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UK National Accounts: GDP and Input-Output Supply and Use Tables

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UK National Accounts: GDP and Input-Output Supply and Use Tables

Abstract and introduction

Contents

1.1 The basic framework of the UK National Accounts
1.1.1 What are the economic accounts?
1.1.2 Overview of the UK National Accounts
1.1.3 Groupings of sectors
1.1.3.1 Private sector and public sector
1.1.3.2 Market sector and non-market sector
1.1.4 Economic activity: what is included and excluded from the production boundary?
1.2 Prices used to value the products of economic activity
1.2.1 Basic prices
1.2.2 Producers' prices
1.2.3 Purchasers' prices or market prices
1.3 Gross domestic product (GDP)
1.3.1 Different approaches to measuring GDP
1.3.1.1 Production
1.3.1.2 Income
1.3.1.3 Expenditure
1.3.2 GDP: Difference between the concept of net and gross
1.3.3 UK GDP
1.3.4 Valuation of GDP and GVA
1.3.4.1 Taxes on production and products
1.3.4.2 Subsidies on production and products
1.3.5 Headline GDP
1.3.6 UK GDP chained volume measure
1.4 Annual chain-linking
1.5 Index numbers and price indices
1.6 Input-Output Annual Supply and Use Tables
1.6.1 GDP and the balancing of the annual accounts
1.6.2 The Input-Output framework and GDP
1.6.3 Industrial analyses
1.6.4 Structure of the UK Input-Output Annual Supply and Use Tables
1.6.5 The balancing process
1.6.5.1 Initial estimates
1.6.5.2 Revised estimates
1.6.5.3 Final estimates
1.6.6 Gross Value Added - link between estimates in the Annual Business Inquiry and Input-Output Annual Supply and Use Tables
1.7 Different stages of the GDP compilation process
1.8 Future plans

References

Annex A – Classification of Input-Output industry/product groups by Standard Industrial Classification (2003) and NACE Rev. 1.1

Abstract

Productivity measures are constructed from output and input data. This paper focuses on output measures produced within the UK National Accounts. The basic framework of the UK National Accounts is provided alongside an explanation of how they are constructed.

A detailed description of gross domestic product (GDP) is given and compared with gross value added (GVA). As part of this, the three approaches to measuring GDP are explained and compared.

This paper also outlines the Input-Output Supply and Use Tables as they are produced in the UK and how they are used as a framework to reconcile the three different approaches to measuring GDP. In turn, these tables are used to underpin the single estimate of current price GDP as derived from the *production*, *income* and *expenditure* approaches.

The Input-Output Supply and Use Tables provide the natural framework which links the inputs used, GVA and the outputs produced on a consistent basis. The industrial analyses produced through these tables provide the natural links to the work on productivity for a range of users.

To produce good quality estimates of productivity, consistent and coherent estimates of outputs produced with the inputs used are required. The data on outputs used in the productivity work are derived from various parts of the UK National Accounts. This paper also forms an input to *The ONS Productivity Handbook – A Statistical Overview and Guide* (ONS 2007).

Introduction - Creating consistent output data

Producing good quality estimates of productivity, requires consistent and coherent estimates of outputs and inputs. The data on outputs used in productivity work are derived from various parts of the UK National Accounts.

Productivity estimates tend to use one of three different measures of output: total output; gross value added (GVA); or gross domestic product (GDP).

Total output, or output, is the value of the goods and services produced. It broadly equals the value of the sales plus any increase in the value of the inventory of finished goods not sold and work-in-progress.

In contrast, the other two measures are net of inputs used. This means that they equal the value of production **less** the value of intermediate inputs and, therefore, are both value-added measures. GVA and GDP are both compiled from the National Accounts. Therefore, in order to fully understand these measures, how they are constructed and the difference between them, an explanation of the UK National Accounts is required.

The Input-Output Supply and Use Tables are also covered as these tables provide the natural framework which links the inputs used, GVA and the outputs produced on a consistent basis. In the UK, these tables underpin the single estimate of annual current price GDP as derived from the production, income and expenditure approaches.

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The basic framework of the UK National Accounts

The accounting framework provides for a systematic and detailed description of the UK economy, and the structure of the framework is laid out as in the *United Nations System of National Accounts 1993* (SNA 93). The SNA 93 forms the basis of the *European System of Accounts 1995* (ESA 95), as used by all Member States.

This framework includes:

- the sector accounts, which provide, by institutional sector, a description of the different stages of the economic process from production through income generation, distribution and use of income to capital accumulation and financing.
- the Input-Output framework, which describes the production process in more detail.

The framework contains all the elements required to compile aggregate measures such as gross domestic product (GDP), gross national income (GNI), saving and the current external balance (the balance of payments).

The economic accounts provide the framework for a system of volume and price indices, so that chained volume measures of aggregates such as GDP can be produced. It should be noted that, in this system, Gross Value Added (GVA), from the production and income approaches, is measured at basic prices (including other taxes **less** subsidies on production but not on products). Factor cost (which excludes all taxes **less** subsidies on production) is not used, nor is GDP, which is valued at market prices. The economic accounts also encompass measures of population and employment to allow for derived analyses such as productivity.

The whole economy is subdivided into institutional sectors. In the UK National Accounts, there are seven main institutional sectors:

- Central government
- Local government
- Public corporations
- Private financial corporations
- Private non-financial corporations
- Households
- Non-profit institutions serving households (NPISHs)

For each sector, current price accounts run in sequence from the production account through to the balance sheet. The accounts for the whole UK economy and its counterpart measure – the rest of the world – follow a similar structure to the UK sectors, although several of the rest of the world accounts are collapsed into a single account because they can never be complete when viewed from a UK perspective. Furthermore because of the data quality, the NPISHs sector is not shown separately but combined with the households sector.

The UK National Accounts also have an industrial dimension and use the *Standard Industrial Classification 2003* (SIC (2003)), which is in line with the UN NACE Rev. 1.1 classification. The present UK Input-Output Supply and Use Tables show 123 industries and products covering the whole economy. **Annex A** lists the present 123 Input-Output industry and product groups.

1.1.1 What are the economic accounts?

The integrated economic accounts of the UK provide an overall view of the economy and the sequence of accounts follow that laid out in the SNA 93 and ESA 95.

An account records and displays all of the flows and stocks for a given aspect of economic life. In each account, the sum of resources is equal to the sum of uses with a balancing item to ensure this equality. Normally the balancing item will be an economic measure which is itself of interest.

The accounts can be built up for different areas of the economy by employing a system of economic accounts which highlight, for example, production, income and financial transactions. In many cases, these accounts can be elaborated and set out for different institutional units and groups of units (or institutional sectors). Usually a balancing item has to be introduced between the total resources and total uses of these units or sectors and, when summed across the whole economy, these balancing items constitute significant aggregates.

The accounting structure is uniform throughout the system and applies to all units in the economy, whether they are institutional units, sub-sectors, sectors or the whole economy, though some accounts (or transactions) may not be relevant for some sectors.

The economic accounts are grouped into four main categories, and the sequence is as follows:

- Goods and Services Account (not split by sector)
- Current Accounts
- Accumulation Accounts
- Balance Sheets

The SNA 93 and ESA 95 provide much more detail describing each of these accounts and the links between them.

1.1.2 Overview of the UK National Accounts

The UK, like many other countries, gives priority to the production of a single estimate of GDP using data covering the *production*, *income* and *expenditure* approaches to measuring GDP. The income analysis is available only at current prices, whereas the expenditure analysis is available at both current prices and chained volume measures. On the production side, analysis of GVA in chained volume measures is compiled quarterly, whereas the current price estimates are compiled annually through the production of Input-Output Supply and Use Tables.

A summary of availability of the detailed components for each approach to measuring GDP is shown in **Figure 1.1**.

1.1

Availability of the detailed components of UK GDP

	Current prices		Chained volume measures	
Approach to GDP	**Quarterly**	**Annual**	**Quarterly**	**Annual**
Production	n/a	✓	✓	✓
Income	✓	✓	n/a	n/a
Expenditure	✓	✓	✓	✓

Income, capital and financial accounts are also produced quarterly for each of the institutional sectors: non-financial corporations, financial corporations, general government and the households and NPISHs sectors. Detailed goods and services accounts and production accounts by industry and by sector are not produced quarterly.

The quarterly accounts produced are fully integrated, but with a statistical discrepancy, known as the statistical adjustment, shown for each sector account. This adjustment reflects the difference between the sector net borrowing or lending from the capital account and the identified borrowing or lending in the financial accounts which should theoretically be equal. Financial transactions and balance sheets are also produced for the rest of the world sector in respect of its dealings with the UK.

