IoP, based on the methodology before March 2008 and on the new methodology. In all cases there has been a clear improvement in the standard error of the estimates based on the new auxiliary variable.

The consequences of compiling industry series at a higher level

As already noted, before March 2008, the IoP was produced by aggregating some 232 detailed component industry series. Since March 2008, the IoP has been compiled using a new industry structure, with only 79 detailed industry components. This has two main benefits, fewer adjustments and, as described below, 'emergent seasonality'.

Box 1

What is a standard error?

The difference between an estimate and its true value is known as the sampling error. The actual sampling error for any estimate is unknown, but a representative error can be estimated from the sample and this is known as the standard error. This provides a means of assessing the accuracy of the estimate of growth: the lower the standard error, the closer the estimate of growth is likely to be to its true value. In fact, the degree of confidence can be expressed more precisely. If estimates of the true growth rate were obtained from many different samples, then approximately two-thirds of these estimates would be less than one standard error away from the true value, and approximately 95 per cent of them would be less than two standard errors away from the true value. Standard errors are often presented in terms of confidence intervals around an estimate (see also Youll *et al* 2007).

For example, if the standard error for an estimated growth rate of 4.0 per cent is 0.4 percentage points, then the estimate of 4.0 per cent has a 95 per cent chance of being within the interval of 3.2 per cent to 4.8 per cent (that is, 4.0 per cent ±2 standard errors). One further way to express the standard error is as a percentage of the estimate itself. This is referred to as the coefficient of variation (CV) of the estimate. In the example above, the estimated growth rate of 4.0 per cent has a CV of 10 per cent (that is, 0.4/4.0 expressed as a percentage).

Table 1

Estimated standard errors of estimated turnover based on the new and old auxiliary variables[1]

Industry description	New standard error (per cent)[2]	Old standard error (per cent)[3]
Manufacture of food products, beverages and tobacco (DA)	*0.6*	*0.7*
Manufacture of textiles and textile products (DB)	*4.8*	*5.5*
Manufacture of leather and leather products (DC)	*2.6*	*7.6*
Manufacture of wood and wood products (DD)	*4.9*	*5.9*
Manufacture of pulp, paper and paper products; publishing and printing (DE)	*1.1*	*2.0*
Manufacture of coke, refined petroleum products and nuclear fuel (DF)[4]	*0.0*	*0.0*
Manufacture of chemicals, chemical products and man-made fibres (DG)	*0.6*	*0.9*
Manufacture of rubber and plastic products (DH)	*1.6*	*4.5*
Manufacture of other non-metallic mineral products (DI)	*1.9*	*2.2*
Manufacture of basic metals and fabricated metal products (DJ)	*1.6*	*3.2*
Manufacture of machinery and equipment not elsewhere classified (DK)	*1.8*	*2.4*
Manufacture of electrical and optical equipment (DL)	*1.1*	*1.7*
Manufacture of transport equipment (DM)	*0.8*	*1.1*
Manufacturing not elsewhere classified (DN)	*2.5*	*4.8*
Production sector	*0.4*	*0.7*

Notes:

1 Based on analysis of the Monthly Production Inquiry for January 2007.
2 Standard error with turnover as the auxiliary variable.
3 Standard error with employment as the auxiliary variable.
4 Subsector DF has no standard error as it is fully enumerated.

Source: Office for National Statistics

Fewer adjustments

As a normal part of the processing of any sample-based estimates, ONS statisticians need to make judgements about data quality. For example, the monthly turnover reported by businesses may be erratic or unproven at the time of the release and may have undue influence on the aggregate estimates. Adjustments are therefore made to some detailed series to counter these effects. As more data become available, and unusual company returns are confirmed with the business or corrected, many of these adjustments are removed. However, at the time of the initial release of the IoP, it is necessary for interventions of this kind to stabilise what are sometimes implausible estimates. In part, the extent of adjustment is dependent on the level at which compilation takes place.

Before March 2008, in a typical month, a total of around 210 adjustments were made to the IoP series. While these adjustments were necessary to stabilise the aggregate estimates, they were still dependent on the judgement of the statistician, albeit taking into account whatever other information was available. In principle, it would be desirable to eliminate the need for adjustments of this type, for example by increasing the sample size used in estimation (and relying on the effect of statistical variation to counter the erratic behaviour in individual company returns).

The change in March 2008 to compiling just 79 detailed component industry series has effectively increased the sample of businesses used in the compilation of each series. This has reduced significantly the requirement for judgemental adjustment following from the principle of statistical cancellation noted above. For example, the average number of judgemental adjustments made in the most recent periods is around 40 (compared with 210 before March 2008). This reduction in the use of judgement means that the aggregate IoP is compiled on a more scientific basis.

Emergent seasonality

The level at which it is appropriate to seasonally adjust series is dependent on the extent to which reasonably regular seasonal movements can be detected. For example, it is very difficult to detect seasonality in a series which has high sampling error. Aggregation allows seasonal patterns to emerge as sample sizes increase. A review by ONS time series experts of the pre-March 2008 level of compilation (the 232 series) found that many had very high noise-to-signal ratios, that is, their

behaviour over time was highly volatile. The review concluded that seasonal adjustment could be improved if many of these detailed industry components were combined first, thereby allowing seasonality to emerge. The level of compilation now used (the 79 series) was guided by the findings of this review and by the structure of the Standard Industrial Classification, which provides a natural basis for deciding when it is appropriate to add series together. The main benefit of this change is that fewer interventions are now needed to ensure that the seasonal adjustment process can extract a signal from the underlying data.

Increased transparency

The new methodology is considerably more straightforward. For example, the lagging of deflators, adjustments for merchanted goods and inventory adjustments to the monthly series based on quarterly series are no longer made. The statistical justification for these changes is described in detail in the January 2008 edition of ELMR (Walton *et al* 2008). The changes also simplify considerably the process of compilation, and thereby allow ONS to have a clearer view of the main drivers of economic change, as measured by the basic survey data of the sales of businesses and their price. ONS is therefore now better able to understand in detail the evolution of the production sector and to articulate this to users in a transparent way.

CONTACT

elmr@ons.gsi.gov.uk

REFERENCES

Walton A, Youll R and Hunt C (2008) 'Planned methodological changes to the Index of Production', *Economic & Labour Market Review* 2(1), pp 30–7 and at www.statistics.gov.uk/cci/article.asp?id=1916

Youll R, Parkin N and Hunt C (2007) 'Measures of accuracy for the Index of Production', *Economic & Labour Market Review* 1(8), pp 24–8 and at www.statistics.gov.uk/cci/article.asp?id=1842