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REVIEWING THE METHODS AND APPROACHES OF THE UK NATIONAL ACCOUNTS[1]

Paper submitted by Office for National Statistics, United Kingdom[2]

OVERVIEW

The Office for National Statistics has initiated a re-engineering project with the aims of reducing processing risks and improving the quality of the UK's National Accounts. A review of the methods used to compile the UK's National Accounts was commissioned from David Caplan, the head of National Accounts co-ordination at the ONS. He carried out an evaluation of different methods and approaches to compiling the National Accounts, with reference to documented methods and informal discussions with other National Statistical Institutes. This led to a series of recommendations for UK National Accounts methods. The recommendations have implications for further methods development, revisions management and the effective communication of changes to National Accounts users. This article summarises the review and recommendations before outlining the implications of these recommendations from the perspective of a National Accounts user.

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[1] The present documentation has been submitted by the Statistical Division after the official deadline due to resource constraints.
[2] Paper prepared by the National Accounts Group, ONS UK.

BACKGROUND TO THE REVIEW

The UK National Accounts will be subject to a major re-engineering project over the next few years. The main aims of the project are to reduce processing risks and improve quality. The project presents an opportunity to review the methods and approaches used in UK and to build on the strengths of the UK National Accounts. It will also furnish the opportunity to compare our accounts with international best practice and to identify improvements to existing methods and approaches to produce a blueprint for the future UK National Accounts with a clear focus on user needs.

The UK National Accounts provide the basis for analysing the economic performance of the country. The key National Accounts users, particularly within Government and the Bank of England, use the accounts as major inputs to decisions on fiscal and monetary policy. Large parts of the accounts have a legal basis in the European Union. Most importantly Gross National Product (Income) is used as the tax base for contributions to the EU budget. There are also many users in the business and research communities, education, media and general public.

The UK was at the centre of the development of National Accounts. The first official accounts were developed during the Second World War under the leadership of Nobel laureates James Meade and Richard Stone. The scope and content of the UK accounts has developed considerably since those early days, as quarterly accounts were introduced in the 1950s. Financial accounts and balance sheets were added later. Three relatively recent developments are worth noting. Firstly, during the late 1980s, there were major concerns about the reliability of UK economic statistics and the subsequent Pickford Report led to a number of changes, including the centralisation of National Accounts compilation within the Central Statistical Office (CSO) and then the introduction of supply and use tables. Secondly, in 1998, the ONS modified its accounts to adopt the conventions of the European System of Accounts, 1995 (ESA95), leading to changes in compilation methods, and changes to the presentation and description of economic series. Most recently, in September 2003 ONS adopted the annual chain-linking method for estimating economic growth, in line with international guidelines.

OVERVIEW OF THE EXISTING UK NATIONAL ACCOUNTS METHODS AND APPROACHES

Introduction

1.   ONS produces a comprehensive set of National Accounts. The main components are quarterly and annual GDP estimates, quarterly and annual sector and financial accounts, financial and non-financial balance sheets. Trade statistics, the balance of payments, the public sector and some short-term indicators of economic activity are all integrated within the system of National Accounts.

Gross domestic product (GDP)

2.   GDP is estimated in the UK using the three theoretical approaches (production, expenditure and income) with a single estimate then being derived and emphasised (see SNA93 and Concepts, Sources and Methods for terminology). There are different approaches to annual and quarterly estimation with subsequent integration. Two key principles drive GDP estimation

in the UK:
>   **Principle 1** – the level of GDP is best estimated using a supply and use framework.
>   **Principle 2** – short-term growth is best estimated using the production measure of GDP.

3.   A production measure at current prices is estimated using data mainly from the Annual Business Inquiry and this is placed alongside expenditure and income measures. Consistency and coherency for current price estimates are achieved through a 123-products-by-123-industries integrated supply and use framework. Almost all the reconciliation is done manually, although there is some automatic balancing in the final stages of the process. For the latest annual totals (years in which the supply and use approach cannot be applied), GDP is calculated as the average of the three approaches. The discrepancies between the expenditure and income measures and the average are published. An implied deflator is derived from the expenditure measure and this is used to deflate the income measure in current prices to give an income measure as chained volume measures (CVM). It is also used to reflate the production measure as CVM to give a production measure in current prices (see Tuke and Beadle explanation of CVM).