UK Input-Output Supply and Use Tables are produced annually, and only at current prices, integrating various parts of the accounting framework. The *production*, *income* and *expenditure* approaches to GDP are wholly integrated in the Input-Output Annual Supply and Use Tables framework. In the UK, consistent income based totals can be derived in three ways: by industry, by institutional sector and by category of income (also known as factor income).

When balanced, the UK Input-Output Annual Supply and Use Tables provide a coherent, consistent and wholly integrated story for a single year, including:

- A single annual estimate of GDP at current market prices, which is underpinned with components of the *production*, *income* and *expenditure* approaches to measuring GDP.
- Full and detailed Goods and Services Accounts.
- Production accounts by industry and by sector.
- Generation of Income Accounts by industry and by sector.

1.1.3 Groupings of sectors

It is important to distinguish that there are different groupings of sectors which meet various user needs. Although the classification and coverage of the sectors are determined by international guidelines, various users are interested in the individual sectors as well as particular groupings of the sectors. For example, the private sector and public sector composition differs from the market sector and non-market sector. These sectors are defined below.

In the UK, there is much interest in market sector based measures, which provide useful indicators for assessing macroeconomic activity and productivity trends, and play a key role in assessing demand pressures and the impact on price inflation. Consequently, Office for National Statistics (ONS) recently began regular production and publication of a market sector productivity measure (ONS, 2007 Chapter 8). The Bank of England and HM Treasury are key users of different sectoral analysis to help them manage various aspects of monetary and fiscal policy.

1.1.3.1 Private sector and public sector

The seven institutional sectors used throughout the UK National Accounts, are classified to the private sector and public sector, as follows:

Private sector:

- private non-financial corporations;
- private financial corporations;
- households; and
- NPISHs.

Public sector:

- central government;
- local government; and
- public corporations (financial and non-financial).

Financial Intermediation Services Indirectly Measured (FISIM) is not currently allocated to either private sector or public sector. FISIM is very briefly covered below.

Financial Intermediation Services Indirectly Measured (FISIM)

The output of many financial intermediation services is not paid for by charges, but by an interest rate differential. FISIM imputes charges for these services and corresponding offsets in property income. Guidance on using FISIM was introduced in the UN System of National Accounts 1993 (a set of worldwide standards for National Accounts calculations) and is soon to be incorporated into the UK National Accounts.

1.1.3.2 Market sector and non-market sector

The role and purpose of the market sector and the non-market sector, and their impact on the economy, differ substantially.

The institutional sectors that form the market sector are:

- private non-financial corporations;
- private financial corporations;
- households; and
- public corporations (financial and non-financial).

The remaining institutional sectors which form the non-market sector are:

- central government;
- local government; and
- NPISHs.

FISIM is not currently allocated to either market sector or non-market sector.

The different roles, coverage, definitions and treatment of the market sector and the non-market sector in the National Accounts are explained in Mahajan (2005) and Mahajan (2006, c).

1.1.4 Economic activity: what is included and excluded from the production boundary?

GDP is defined as the sum of all economic activity taking place in the UK territory. Having defined the economic territory it is important to be clear about what is defined as economic activity.

In its widest sense, it could cover all activities resulting in the production of goods or services and so encompass some activities which are very difficult to measure. For example, since the 2001 edition of the UK National Accounts *Blue Book*, the National Accounts has included estimates of the smuggling of alcoholic drink and tobacco products, and the production, income and expenditure directly related to it.

On the other hand, the UK National Accounts do not include estimates for illegal activities such as narcotics and prostitution.

In practice, as defined under SNA 93 and ESA 95, the production boundary is where all the economic activities are taken to contribute to economic performance. This economic production may be defined as activity carried out under the control of an institutional unit that uses inputs of labour or capital, goods and services to produce outputs of other goods and services. They are all activities where an output is owned and produced by an institutional unit, for which payment or other compensation has to be made to enable a change of ownership to take place. This omits purely natural processes.

The decision whether to include a particular activity within the production boundary takes the following into account:

- Does the activity produce a useful output?
- Are the products or activity marketable and does it have a market value?
- If the product does not have a meaningful market value can a market value be assigned (for instance, can a value be imputed)?
- Would exclusion (or inclusion) of the product of the activity make comparisons between countries or over time more meaningful?

In practice, the ESA 95 production boundary can be summarised as follows:

> "The production of all goods, whether supplied to other units or retained by the producer for own final consumption expenditure or gross capital formation, and services only in so far as they are exchanged in the market and/or generate income for other economic units."

For households, this has the result of including the production of goods on own-account, for example the produce of farms consumed by the farmer's own household. (However, in practice, produce from gardens or allotments has proved impossible to estimate in the UK so far.) There are further details of exclusions from the production boundary in **Box 1.1**.

Box 1.1 Exclusions from the production boundary

The present production boundary excludes:

- Domestic and personal services produced and consumed within the same household, for example: cleaning, decoration and maintenance of the dwelling; cleaning, servicing and repair of household durables; preparation and serving of meals; care, training and instruction of children; care of sick or elderly people; and transportation of household members or goods.
- Volunteer services that do not lead to the production of goods, for example: caretaking and cleaning without payment.
- Natural breeding of fish in open seas.

Although the production of some of these services does take considerable time and effort, the activities are self-contained with limited repercussions for the rest of the economy and, as the vast majority of household domestic and personal services are not produced for the market, it is very difficult to value the services in a meaningful way.

The ESA 95 records all outputs that result from production within the production boundary. However, there are two notable exceptions:

- Outputs of ancillary activities are not recorded; all inputs consumed by an ancillary activity, for example, materials, labour and consumption of fixed capital. are treated as inputs into the principal or secondary activity which it supports.
- Outputs produced for intermediate consumption in the same local kind-of-activity unit are not recorded. However, all outputs produced for other local kind-of-activity units belonging to the same institutional unit are to be recorded as output.

It should be noted that GDP is a measure of economic activity, and does not measure human well being and thereby is only an indicator of welfare of society. Also, GDP does not reflect the impact of economic activity on the environment. Analyses of GDP through the Input-Output Supply and Use Tables are used as inputs to produce the environmental accounts.

1.2 Prices used to value the products of economic activity

In the UK a number of different prices may be used to value inputs, outputs and purchases, with prices being different depending on the perception of the bodies engaged in the transaction. For example, the producer and user of a product will usually perceive the value of the product differently with the result that the output prices received by producers can be distinguished from the prices paid by purchasers.

These different prices – basic prices, producers' prices and purchasers' prices – are looked at in turn below. They differ as a result of the treatment of taxes on products **less** subsidies on products, and trade and transport margins.

1.2.1 Basic prices

Basic prices are the preferred method of valuing output and GVA in the accounts. This price basis reflects the amount received by the producer for a unit of goods or services, minus any taxes payable, and plus any subsidy receivable on that unit as a consequence of production or sale (for instance, the cost of production including subsidies).

The only taxes included in the price will be taxes on the output process – for example, in the UK these include business rates and vehicle excise duty – which are not specifically levied on the production of a unit of output. Basic prices exclude any transport charges invoiced separately by the producer. When a valuation at basic prices is not feasible then producers' prices may be used. The basic price valuation is used to construct the Input-Output Analytical Tables which are used by many users in constructing structural models of the economy or modelling particular features of economic behaviour.

1.2.2 Producers' prices

Producers' prices may be thought of as the prices of goods and services 'at the factory gate'. This valuation includes all taxes on production and some taxes on products, for example excise duties.

Producers' prices = basic prices
plus those taxes paid per unit of output (other than taxes deductible by the purchaser, such as Value Added Tax (VAT), invoiced for output sold)
less any subsidies received per unit of output.

1.2.3 Purchasers' prices or market prices

Purchasers' prices are those prices paid by the purchaser and include transport costs, trade margins and taxes (unless the taxes are deductible by the purchaser).

Purchasers' prices = producers' prices
plus any non-deductible VAT or similar tax payable by the purchaser
plus transport costs paid separately by the purchaser and not included in the producers' price.

Purchasers' prices are sometimes referred to as market prices, for example, GDP is valued at market prices and not purchasers' prices. There is a minor distinction between the purchasers' price and market price valuation of GDP. This is because of the valuation of imports, which are recorded as free on board and not as purchasers' prices (which will include taxes [**less** subsidies] on imports) when deducted from the *expenditure* approach. A balance is achieved as these taxes (**less** subsidies) are added in the *production* approach. Therefore the valuation of GDP is referred to as market prices and not as purchasers' prices.

1.3 Gross domestic product (GDP)

As mentioned earlier, priority is given in the UK to measuring GDP. This forms the major component of GNI, which in turn forms one of the key measures used to estimate the UK contribution to the European Union. The GDP measure is sometimes used for calculating productivity, particularly when constructing international comparisons of productivity, see (ONS, 2007 Chapter 12).

1.3.1 Different approaches to measuring GDP

The three approaches to measuring GDP and the need for balancing GDP, arguably the most important aggregate or summary indicator for purposes of economic analysis, and comparisons over time are detailed below.

All three approaches also form the basis of estimating UK GDP both quarterly and annually. The use of three different methods which, as far as possible, use independent sources of information avoids sole reliance on one source and allows greater confidence in the overall estimation process. This in turn also underpins the quality of the key aggregates.

1.3.1.1 Production

The *production* approach looks at the contribution of each economic unit by estimating the value of their output **less** the value of goods and services used up in the production process to produce their output, this is also known as GVA. The estimation and coverage of output is described in detail in the SNA 93 and ESA 95 but in broad terms is turnover (excluding VAT) adjusted for changes in inventories.

Using the *production* approach:

GDP = the sum of gross value added of the institutional sectors or of the industries
plus taxes on products and imports, and
less subsidies on products (which are not allocated to sectors and industries).

Where:

GVA = the total value of output of goods and services produced
less the intermediate consumption (goods and services used up in the production process in order to produce the output).

GDP is also the balancing item in the whole economy production account.

The above treatment for GDP is applied to producing units classified to the market sectors and it is important to note, that the treatment differs for producing units classified to the non-market sectors.

The estimate of output for producing units in the non-market sector is derived by summing their costs for example intermediate consumption, compensation of employees, taxes (**less** subsidies) on production and consumption of fixed capital. GVA is the sum of compensation of employees, taxes (**less** subsidies) on production and consumption of fixed capital.

The *production* approach to GDP, and the estimates of GVA, can be analysed by using an industry dimension or by a sector dimension as presented in the *UK Input-Output Analyses*, 2006 Edition.

GVA is the variable used when producing labour productivity estimates, in particular the headline measure in the UK Productivity First Release. Also, output per worker uses GVA as the output measure, see (ONS, 2007 Chapter 1).

Annual current price estimates of GVA by industry and by sector are produced through the process of producing annual Input-Output Supply and Use Tables, which are described later in this paper, see Section, 1.6. However, quarterly estimates of chained volume measures of GVA by industry are produced using an output based approach. Again, this is covered later in this paper, see Section 1.3.6.

1.3.1.2 Income

The *income* approach measures the incomes earned by individuals and corporations in the production of goods and services.

Using the *income* approach:

GDP = the sum of uses in the whole economy generation of income account (compensation of employees, taxes on production and imports **less** subsidies, gross operating surplus and gross mixed income of the whole economy)

plus taxes on products and imports

less subsidies on products.

The *income* approach provides estimates of GDP and its income component parts at current market prices. The sources and methods of this approach are described in detail in Chapter 14 of Concepts, Sources and Methods (ONS 1998).

As it suggests, the *income* approach adds up all income earned by resident individuals or corporations in the production of goods and services and is therefore the sum of uses in the generation of income account for the total economy (or alternatively the sum of primary incomes distributed by resident producer units).

Box 1.2 Exclusions from the income approach

However some types of income are not included, for example, transfer payments such as unemployment benefit, child benefit or state pensions. Although they do provide individuals with money to spend, the payments are made out of, for example, taxes and national insurance contributions.

Transfer payments are a redistribution of existing incomes and do not represent any addition to current economic activity. To avoid double counting, these transfer payments and other current transfers, for example taxes on income and wealth, are excluded from the calculation of GDP although they are recorded in the secondary distribution of income account.

In the UK, the income measure of GDP is obtained by summing together:

- gross operating surplus;
- compensation of employees;
- taxes on production and imports **less** any subsidies on production; and
- taxes on products and imports **less** any subsidies on products.

Gross operating surplus excludes holding gains but includes:

- self-employment income (mixed income and quasi-corporations);
- gross trading profits of private financial corporations;
- gross trading profits of private non-financial corporations;
- gross trading surplus of public corporations (financial and non-financial);
- rental income;
- non-market consumption of fixed capital; and
- FISIM.

The *income* approach to GDP can be analysed either by industry, by sector or by type of factor income as presented in the *UK Input-Output Analyses*, 2006 Edition.

The *income* approach cannot be used to calculate chained volume measures directly because it is not possible to separate income components into prices and quantities in the same way as for goods and services. However, a chained volume measure of the income based total is obtained indirectly. The expenditure based GDP deflator at market prices (also known as the index of total home costs) is used to deflate the current market price income based total estimate to provide a chained volume measure of the total income component of GDP for balancing purposes.

1.3.1.3 Expenditure

The *expenditure* approach measures the final expenditures or uses by consumers and producers of goods and services produced within the domestic economy.

Using the *expenditure* approach:

GDP = the sum of final uses of goods and services by resident institutional units (actual final consumption expenditure and gross capital formation),
plus exports of goods and services and
less imports of goods and services.

The total is obtained from the sum of final consumption expenditure on goods and services by households, NPISHs and government, gross capital formation (gross fixed capital formation on tangible and intangible fixed assets, changes in inventories and acquisitions **less** disposals of valuables) and net exports of goods and services.

The *expenditure* approach can also be represented as:

- households final consumption expenditure;
- NPISHs final consumption expenditure;
- central government final consumption expenditure;
- local government final consumption expenditure;
- gross fixed capital formation;
- changes in inventories;
- acquisitions less disposals of valuables;
- exports of goods and services; and
- **less** imports of goods and services.

The data for these categories are estimated from a wide variety of sources including business surveys, expenditure surveys, the government's internal accounting system, surveys of traders and the administrative documents used in the importing and exporting of goods.

To avoid double counting in this approach it is important to classify consumption expenditures as either final or intermediate.

Final consumption expenditure involves the consumption of goods purchased by or for the ultimate consumer or user. These expenditures are final because the goods are no longer part of the economic flow or being traded in the market place. Intermediate consumption, on the other hand, is consumption of goods and services that are used or consumed in the production process. Gross capital formation is treated separately from intermediate consumption as the goods (or services) involved are not used up within the production process in an accounting period, except for depreciating over time.

Exports include all sales to non-residents, and exports of both goods and services have to be regarded as final consumption expenditure, since they are final as far as the UK economy is concerned.

Imports of goods and services are deducted because, although they are included directly or indirectly in final consumption expenditure, they are not part of domestic production.

The *expenditure* approach is also used to estimate chained volume measures of GDP. The chained volume measure shows the change in GDP after the effects of inflation has been removed, this is covered later in this paper (see Section 1.3.6).

1.3.2 GDP: Difference between the concept of net and gross

The term gross refers to the fact that when measuring domestic production, this does not allow for an important phenomenon: capital consumption or depreciation of capital assets. Capital goods are different from the materials and fuels used up in the production process because they are not used up in the period of account but are instrumental in allowing that process to take place. However, over time capital goods do wear out or become obsolete, and in this sense GDP does not give a true picture of value added in the economy.

In other words, in calculating value added as the difference between output and intermediate consumption, we should include as a current cost that part of the capital goods used up in the production process; that is, the depreciation of the capital assets.

Net concepts of domestic product are net of this capital depreciation, for example:

	Gross domestic product at market prices
less	Consumption of fixed capital
equals	**Net domestic product** at market prices

However, because of the difficulties in obtaining reliable estimates of the consumption of fixed capital (depreciation), GDP remains the most widely used measure of economic activity.

1.3.3 UK GDP

The resulting estimates from the three approaches, like all statistical estimates, contain errors and omissions as data sources are inevitably imperfect and have associated statistical measurement error. The best estimate of GDP is attained by reconciling the estimates obtained from all three approaches: *production*, *income* and *expenditure*.

On an annual basis, this reconciliation is carried out through the construction of the Input-Output Supply and Use Tables for the years for which data are available. For subsequent periods, the level of GDP set by the annual balancing process is carried forward by using the quarterly movements in production, income and expenditure indicators.