4.   The production measure is the main method for estimating quarterly change in GDP. Quarterly GDP is also estimated using expenditure and income measures. The quarterly growth rates produced by the three measures of GDP are compared in an informal and judgmental process and almost all adjustments are made to income and expenditure components. Full reconciliation (subject to annual constraints) is achieved by making automatic adjustments to the gross operating surplus of non-financial corporations (a component of the income measure) and change in inventories (a component of the expenditure measure). The three measures cannot therefore be described as balanced; rather that expenditure and income measures are adjusted, formally and informally, to produce the same growth as the production measure.

Sector and financial accounts including the balance of payments

5.   Sector and financial accounts are compiled for five institutional sectors:
*   non-financial corporations (including public corporations);
*   financial corporations;
*   general government;
*   households (including non-profit institutions serving households);
*   the rest of the world (see SNA93).

6.   The production and generation of income accounts are derived as part of the compilation of annual supply and use tables. These accounts are available only at the annual frequency and over a year in arrears. Other accounts and financial balance sheets are derived quarterly with the same method being used for annual and quarterly data.

7.   The Dividends and Interest Matrix (DIM) is a key input into sector and financial accounts. The DIM provides estimates of gross payments/receipts of dividends and interest for each sector across a number of different financial instruments. Some cells within the DIM can be estimated by residual, making use of the fact that the sum of transfers across sectors must equal zero. For other cells, estimates are derived from a range of sources, primarily survey data. Government data are used for most 'other transfers'. Financial transactions are estimated

quarterly using a range of data. Estimation is within a matrix format to ensure that instrument totals net to zero. For example, household bank borrowing is counterpart to bank lending to households and they should therefore be identical.

8. The balancing process for sector and financial accounts is carried out by committee drawing on the experience of those involved in the process, and is not mechanised in any way. The balance of payments accounts are fully integrated with the domestic sectors and so are consistent with the 'rest of the world' accounts.

Monthly indicators of economic activity and government data

9. Short-term indicators include:
• Index of Industrial Production (IoP);
• Index of Distribution (IoD);
• Retail Sales Index (RSI);
• experimental Index of Services (IoS).

10. The IoP is a monthly indicator incorporated in the quarterly production-based estimate of GDP whereas the IoD and IoS are currently constrained to be consistent with previously published production-based GDP estimates. These three indices are conceptually consistent with the National Accounts. The RSI is a data input to the National Accounts but, unlike the IoP, is not presented as a National Accounts component and does not share methods with the rest of the accounts.

11. Estimates of imports and exports of goods and services are also produced monthly on a balance of payments basis.

12. Fiscal indicators for government are compiled on a National Accounts basis and are consistent with published National Accounts.

Strengths and weaknesses of the UK National Accounts methods and approaches

13. The UK National Accounts methods and approaches have a strong reputation internationally. This is based primarily on:
• completeness (including sector and financial accounts and a range of monthly indicators);
• high level of integration;
• timeliness of some estimates (particularly early estimates of GDP);
• strong emphasis on data for short-term indicators.

14. There are, however, some perceived weaknesses in the UK National Accounts methods and approaches. The issues, which were identified by ONS personnel and external users, include:

Completeness	Absence of some accounts, in particular quarterly production and generation of income.
Accuracy	Suggestion of bias in early estimates.
Coherence	Imbalances in sector and financial accounts.
Clarity	Lack of transparency and documentation for some methods and the

subjective nature of some approaches, including annual balancing.

Data efficiency A perception that the quarterly process does not make full use of data, or that data sources are not strong enough for the purposes for which they are used.

Reliability Revisions to historical data.

15. The review's recommendations seek both to preserve the strengths of the UK National Accounts methods and address perceived weaknesses.