Box 1.3 Statistical discrepancy

For years in which no balance has been struck through the Input-Output Supply and Use Tables, a statistical discrepancy exists between estimates of the total expenditure components of GDP and the total income components of GDP after the balancing process has been carried out. This statistical discrepancy is made up of two components shown in the accounts, namely:

- The expenditure statistical discrepancy, which is the difference between the sum of the expenditure components and the definitive estimate of GDP. The expenditure adjustment is allocated to the estimate of changes in inventories component.
- The income statistical discrepancy, which is the difference between the sum of the income components and the definitive estimate of GDP (with sign reversed). The income adjustment is allocated to the estimate of gross operating surplus (profits) component for the private non-financial corporations sector.

1.3.4 Valuation of GDP and GVA

The figure below shows the link between GDP and GVA as well as the distinction between market prices, basic prices and factor cost measures in the UK:

	GVA at factor cost
plus	taxes on production other than taxes on products
less	subsidies on production other than subsidies on products
less	FISIM
equals	**GVA at basic prices**
plus	value added taxes on products
plus	other taxes on products
less	subsidies on products
equals	**GDP at market prices**

GDP at market prices includes other taxes (**less** subsidies) on production and products, while GVA at basic prices includes only those other taxes (**less** subsidies) on production, such as business rates which are not taxes on products and GVA at factor cost excludes all taxes (**less** subsidies) on production and products.

A brief explanation of taxes and subsidies is given below and much more detail covering those taxes and subsides within the UK production boundary can be found in Mahajan (2006, b).

1.3.4.1 Taxes on production and products

Taxes on production and imports including taxes on products, along with subsidies, make up the factor cost adjustment which represents the difference between GDP at market prices (sum of final expenditures) and GVA at factor cost (sum of incomes).

Part of this adjustment in the UK National Accounts has to be added to the sum of incomes to obtain GDP at market prices. The basic price adjustment, which is the sum of taxes on products **less** subsidies on products, is the difference between GVA at basic prices and GDP at market prices. Prior to the introduction of the ESA 95, the factor cost valuation was applied to both GVA and GDP for the UK.

Taxes on production and imports are taxes paid during the production or import of goods and services. They are paid irrespective of whether profits are made. They comprise taxes on products and other taxes on production.

Taxes on products are taxes paid per unit of good or service produced, sold, leased, transferred, exported or imported. They are included in the prices paid to suppliers of goods and services, so they are included in intermediate consumption at purchasers' prices, except for deductible VAT.

Deductible VAT

Deductible VAT differs from other taxes on products. It is levied like other taxes on products but producers are reimbursed by government for the amount they pay when goods and services are bought. Intermediate consumption at purchasers' prices is the price paid less deductible VAT refunded. The value of sales or production at producers' prices also excludes any deductible VAT charged.

Suppliers are required to pay to government any taxes on products included in their prices. So the supplier's net revenue from selling the good is the selling price **less** the taxes on products included in the selling price. This is the basic price. It is the price at which market output is measured since it represents the producer's actual revenue.

Other taxes on production are taxes which producers have to pay but they are not paid when goods and services are bought and therefore not included in intermediate consumption. They are levied separately and are usually linked to the use of fixed capital or to the right to undertake certain regulated activities.

1.3.4.2 Subsidies on production and products

Subsidies should be considered at the same time, whenever, taxes on production or taxes on products are referred to, but treated in reverse, for example where taxes are added, subsidies are deducted and vice-versa.

Subsidies are current unrequited payments which general government or the Institutions of the European Union make to resident producers, with the objective of influencing their levels of production, their prices or the remuneration of the factors of production.

Other non-market producers can receive other subsidies on production only if those payments depend on general regulations applicable to market and non-market producers as well. By convention, subsidies on products are not recorded on other non-market output.

1.3.5 Headline GDP

The chained volume measure of GDP at market prices provides the key indicator of the state of the economy; this is sometimes called 'headline' GDP. The chained volume measure of GVA at basic prices, another useful short-term indicator of growth in the economy, is the headline measure for the *production* approach. It is compiled in a way which is relatively free of short-term fluctuations because of uncertainties of timing.

1.3.6 UK GDP chained volume measure

When looking at the change in the economy over time, the main concern is usually whether more goods and services are actually being produced now than at some time in the past. With productivity, however, the point of interest is whether this capital is increasing relative to the inputs.

Over time, changes in current price GDP show changes in the monetary value of the components of GDP and, as these changes in value can reflect changes in both price and volume, it is difficult to establish how much of an increase in the series is due either to increased activity in the economy or to an increase in the price level; only the former should be included in productivity measures. It is therefore useful to measure GDP in real terms, meaning excluding price effects, as well as at current prices. In most cases, the revaluation of current price data to remove price effects (known as deflation) is carried out by using price indices such as component series of the retail prices index or producer price index to deflate current price series at a detailed level of disaggregation.

In the 2003 edition of the *Blue Book* a new method of measuring GDP in real terms, annual chain-linking, was introduced to replace fixed base chain-linking which was used in previous editions. The real GDP time series produced by annual chain-linking are referred to as chained volume measures.

- In the UK economic accounts, the *expenditure* approach is used to provide current price and chained volume measures of GDP.

- Changes in labour productivity are difficult to measure, and as a result, it is not possible to obtain direct chained volume measures of GDP from the income data. However, an approximate aggregate *income* measure is calculated by deflating the current price estimates using the GDP deflator derived from the *expenditure* approach for balancing purposes.

- The quarterly *production* approach to estimating the chained volume measure of UK GDP is largely based on output indicators, and in the UK is often referred to as the *output* approach

The reference year for the chained volume measure series in the 2006 edition of the *Blue Book* is 2003; the chained volume measure of GDP for 2003 is referenced to, and therefore equal to, the annual current price estimate of GDP for 2003. The price indices also make allowances for quality changes over time and the use of hedonic adjusted price deflators are applied in industries producing high-technology type products such as computers.

The Eurostat Handbook on Prices and Volume Measures in National Accounts presents preferred methods, and alternatives, to deflate various components of the National Accounts and also describes how to handle quality change type issues. Quality adjustments and related issues are covered in more detail in ONS (2007, Chapter 6).

There are two main methods used to remove the effects of inflation to obtain these chained volume measures. For some series, price indices for particular goods and services are used to deflate the current price series, such as components of the:

- consumer price index (CPI)
- retail prices index (RPI)
- producer price index (PPI)
- corporate services price index (CSPI)
- import prices
- export prices

For other series, chained volume measures are assumed to be proportional to the volume of goods or services. The calculation of these chained volume measures are explained in Box 1.7.

Double deflation

Double deflation is the preferred method to estimate real GVA. This is achieved by deflating the value of output and the value of intermediate inputs separately to get corresponding chained volume measures, and then subtracting the latter from the former. This is in contrast to the single deflation method whereby the subtraction is done at current prices and the difference (GVA at current prices) is deflated using an output based deflator to arrive at real GVA estimates. This means that an industry's total output is deflated by the price of its output, while each input is deflated by its own price index.

1.4 Annual chain-linking

The fixed-base chain-linking method, which was used in editions of the *Blue Book* prior to 2003, produced constant price estimates of GDP whereby the price structure prevailing in 1995 was used to compile data from 1994 onwards. For years prior to 1994, more appropriate pricing structures were used and, in order to link all of the constant price estimates to produce continuous time series, a process of chain-linking was used whereby blocks of constant price data with different price bases were linked together.

In the link years, figures were calculated with reference to two consecutive base years to obtain a linking factor so that the whole time series could be shown with reference to the latest base year. This system of fixed-base chain-linking is described later in this section.

In the 2003 edition of the *Blue Book*, the fixed-base chain-linking method was replaced with an annual chain-linking process which produces chained volume measures of GDP. Chained volume measures are calculated by applying the price structure prevailing in the previous year for each year, except the most recent year(s), 2004 and 2005, where chained volume measures are calculated by applying the price structure prevailing in 2003.

The year 2003 is the latest base year for chained volume measures published in the 2006 edition of the *Blue Book*. Therefore estimates for 2004, 2005 and the early periods of 2006 are based on 2003 prices, estimates for 2003 are based on 2002 prices and so on. These previous years' prices data are chain-linked to produce continuous time series called chained volume measures, in a similar fashion to the fixed-based chain-linking described earlier. As 2003 is the latest base year, current price data therefore equals chained volume measures annually in 2003.

Chained volume measures prior to 2003 are non-additive in the 2006 edition of the *Blue Book*.

Box 1.7 Calculating chained volume measures

In theory, chained volume measures of GVA should be estimated by double deflation as briefly described in Box 1.8. In the UK, double deflation is only used in the estimation of output for the agriculture and electricity industries, as it is hard to get complete and reliable data from companies. So, for most industries' movements, the chained volume measures for GVA are estimated by only using the output series.

This approach assumes stable relationships between variables such as intermediate consumption, GVA and output over the short-term. For example, current price turnover is used as a proxy for output, and in turn when deflated, forms a proxy for the chained volume measure of GVA. In other cases, direct indicators of the volume of output are used as a proxy to produce the chained volume measure of GVA.

Double deflation is planned as part of the future production of GVA methodology through the Input-Output Supply and Use Tables in both current prices and chained volume measures, see ONS (2007, Chapter 13) for more details.

For industries whose outputs are mainly goods, output can be estimated from the physical quantities of goods produced or from the value of output deflated by an index of price. Examples include alcohol, motor vehicles and some energy producing industries.

Apart from the use of output to estimate chained volume measures of GVA, which accounts for around 90 per cent of the total of the production measure, a number of other kinds of indicator might be used as a proxy for the change in GVA. For example, they may be estimated by changes in inputs, where the inputs chosen may be materials used, employment or some combination of these.

In the short-term, it is assumed that movements in GVA can be measured this way. However, changes in the ratio of output and inputs to GVA can be caused by many factors: new production processes, new products made and inputs used; and changes in inputs from other industries will all occur over time.

Aggregated over all industries the impact of these changes will be lessened. In the longer term all indicators are under constant review, with more suitable ones being used as they become available.

Again, it is worth noting that non-market dominated industries are treated different from the market sector dominated industries. In many cases, direct volume measures are used for deflating non-market output. Collective services such as defence in chained volume measures are measured according to the traditional convention whereby output is equal to the total value of the inputs.

The estimate of GVA for all industries, the proxy for the quarterly *production* measure of GDP in chained volume terms, is finally obtained by combining or weighting together the estimates for each industry according to its relative importance in terms of GVA as established in the Input-Output Supply and Use Tables for the reference year.

For each year, these GVA weights are based on the Input-Output Supply and Use Tables for the immediately preceding year, except for the most recent years. For example, in the 2006 *Blue Book*, GVA weights are derived from the Input-Output Supply and Use Tables for 2003, and the years 2004 and 2005 will also be based on these weights. This process occurs annually on a rolling-basis.

Although Input-Output Supply and Use Tables for 2004 were produced for the first time in the 2006 *Blue Book*, these tables are considered as provisional and become much more firmly based after the first annual revision to these tables, therefore the GVA weights for 2004 are not taken on at this stage. This situation reflects the basis and quality of the survey and administrative source data as well as past revisions performance of the data used to populate these tables.

This use of previous years' weights is a feature of the move to annual chain-linking, introduced in the UK National Accounts in the 2003 edition of the *Blue Book*.

These chained volume measure series are shown in £ million and referenced onto the latest base year. The process of annually chain-linking previous years' prices data onto a continuous time series referenced onto the latest base year results in a loss of additivity in the annual data prior to the latest base year. Each year the latest base year and therefore the reference year will move forward by one year.

In the *expenditure* measure of GDP all of the components are annually chain-linked, as described above, and the chained volume measure of total GDP is aggregated from these components. The *production* (output) approach involves weighting together the detailed components using the contribution to current price GVA (or weight) in the immediately preceding year and annually chain-linking to produce a continuous time series. The application of annual chain-linking to the *production* (output) measure of GDP is described in detail in Reed and Tuke (2001).

Annual chain-linking provides more accurate measures of growth in the economy than that provided by the old method of fixed-base chain-linking because more up to date, and therefore more appropriate, price structures are used. The move to annual chain-linking is also consistent with international guidelines as laid down in SNA 93.

1.5 Index numbers and price indices

Some chained volume measure series are expressed as index numbers in which the series are simply scaled proportionately to a value of 100 in the reference year. These index numbers are volume indices of the 'base weighted' or 'Laspeyres' form, see Chapter 2 of Concepts, Sources and Methods (ONS 1998).

Aggregate price indices are of the 'Paasche' or 'current-weighted' form. They are generally calculated indirectly by dividing the current price value by the corresponding chained volume measure and multiplying by 100. Examples are the GDP deflator and the households' consumption deflator.

Value indices are calculated by scaling current price values proportionately to a value of 100 in the reference year. By definition such a value index, if divided by the corresponding volume index and multiplied by 100, will give the corresponding price index.

1.6 Input-Output Annual Supply and Use Tables

The main aim of ONS's Input-Output work is to provide a framework for the detailed reconciliation of the components of the three approaches to measuring of GDP, thereby agreeing a single annual estimate of current market price GDP.

The annual estimates prepared for the *Blue Book* incorporate the results of annual inquiries which become available in the first part of the year, although estimates for the latest year are still based largely on quarterly information. As new data are collected it is likely that revisions will be necessary.

The process of reassessing these estimates involves the preparation of Input-Output Supply and Use Tables. This Input-Output approach amalgamates all the available information on inputs, outputs, GVA, income and expenditure. Similarly the production of the consolidated sector and financial accounts requires the preparation of 'top-to-bottom' sector and sub-sector accounts to identify discrepancies in the estimates relating to each sector. The thorough and detailed nature of this estimation process takes time, and has often included large revisions to earlier years.

There are also various Input-Output based analyses published in ONS *Economic Trends*, for example covering Information and Communication Technologies (ICT), Creative Sector, and the Oil and Gas Sector as well as available on the Input-Output web-page, www.statistics.gov.uk/inputoutput.

1.6.1 GDP and the balancing of the annual accounts

As discussed earlier, the three different approaches to estimating current price GDP should theoretically produce the same result. However, the different approaches are based on different surveys and administrative data sources and each produces estimates which, like all statistical estimates, are subject to errors and omissions. A definitive GDP estimate can only emerge after a process of benchmarking components, balancing and adjustment.

ONS believes that the most reliable 'definitive' estimate of the current price level of GDP is that derived using the annual Input-Output Supply and Use Tables framework. Therefore, for the years when Input-Output Supply and Use Tables are available, GDP is set at the level derived from that year's balance. For periods subsequent to the latest Input-Output Supply and Use Tables, the level of GDP is carried forward using the quarterly movements in production, income and expenditure totals.

The annual balancing and compilation process is described in Mahajan (1997 a, b) and the quarterly balancing process is described in Chapter 11 of ONS (1998).

1.6.2 The Input-Output framework and GDP

The main National Accounts is primarily concerned with the composition and value of goods and services entering into final demand (for example, purchases by consumers) and the outputs and incomes generated in the production process. It does not display the inter-industry transactions which link these activities.

The UK Input-Output Supply and Use Tables, however, do include these intermediate transactions which form inputs into these processes, therefore providing an extra dimension. The Input-Output analyses are constructed to show a balanced and complete picture of the product flows in the economy and illustrate the relationships between producers and consumers of goods and services.

On an annual basis Input-Output Supply and Use Tables are used to achieve consistency in the economic accounts' aggregates by linking the components of GVA, inputs, outputs and final demand. As the *production*, *income* and *expenditure* approaches to measuring GDP can all be calculated from the Input-Output Supply and Use Tables, a single estimate of GDP can be derived by balancing the supply and demand for goods and services and reconciling them with the corresponding GVA estimates.

1.6.3 Industrial analyses

The Input-Output Supply and Use Tables and other industrial based analyses produced in the ONS use the *Standard Industrial Classification 2003* (SIC (2003)). This classification is applied to the collection and publication of a wide range of economic and industrial statistics. The current version, SIC (2003) is consistent with the NACE Rev. 1.1 and the links are shown in Annex A. The industrial dimension is also used in the range of productivity analyses and per head type analyses.

The Input-Output process, which produces Input-Output Supply and Use Tables annually as well as benchmarking various components of GDP, has been speeded up considerably over the last few years. The result is that the UK produces the first GDP balance through the Input-Output framework for a year around eighteen months after the end of that year. These full Input-Output Supply and Use Tables, consistent with the National Accounts *Blue Book*, are published as a separate web-only publication at the same time as the *Blue Book*. The latest annual Input-Output publication covers the periods 1992 to 2004, with summary information provided in the *Blue Book* (Chapter 2) itself.

The Input-Output Supply and Use Tables use the SIC (2003) covering the whole economy based on 123 Input-Output groups which form a mix of 2-digit, 3-digit and 4-digit categories across the hierarchy of the classification. The annex to this section shows the Classification of 123 Input-Output industry/product groups by SIC (2003) and how they relate to the NACE Rev. 1.1 classification. The NACE Rev. 1.1 categories are shown at the Division, Sub-section and Section level whereas the SIC (2003) links to the 123 I-O groups by Division, Group or Class as appropriate.