RECOMMENDATIONS FOR THE UK NATIONAL ACCOUNTS METHODS AND APPROACHES

16. Methods and approaches in the UK National Accounts which should continue

The scope of the UK National Accounts should be maintained	They should continue to include GDP and supply and use tables, the sector and financial accounts including the balance of payments and monthly indicators together with government financial indicators and trade statistics.
All of the products included in the UK National Accounts should continue to follow the same conceptual basis and classifications.	In the main, this will be the full European System of Accounts (1995 version) and its associated classifications.
National Accounts estimates should continue to be based on data, normally derived from statistical surveys and administrative records.	This is preferable to more extensive use of econometric modeling. It is inevitable that there will be some variables for which there will not be survey or administrative data available, and when this occurs, explicit, documented estimation methods should be used.
Annual National Accounts estimates data are the most robust and should continue to be used to provide benchmarks and structures for shorter period estimates.	This does not imply that annual estimates are more important than those based on quarterly or monthly data but that they can be more reliably compiled. Quarterly and monthly data will be improved by the use of reliable annual benchmarks.
Expenditure information and income totals should continue to supplement the production-based measure of quarterly GDP.	Expenditure information should be compiled from survey and administrative data and cover all categories of expenditure.
The sector and financial accounts should continue to be estimated within a matrix framework and transactions should sum across sectors.	For each institutional sector, the total financial transactions and the estimate for net lending and borrowing from the capital account should be equal.
Balance of payments statistics and their estimation should continue to be fully integrated with estimation of the domestic	

sectors in the sector and financial accounts. Monthly indicators should be compiled where they satisfy a legitimate user-need to provide early indicators of economic activity for monetary and fiscal policy decision-making.

Recommendations for general changes to the UK National Accounts

New data should be included in the National Accounts as quickly as practicable, subject to the constraints of the production processes.

Revisions to data are inevitable, as additional survey and administrative sources become available. A clear National Accounts revisions policy will be needed which is consistent with the National Statistics Protocol on Revisions and is driven by user needs.

Data aggregation should be clearly separated from the core National Accounts activities of balancing and data confrontation.

Data aggregation means the process by which National Accounts data are prepared. It includes:

- take-on of survey and administrative data
- conversion to National Accounts concepts
- presentation in the form required for National Accounts balancing and confrontation.

Separating out aggregation allows control of the data entering the balancing process and gives transparency and the possibility of accurately monitoring the impact of balancing.

A suite of additional analytical checks and tools should be integrated with the National Accounts compilation methods.

Such a suite should include but not be limited to:

- comparisons with labour market statistics
- input-output analytical tables
- revisions analyses
- analysis of quality and balancing adjustments
- analyses of imbalances in the accounts for institutional sectors.

Recommendations for changes to annual GDP

Annual GDP should be compiled at current prices and the prices of the previous year using an integrated supply and use framework.

The supply and use framework integrates the estimates of GDP from the production, expenditure and income side using an industry/product structure and this enables balancing to take place at a detailed level and for reasonable industrial structures to be preserved. Balancing at current and previous years' prices also enables information on

Balancing through the supply and use framework should be mechanised as far as possible.	deflators to be used in the balancing and provides a tool for ensuring that the deflation of production and expenditure is consistent. This would allow the latest data to be balanced more efficiently, balancing assumptions clearly stated and all adjustments easily recorded.
Any expansion of the dimensions of the supply and use tables should focus on service industries.	For balancing, there may be some justification for expanding the number of products to improve balancing if the basic data can justify the expansion and any expansion should focus on service industries.
There should be consistent deflation across the National Accounts, integrated within the supply and use framework.	The deflators used to estimate supply and demand should be consistent with each other and the most useful framework to ensure this consistency is the supply and use framework.

Recommendations for changes to quarterly GDP

A production-based measure of quarterly GDP should be produced at current and previous years' prices as the primary measure of output.	The production measure of GDP should be produced by use of surveys or administrative data where possible. Survey data on gross output should be available but where information on intermediate consumption is not available, it will have to be estimated using historical structures.
Quarterly GDP should be estimated within a supply and use framework with automatic balancing.	Production, income and expenditure estimates should be reconciled through supply and use tables although possibly at a higher level of aggregation than the annual supply and use tables.