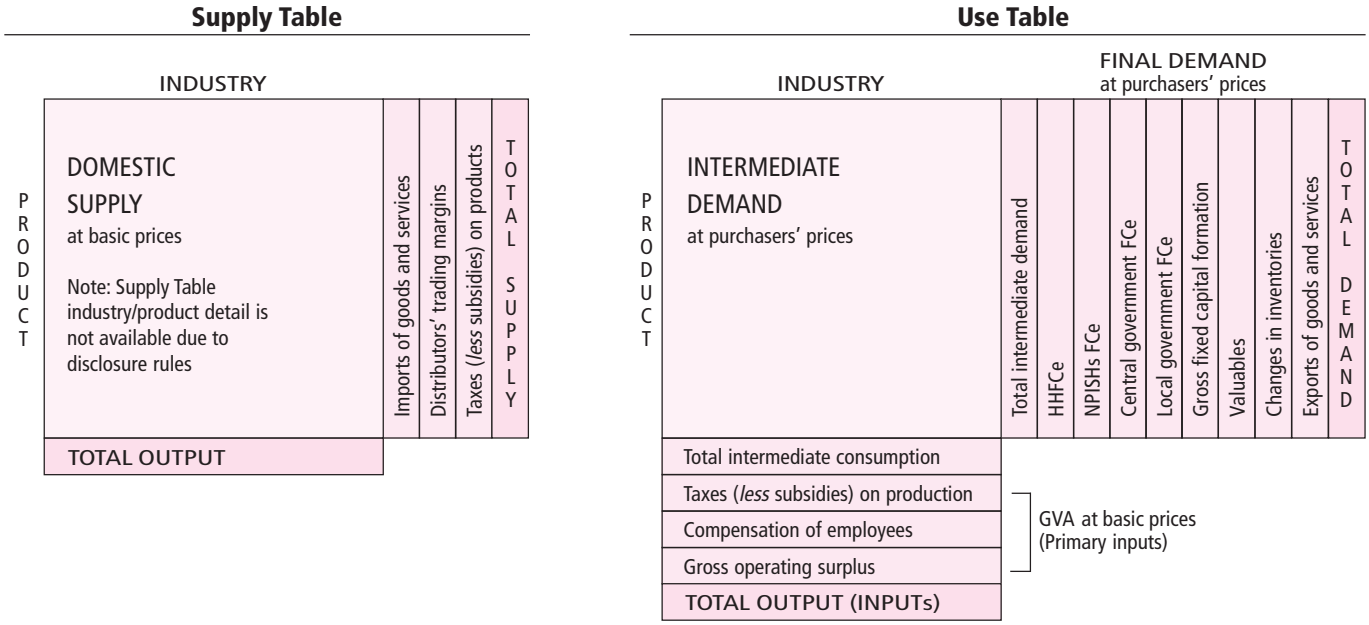
A more common level, and widely used level of aggregation covers the 11-industry level as shown here:

11 industry level classification	I-O groups
Agriculture, forestry & fishing	1-3
Mining & quarrying	4-7
Manufacturing	8-84
Electricity, gas & water supply	85-87
Construction	88
Distribution & hotels	89-92
Transport & communication	93-99
Finance & business services	100-114
Public administration & defence	115
Education, health & social work	116-118
Other services	119-123

1.6.4 Structure of the UK Input-Output Annual Supply and Use Tables

The Input-Output Annual Supply and Use Tables consist of two matrices, which bring together the *production*, *income* and *expenditure* measures of GDP. When balanced, they provide a single measure of annual current price GDP, which integrates the components of GVA, inputs and outputs, and final demands.

I-O Supply and Use Tables framework



HHFCe represents Households final consumption expenditure.
NPISHs FCe represents Non-profit institutions serving households final consumption expenditure.

The Input-Output Annual Supply and Use Tables as illustrated in the above graphic, reflect the structure and availability of the data collected and the components needed to balance the three measures of UK GDP:

- The Input-Output Annual Supply and Use Tables show the supply and demand for products in terms of 123 industries (represented by columns) and 123 products (represented by rows). Industries are defined using the SIC (2003) and businesses are classified on the ONS Inter-Departmental Business Register (IDBR) to industries according to whatever product accounts for the greatest part of their output. See Annex A for the classification of the 123 Input-Output groups and their links to SIC (2003).

- The Supply Table shows the output of each industry by type of product at basic prices. Industries, by definition, produce mainly the principal product of the industry to which they are classified. The off-diagonal products are secondary production or by-products of the production process. The Supply Table is published in summary form only because of disclosure rules prohibiting the publication of data that may be traced to a single contributor to ONS inquiries.

- The industrial dimension of the Use Table shows, for each industry, the costs incurred in the production process as intermediate consumption along with primary inputs (labour costs, taxes on production, profits, etc.). Note that productivity estimates use primary factors, for example labour and capital. These estimates are compared with GVA, for example the headline measure of GVA per worker. In addition, productivity can be measured with output matched to the sum of both primary and intermediate inputs, for example the KLEMS work, see ONS (2007, Chapter 12) for more detail.

- The product dimension of the Use Table shows intermediate demand and final demand and is valued at purchasers' prices, which represent the prices that purchasers actually pay.

- Estimates of consumption (both intermediate and final demand) include goods and services both domestically produced and imported.

Further details on the tables are given in Chapter 13 of Concepts, Sources and Methods (ONS 1998). A full description of the present methodology is given in the Input-Output Balances Methodological Guide (ONS 1997).

The Input-Output Supply and Use Tables are balanced, when:

For each industry:

Total inputs (from the Use Table) ***equals*** Total outputs (from the Supply Table)

For each product:

Supply (from the Supply Table) ***equals*** Demand (from the Use Table)

That is, when the data from the *production*, *income* and *expenditure* approaches used to fill these tables is balanced, all approaches produce the same estimate of current price GDP at market prices.

GDP at current market prices can be derived from the balances by taking the estimate of total GVA at basic prices (from the Use Table) and adding taxes on products and deducting subsidies on products (from the Supply Table).

1.6.5 The balancing process

The balancing process is carried out over a number of months and encompasses the validation of source data and benchmarking of various quarterly data onto the more comprehensive annual survey sources. This process involves the Current Price Input-Output team as well as compilers across National Accounts and Survey suppliers, who feed data directly into the process from surveys or through the economic accounts compilation process.

1.6.5.1 Initial estimates

Once the initial data estimates have been gathered, estimates of the components of supply and demand for products are prepared, together with the estimates of industry outputs and inputs and thus GVA. The resulting production based estimates of current price GVA are then compared with the *income* and *expenditure* measures and the checks, investigations and analyses which follow extend the validation checks which will already have been carried out on the initial data estimates. The investigations which follow often lead to the revision and redelivery of data.

In parallel with this work alternative estimates of GVA for each of the 123 industries are prepared using income based data.

The coherence of these initial estimates is then assessed by:

- comparisons of GVA for each industry using the *income* and *production* based approaches, and
- comparisons of the components of supply and demand for each type of product (which effectively compare the *production* and *expenditure* approaches).

In addition a variety of time series (e.g. growth rates and the ratio of gross value added to total output) are compiled to aid the assessment.

At this stage, the resulting *production*, *income* and *expenditure* aggregates will typically show different profiles over time.

1.6.5.2 Revised estimates

To obtain the revised estimates an iterative process begins, to reconcile:

- the *income* and *production* based estimates of industry GVA, and
- the supply and demand for each product.

These estimates are scrutinised, validated and checked for their plausibility and coherence across all industries, products and sectors, as appropriate. Consistency and coherence over time are also important and the impact of revisions to earlier years and the quality of the relative data sources are also taken into account. When necessary other sources (e.g. detailed National Statistics survey data, regulatory data, and company annual reports and accounts) are used to inform the investigation of particular areas. Discussions follow between the Current Price Input-Output team and data compilers and any issues are resolved.

1.6.5.3 Final estimates

As final estimates are received from data compilers the steps of assessment, scrutiny, comparison and reconciliation continue. For the time series under consideration the quality of source data, revisions performance and any specific estimation problems are taken into account. Any changes to estimates are agreed and the inconsistencies between supply and demand, and between *production* and *income* based GVA, are progressively reduced. This process continues until convergence between the aggregate totals is achieved.

The single best estimate of GDP which emerges will reflect the relative merits of the *production*, *income* and *expenditure* estimates at the aggregate level. It will also have been assessed after consideration of the effect on current price and chained volume measure expenditure growth rates, the impact on the expenditure deflator and the relationship between the current price and chained volume measures of GVA.

Once this GDP estimate has been fine-tuned and agreed by all concerned, the industry GVA estimates and the GVA weights are fixed after a full reconciliation of the *income* based components with the *production* based estimate. Product supply and demand will still differ at this stage, mainly reflecting the approximations in transforming source data to I-O group level. Further adjustments are made at this stage to address these imbalances; for example, distributors' trading margins and the allocation of other services provided by manufacturers. The Use Table is then fully balanced by adjusting the intermediate consumption within the predetermined column and row totals.

This final step in the balancing process is to apply the r.A.s. method to the intermediate section of the Use Table. This process will adjust the intermediate consumption in line with pre-determined row and column totals, resulting in a fully balanced table. The term r.A.s. refers to an iterative mathematical process, where A is the coefficient form of the intermediate section of the Use Table. 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 the process is repeated until the desired balance has been achieved, that is supply being equal to demand for each product.

The end result is a full set of Input-Output Supply and Use Tables where,

- for each of the 123 industries, inputs equal outputs, and
- for each of the 123 product groups, supply equals demand.

1.6.6 Gross Value Added - link between estimates in the Annual Business Inquiry and Input-Output Annual Supply and Use Tables

Data collected and published through the ONS Annual Business Inquiry (ABI) is used to calculate 'approximate' GVA at basic prices and 'approximate' total output at basic prices. The ABI forms a major data input in the production of Input-Output Annual Supply and Use Tables, which also show industry estimates of total output at basic prices and gross value added at basic prices but are different from those shown in the ABI.

Alternative data sources are used for industries not covered by the ABI. In producing these estimates to be fully consistent with the ESA 95, there are essentially four key adjustments required: coverage adjustments; conceptual and valuation adjustments; quality adjustments and coherence adjustments.

The adjustments can be briefly described as follows:

Coverage adjustments

These include, for example: allowances made for units missing from the IDBR; the self-employed; and, in the past, the transformation of inquiry based estimates covering only Great Britain onto a full United Kingdom basis (including Northern Ireland).

Conceptual and valuation adjustments

These are needed to move the inquiry based estimates onto a full ESA 95 basis required for National Accounts. These adjustments include for example: income earned-in-kind; imputed insurance premium supplement; taxes and subsidies on production; and capital formation on cultivated assets.

Quality adjustments

These are needed to address issues such as known biases or discontinuities in the source data. These may be specific to a range of products, industries or even to just one year, and are often not taken into source survey results due to timing or system constraints.

Coherence adjustments

These are needed to resolve the data confrontation posed by the various data sources used in producing and balancing the *production*, *income* and *expenditure* measures of GDP through the Input-Output Annual Supply and Use Tables framework.

Annual coherence adjustments

The role of the Input-Output framework as used in the ONS has been briefly discussed earlier in this section.

In practice, the data sources used in the National Accounts are subject to statistical error and complete coherence between measures of economic activity is not achieved without making specific adjustments. For the period 1989-2004, these adjustments are made through the current price I-O balancing process using the Input-Output Annual Supply and Use Tables and the underlying framework.

An article in the October 1999 *Economic Trends* describes the background to these adjustments and briefly shows how they are made. The compilation and balancing process is described in more detail in the Input-Output Methodological Guide and the January 1997 Economic Trends. The process of achieving coherence in the accounts by balancing Input-Output Annual Supply and Use Tables can most simply be explained as a series of different types of adjustment.

The three main types of adjustment described in the October 1999 *Economic Trends* article are:

- conceptual and coverage adjustments;
- quality adjustments; and
- coherence adjustments.

1.7 Different stages of the GDP compilation process

Data feeding into the compilation of GDP, like many economic statistics are continually revised and these revisions occur at different stages of the GDP compilation process.

The 2006 edition of *UK Input-Output Analyses* covers the evolution of the first GDP estimate through successive monthly and quarterly exercises through to the first Blue Book and second Blue Book exercises. Also shown are how the first UK GDP estimate for a particular quarterly period is revised and the timing of subsequent revisions to this period up to the annual benchmarking exercise through the production of Input-Output Annual Supply and Use Tables, including the cause of revisions at each stage.

1.8 Future plans

The development of new methods is planned following a high level review to look at the strengths and weaknesses of the UK National Accounts. This found that users' main concern is the evidence of bias in the early estimates of GDP leading to persistent upward revisions. The review recommended that the UK system should extend the use of the Input-Output Supply and Use Tables framework for the estimation of GDP and its components.

These planned changes will provide a robust foundation for supporting analysis of various dimensions of productivity and growth accounting. The Input-Output Supply and Use Tables framework would support the analysis of productivity; using the ability to present the elements of output and value added generated within the economy alongside the inputs used in each industry in a consistent framework.

In order to take full advantage of the current changes planned to the National Accounts systems, a structure for long-term productivity analysis will be included. This structure will be composed of National Accounts data sources along with checks and calculations to automatically produce detailed productivity estimates consistent with National Accounts. More details of this planned work are given in Beadle (2007) and in ONS (2007, Chapter 13).

References:

Atkinson A B (2005) *Atkinson Review: Final report. Measurement of Government Output and Productivity for the National Accounts*, Office for National Statistics: London, available at: www.statistics.gov.uk/about/data/methodology/specific/PublicSector/Atkinson/final_report.asp

Beadle J (2007) 'Modernising the UK's National Accounts', *Economic & Labour Market Review* vol 1, no 4, pp 27–32 available at:
www.statistics.gov.uk/cci/article.asp?id=1737

Eurostat (1995) *European System of Accounts 1995* (ESA 95), Office for Official Publications of the European Communities, Office for Official Publications of the European Communities: Luxembourg.

Eurostat (2001) *Handbook on price and volume measures in national accounts*, Office for Official Publications of the European Communities: Luxembourg, available at: http://epp.eurostat.cec.eu.int/cache/ITY_OFFPUB/KS-41-01-543/EN/KS-41-01-543-EN.PDF

International Labour Organization (2004) Consumer Price Index Manual: Theory and Practice, Chapter 7, ILO: Geneva, available at: www.ilo.org/public/english/bureau/stat/guides/cpi/index.htm#manual

Mahajan S (1997, a) *Input-Output Methodological Guide,* 1997 edition, Office for National Statistics: London.

Mahajan S (1997, b) 'Balancing GDP: UK Annual Input-Output Balances', *Economic Trends* 519, pp 29–40.

Mahajan S (2005) 'Input-Output: Market sector and non-market sector activity', Economic Trends 623, pp 20–41, available at: http://www.statistics.gov.uk/StatBase/Product.asp?vlnk=11041&Pos=2&ColRank=1&Rank=272

Mahajan S (2006, a) 'Development, Compilation and Use of Input-Output Supply and Use Tables in the UK National Accounts', *Economic Trends* 634, pp 28–46, available at: http://www.statistics.gov.uk/StatBase/Product.asp?vlnk=11041&Pos=2&ColRank=1&Rank=272

Mahajan S (2006, b) 'Taxes and subsidies within the production boundary, 1992–2004',
Economic Trends 635, pp 48–62, available at: http://www.statistics.gov.uk/StatBase/Product.asp?vlnk=11041&Pos=2&ColRank=1&Rank=272

Mahajan S (2006, c) *UK Input-Output Analyses,* 2006 edition, Office for National Statistics, available at: www.statistics.gov.uk/inputoutput

Office for National Statistics (1995) *UK ESA95 Gross National Income Inventory of Methods*, available at: www.statistics.gov.uk/Statbase/Product.asp?vlnk=6392

Office for National Statistics (1998) *National Accounts Concepts, Sources and Methods*, TSO: London, available at: www.statistics.gov.uk/statbase/Product.asp?vlnk=1144

Office for National Statistics (2006) *United Kingdom National Accounts – The Blue Book*, 2006 edition, TSO: London.

Office for National Statistics (2007), *The ONS Productivity Handbook – A Statistical Overview and Guide*, Palgrave Macmillan: London

Penneck S and Mahajan S (1999) 'Annual Coherence Adjustments in the National Accounts', *Economic Trends* 551, pp 27–32.

Reed G and Tuke A (2001) 'The effects of annual chain-linking on the output measure of GDP', *Economic Trends* 575, pp 37–53 available at:
www.statistics.gov.uk/cci/article.asp?ID=87&Pos=5&ColRank=1&Rank=1

Sharp, Peter (1999) *Gross Domestic Product: Output Approach (Gross Value Added),* 1999 edition, GSS methodology series no 15, Office for National Statistics: London.