Recommendations for changes to sector and financial accounts and balance of payments

Fundamental research should be carried out to improve balances in sector and financial accounts.	Any imbalance should be seen as identification of problems with data. In the past, the imbalances in current UK raw data have proved too large for successful automatic balancing.
In the event that a full balance for sector and financial accounts cannot be achieved, a mechanical balance should be produced	The method for automatic balancing of sector and financial accounts should follow Meade and Stone (1944) but should not allow modifications to estimates of GDP components, which will be better estimated in the supply and use framework.

Recommendations for changes to monthly indicators

Monthly indicators should follow as closely	Although they can be expected to be broadly

as possible the concepts and classifications of the National Accounts but should not necessarily be bound by the same revisions policy as the rest of the National Accounts. A monthly estimate of GDP based on a proxy production measure should be produced as close as possible to the end of the month and this should be retrospectively constrained to estimates of GDP produced quarterly.

consistent with the later accounts, monthly indicators may not be an integral part of the accounts.

Such an indicator will inevitably be based on less data than later estimates.

Implications of the recommendations

17.   The recommended methods for the UK National Accounts contain some significant differences from the current methods and will require the resolution of technical and practical issues before system specifications can be developed. A methods development team has been set up with the objective of co-ordinating, managing and testing the development of new methods. The main requirements from development work are:

- a method for producing unbalanced supply and use tables at current and previous years' prices which establishes the size of the tables to be balanced for annual GDP;
- a method for simultaneous balancing of tables in current and previous years' prices;
- a specification for computer-aided balancing to implement the balancing approach;
- a method for estimating a quarterly production measure of GDP;
- a supply and use framework for quarterly GDP estimation;
- methods for populating cells in the unbalanced quarterly supply and use table, either data-based or using methods consistent with corporate standards;
- a method for assessing weaknesses in the sector and financial accounts;
- a method for producing a production proxy approach to producing monthly estimates of GDP;
- specification of analytical checks and feedback mechanisms (including analysis of revisions, adjustments and other data comparisons).

18.   The recommended methods for the UK National Accounts will also require changes in operational policy and to publications. The main requirements from development work include reviewing and recommending changes to:

- the existing publication schedule;
- the level of detail of data published;
- the form/format of publication;
- the existing revisions policy.

MANAGING REVISIONS ARISING FROM THE REVIEW

Potential causes for revisions

19.   The review of National Accounts methods and approaches will potentially have an impact on both National Accounts outputs and other products that depend on National Accounts outputs. The most significant areas of change are likely to derive from:

- balancing supply and use tables at current and previous years' prices (Annex 1);

- reviewing deflators and price indices to be used in the new supply and use framework;
- using supply and use tables to balance quarterly GDP estimates;
- automatic balancing techniques (Annex 2);
- reviewing methods in the UK National Accounts not covered by the above changes.

Scale and scope of potential revisions

20.   It is not yet clear what the effect of changes on, for example, levels of GDP or growth rates will be. In addition, no decision has yet been taken on which time periods will be affected. Many factors will limit the application of new methods in the National Accounts. For example, the major annual source for the annual GDP estimates, the Annual Business Inquiry, only dates from 1998. The existing supply and use tables link to data for earlier periods by a set of link factors. Also:
- the existing supply and use framework dates back to 1992, although there are tables for 1989 to 1991;
- the current approach of using alignment adjustments to bring the three measures of GDP in line only exists back to 1983;
- data underlying the short-term output indicators are only available back to 1994;
- a full set of sector accounts is available only from 1987 onward;
- financial accounts and balance sheets are only fully available only from 1987.

21.   There are also a number of discontinuities in banking data in the late 1980s as a result of deregulation. It is possible that new methods could be instituted only after a certain time period. It is important that this can be managed in a way that will not produce data discontinuities.

Principles for managing revisions

22.   In order that revisions are managed through an efficient and transparent process, a clear set of principles will be needed as guidance and to ensure users understand the process. Some of these will be critical in dealing with changes that emerge from reviewing methods. All of the principles will be relevant in handling a long-term revisions policy.