United Nations Statistics Division (1993) *System of National Accounts* (SNA93), available at: http://unstats.un.org/unsd/sna1993/toctop.asp

A Classification of Input-Output industry/product groups by Standard Industrial Classification (2003) and NACE Rev. 1.1

11 level	Detail 123 level	Industry/product groups	Standard Industrial Classification (2003) Divisions, Groups, Classes	NACE Rev. 1.1 Industrial classifications			
				Divisions A60	**Sub-sections A31**	**Sections A17**	**A6**
Agriculture	1	Agriculture, hunting and related service activities	01	01	A	A	1
	2	Forestry, logging and related service activities	02	02			
	3	Fishing, fish farming and related service activities	05	05	B	B	
Mining and quarrying	4	Mining of coal and lignite; extraction of peat	10	10	CA	C	
	5	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction	11 + 12	11 + 12			
	6	Mining of metal ores	13	13	CB		
	7	Other mining and quarrying	14	14			
Manufacturing	8	Production, processing and preserving of meat and meat products	15.1	15	DA	D	2
	9	Processing and preserving of fish and fish products; fruit and vegetables	15.2 + 15.3				
	10	Vegetable and animal oils and fats	15.4				
	11	Dairy products	15.5				
	12	Grain mill products, starches and starch products	15.6				
	13	Prepared animal feeds	15.7				
	14	Bread, rusks and biscuits; pastry goods and cakes	15.81 + 15.82				
	15	Sugar	15.83				
	16	Cocoa; chocolate and sugar confectionery	15.84				
	17	Other food products	15.85 to 15.89				
	18	Alcoholic beverages - alcohol and malt	15.91 to 15.97				
	19	Production of mineral waters and soft drinks	15.98				
	20	Tobacco products	16	16			
	21	Preparation and spinning of textile fibres	17.1	17	DB		
	22	Textile weaving	17.2				
	23	Finishing of textiles	17.3				
	24	Made-up textile articles, except apparel	17.4				
	25	Carpets and rugs	17.51				
	26	Other textiles	17.52 to 17.54				
	27	Knitted and crocheted fabrics and articles	17.6 + 17.7				
	28	Wearing apparel; dressing and dyeing of fur	18	18			
	29	Tanning and dressing of leather; luggage, handbags, saddlery and harness	19.1 + 19.2	19	DC		
	30	Footwear	19.3				
	31	Wood and wood products, except furniture	20	20	DD		
	32	Pulp, paper and paperboard	21.1	21	DE		
	33	Articles of paper and paperboard	21.2				
	34	Publishing, printing and reproduction of recorded media	22	22			
	35	Coke, refined petroleum products and nuclear fuel	23	23	DF		
	36	Industrial gases, dyes and pigments	24.11 + 24.12	24	DG		
	37	Other inorganic basic chemicals	24.13				
	38	Other organic basic chemicals	24.14				
	39	Fertilisers and nitrogen compounds	24.15				
	40	Plastics and synthetic rubber in primary forms	24.16 + 24.17				
	41	Pesticides and other agro-chemical products	24.2				
	42	Paints, varnishes and similar coatings, printing ink and mastics	24.3				
	43	Pharmaceuticals, medicinal chemicals and botanical products	24.4				
	44	Soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	24.5				
	45	Other chemical products	24.6				
	46	Man-made fibres	24.7				
	47	Rubber products	25.1	25	DH		
	48	Plastic products	25.2				
	49	Glass and glass products	26.1	26	DI		
	50	Ceramic goods	26.2 + 26.3				
	51	Bricks, tiles and construction products in baked clay	26.4				
	52	Cement, lime and plaster	26.5				
	53	Articles of concrete, plaster and cement; cutting, shaping and finishing of stone; manufacture of other non-metallic mineral products	26.6 to 26.8				
	54	Basic iron and steel and of ferro-alloys; manufacture of tubes and other first processing of iron and steel	27.1 to 27.3	27	DJ		
	55	Basic precious and non-ferrous metals	27.4				
	56	Casting of metals	27.5				
	57	Structural metal products	28.1	28			
	58	Tanks, reservoirs and containers of metal; central heating radiators and boilers; steam generators	28.2 + 28.3				
	59	Forging, pressing, stamping and roll forming of metal; powder metallurgy; treatment and coating of metals	28.4 + 28.5				
	60	Cutlery, tools and general hardware	28.6				
	61	Other fabricated metal products	28.7				
	62	Machinery for the production and use of mechanical power, except aircraft, vehicle and cycle engines	29.1	29	DK		
	63	Other general purpose machinery	29.2				
	64	Agricultural and forestry machinery	29.3				
	65	Machine tools	29.4				
	66	Other special purpose machinery	29.5				
	67	Weapons and ammunition	29.6				
	68	Domestic appliances not elsewhere classified	29.7				
	69	Office machinery and computers	30	30	DL		
	70	Electric motors, generators and transformers; manufacture of electricity distribution and control apparatus	31.1 + 31.2	31			
	71	Insulated wire and cable	31.3				
	72	Electrical equipment not elsewhere classified	31.4 to 31.6				
	73	Electronic valves and tubes and other electronic components	32.1	32			
	74	Television and radio transmitters and apparatus for line telephony and line telegraphy	32.2				
	75	Television and radio receivers, sound or video recording or reproducing apparatus and associated goods	32.3				
	76	Medical, precision and optical instruments, watches and clocks	33	33			
	77	Motor vehicles, trailers and semi-trailers	34	34	DM		
	78	Building and repairing of ships and boats	35.1	35			
	79	Other transport equipment	35.2 + 35.4 + 35.5				
	80	Aircraft and spacecraft	35.3				
	81	Furniture	36.1	36 + 37	DN		
	82	Jewellery and related articles; musical instruments	36.2 + 36.3				
	83	Sports goods, games and toys	36.4 + 36.5				
	84	Miscellaneous manufacturing not elsewhere classified; recycling	36.6 + 37				
Electricity, gas and water supply	85	Production, transmission and distribution of electricity	40.1	40	E	E	
	86	Gas; distribution of gaseous fuels through mains; steam and hot water supply	40.2 + 40.3				
	87	Collection, purification and distribution of water	41	41			
Construction	88	Construction	45	45	F	F	3
Wholesale and retail trade	89	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	50	50	G	G	4
	90	Wholesale trade and commission trade, except of motor vehicles and motorcycles	51	51			
	91	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	52	52			
	92	Hotels and restaurants	55	55	H	H	
Transport and communication	93	Transport via railways	60.1	60	I	I	
	94	Other land transport; transport via pipelines	60.2 + 60.3				
	95	Water transport	61	61			
	96	Air transport	62	62			
	97	Supporting and auxiliary transport activities; activities of travel agencies	63	63			
	98	Post and courier activities	64.1	64			
	99	Telecommunications	64.2				
Financial intermediation	100	Financial intermediation, except insurance and pension funding	65	65	J	J	5
	101	Insurance and pension funding, except compulsory social security	66	66			
	102	Activities auxiliary to financial intermediation	67	67			
	103	Real estate activities with own property; letting of own property, except dwellings	70.1 + 70.2(pt)	70	K	K	
	104	Letting of dwellings, including imputed rent	70.2 (pt)				
	105	Real estate activities on a fee or contract basis	70.3				
	106	Renting of machinery and equipment without operator and of personal and household goods	71	71			
	107	Computer and related activities	72	72			
	108	Research and development	73	73			
	109	Legal activities	74.11	74			
	110	Accounting, book-keeping and auditing activities; tax consultancy	74.12				
	111	Market research and public opinion polling; business / management consultancy activities; management activities of holding companies	74.13 to 74.15				
	112	Architectural and engineering activities and related technical consultancy; technical testing and analysis	74.2 + 74.3				
	113	Advertising	74.4				
	114	Other business services	74.5 to 74.8				
Public administration	115	Public administration and defence; compulsory social security	75	75	L	L	6
Education, health and social work	116	Education	80	80	M	M	
	117	Human health and veterinary activities	85.1 + 85.2	85	N	N	
	118	Social work activities	85.3				
Other services	119	Sewage and refuse disposal, sanitation and similar activities	90	90	O	O	
	120	Activities of membership organisations not elsewhere classified	91	91			
	121	Recreational, cultural and sporting activities	92	92			
	122	Other service activities	93	93			
	123	Private households employing staff and undifferentiated production activities of households for own use	95 to 97	95 to 97	P	P	