23.   The context for these principles will be:
- the National Statistics Protocol on revisions;
- the needs of key users – user preference will contribute to determining how conflicts should be resolved. For example, the timeliness of taking on revisions and the stability of time series;
- the need to publish regular analyses of revisions and thorough briefing on revisions;
- the need to balance the introduction of improvement with managing stability. This may mean cumulating changes so that several are made at once rather than making them individually.

Future communication plans

24.   This article represents the start of communicating methods developments following the review. We aim to continue the process of informing users on developments by:

- publishing a series of Economic Trends articles throughout the re-engineering project and the development of methods;
- regular updates to an existing list of National Accounts users (please contact the authors to ensure you are included);
- publishing updates on methods developments on the National Statistics website;
- hosting seminars and consultations with National Accounts users as key issues emerge.

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ANNEX 1

When compiling Supply and Use Tables (SUTs) in current and previous years' prices two approaches are possible:

Sequential approach
First, the SUT is compiled and balanced at either current or previous years' prices and then deflated or reflated. The second SUT in the sequence is then balanced.

Simultaneous approach
The current and previous year's tables are compiled and balanced at the same time. This is the recommended approach in the review of National Accounts methods.

There are several advantages in using the simultaneous approach.

Firstly, it allows the possibility of analysing value, price and volume indices in relation to each other. All three indicators must give a plausible picture hence improving the quality of the balancing process.

Secondly, it offers the opportunity at the earlier stage of compilation to check the data by comparing price and volume indices before they are entered in the SUTs. This will allow the double-checking of data consistency because even if the results in current prices look plausible, analysis of the volume and price data may still highlight issues.

Thirdly, in the relationship:

intermediate consumption + value added = output

the simultaneous approach allows an early check of the value added to output ratios to give a clear view on the reliability of the data on value added and/or on intermediate consumption by industry. At present, in calculating the annual and quarterly production measures of GDP, we make the assumption that the value added to output ratio is stable over time.

ANNEX 2

Automatic balancing of Supply and Use tables (SUTs)

There are several automatic balancing techniques. Currently, the UK SUTs at current prices are mostly balanced manually but a 'rAs' iterative procedure is used near to the end of the balancing process to ensure total supply equals total use for each product. The term 'rAs' refers to an iterative mathematical process, where 'A' is the coefficient form of the intermediate section of the ' Combined Use' matrix. 'A' is pre-multiplied by a diagonal matrix, with the vector 'r' of replacement factors forming the diagonal, and post-multiplied by a diagonal matrix with the substitution vector 's' forming the diagonal. A single iteration applies the above process for each row and then for each column. After each iteration the replacement factors are changed appropriately and repeated until a desired balance has been achieved. The end result of this process is that supply equals demand for each product. The process is used in the UK as the very final step in the compilation of the annual supply and use tables after a near balance has been achieved.

In developing new automatic balancing procedures for the simultaneous balancing of SUT at current and previous years prices, the focus will be on the use of the least square balancing technique, also called the Stone method. More than sixty years ago, Stone, Champernowene and Meade (1942) made a first attempt at developing an application of the least squares methods that could be used to balance National Accounts. This method redistributes the discrepancy on the basis of information on the degree of relative reliability of the aggregates.

Since then, the method has been revised and improved by several researchers, among them Stone, but, although it has been tested with National Accounts data by researchers and statisticians, it has not found extensive application in National Statistical Institutes (NSIs). One of the main reasons behind the lack of application of the Stone method in NSIs has been the complexity of the accounting equations involved in this method which results in highly demanding computational requirements.

ISTAT, the Italian statistics institute, which has a long tradition of applying the Stone method in balancing input-output tables, has recently introduced in its automatic balancing process a new algorithm developed by Vittorio Nicolardi (2000). This algorithm uses the conjugate gradient method, which can handle accounting structures of tens of thousands of equations. The main feature of this balancing technique is the use of a variance matrix that allows the redistribution of accounting residuals on the basis of the relative reliability of the individual aggregates. ONS is investigating the feasibility of developing this approach to automatic balancing. One of the main objectives of future work will be to develop a mechanised procedure for balancing SUTs at current and previous years' prices, which will perform the least square balancing calculations using the conjugate gradient algorithm.