# 6.0 Estimating GDP in practice (Module 6)

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## 6.1 Module Overview

This module describes some practical methods for estimating GDP in a timely manner.

The methods described here are especially suitable for small economies with few statistical resources. Although in some ways there are benefits in being small, there is a difficulty when it comes to statistical sample surveys and their cost. The sample sizes needed to achieve the expected accuracy are disproportionately large when compared with the big economy with large numbers of enterprises. Also, the number of staff available to work on national accounts means that short-cuts must be taken and the methods kept as simple as possible.

The methods described depend first of all on establishing a benchmark level of GDP and its components. This is a complex undertaking, but it is best to do so by means of a (simplified) Supply Use Table (SUT) as the framework for assembling the data from many different sources. This is the subject of section 6.2.

Thereafter, timely estimates of GDP can be made by extrapolating the benchmark using indicators of production. A key source of data for this purpose, covering the formal sector, is the sales data supplied by enterprises on their VAT returns (or equivalent sales tax system). The methods are described in the sections 6.2 and 6.3. Because these estimates can go off-track, it is important to re-establish the benchmark at least every five years.

## 6.2 Supply and Use Tables

### Objectives

This chapter aims to provide an understanding of:

* What a supply use table looks like
* What it is used for
* How to go about compiling one
* What data sources are required

### 6.2.1 What does a Supply Use Table look like?

#### Overview

A full Supply Use Table (SUT) is a complex table. In fact, it comprises three tables:

* A supply tables
* A use tables
* A value-added table

The three tables are usually arranged like this:



In publications, the supply table may be placed above the use table. The precise order and detail of the columns may vary slightly, but essentially they consist of the SNA transactions labelled P. These are flows of goods and services (products). On the supply side we have:

P1 Total output (at basic prices)

P7 Imports of goods and services Margins) These two items are

D21&31 Taxes (lees subsidies) on products) valuation adjustments

On the demand (use) side we have:

P.2 Intermediate consumption (IC)

P.31 Household final consumption expenditure (HFCE)

P.32 Government final consumption expenditure (GFCE)

P.5 Capital formation (in fixed assets and changes in inventories)

P.6 Exports of goods and services

#### The parts of a Supply Use Table

Another way of presenting the tables in a printed publication is illustrated here, according to the Parts of the SUT shown in the diagram. The tables contain the results of a typical SUT compilation, designed to establish the level of GDP and its components.

The first is Part A:

Part A consists of the three areas of the SUT diagram above designated by vertical shading. The three areas show

* the total output of each activity at basic prices,
* the intermediate consumption by each activity at purchasers’ prices,
* the gross value added by each activity.

In the table, the presentation has been switched from horizontal to vertical. The overall input-output ratios are also shown.

The areas marked “Part B” (with horizontal shading) constitute a set of summary supply-use balances (also known as commodity flow accounts) for each product with no details of activity.



Part C is the intermediate consumption (IC) matrix, in which the IC of by all the enterprises in each activity is split up into all the different raw materials and other goods and services that they consumed in the production process.





Parts D and E were not produced in this example of SUT compilation. The detailed information needed to make these Parts was not available.

Part D is called the make matrix, showing the products produced by the enterprises classified to each activity. This matrix is predominantly a diagonal one and can be assumed to be so, without much loss of accuracy.

In other words, this means for example that (within the rows) the great majority of agricultural products are produced by businesses whose main activity is agriculture. Also, (within the columns) almost all products produced by businesses whose main activity is agriculture are agricultural products.

Part E provides further details of the elements making up gross value added. In the SNA this is known as the generation of income account.

The key feature of the SUT are the following identities:

* For each activity total output *equals* intermediate consumption *plus* gross value added
* For each product (or group of products) total supply *must equal* total demand
* Total output in Part A *must equal* total output in Part B
* Total intermediate consumption in Part A *must equal* total intermediate demand in Part B. However intermediate consumption by activity is **not** the same as intermediate demand by product

***Exercise: Calculate GDP in two ways from the following overall balance from Part B:***



The total of the margins column is zero, because the total of all margins is equal to the production (output) of wholesaling and retailing services, and a balance is achieved by putting an equal and opposite (negative) figure in the wholesaling and retailing row of the margins column.

#### The classification of products and activities

The *International Standard Industrial Classification* (ISIC) is universally recognised s the way to classify activities. It has a letter (optional) and groupings denoted by 2, 3 or 4 digits. There are several ways to classify products. In the SNA, the *Central Product Classification* (CPC) is recommended. In this classification products are arranged in a similar way to ISIC, but with some differences.

However, most countries adapt these classifications to suit both the local economy and the purpose of the statistics. Fr example, the Asian Development Bank combines the ISIC categories into 13 activity groups and the CPC categories into 25 product groups for publishing SUTs. On the other hand, many countries develop a national *Classification of Products by Activity* (CPA) or a similar scheme for both activities and products. The products are classified according to the activity that produces them. For practical reasons, for compiling a SUT, it is useful to group products by end-use. In other words, products are grouped where possible into those typically used by households, those that are typically used up in the production process (IC) and fixed assets. It is also important to distinguish key exports which may vary from country to country.

### 6.2.2 What is a Supply Use Table used for?

There are two main uses of SUTs: for economic analysis and for compiling GDP and its components for a given year. A brief summary of the analytical use is given here. But more important for national accountants is its use as a framework for estimating the level of GDP.

#### Economic analysis

A Supply Use Table provides an overall picture of the supply and use of goods and services, and of the structure of production in an economy. One example of its use is to estimate the effect of price changes on the cost structures of the various activities. Petroleum prices are particularly volatile and can affect the input- output ratios of local producers, especially in the case of transport and of electricity (if generated from petroleum products).

An SUT (or Input-Output Table) shows the extent to which one industry relies on the products of other industries. So, if the production of an industry increases to meet the demand for the product, this will lead to an increased demand for the inputs to that industry. To the extent that these inputs are not imported, the local production of the inputs will need to increase also. This iterates to yield what is called the *multiplier effect* which can be determined using matrix algebra. The dependence of an industry on imports can also be assessed.

Input-Output Tables (IOT) are very similar to SUTs. The main differences are in the shape of the tables and the valuation. An IOT is always square while an SUT need not be. In an IOT products may be valued at producers’ prices rather than at purchasers’ prices. An IOT is usually derived from an SUT with some additional information.

However, an SUT does not provide a complete picture of the linkages in an economy. For example, other things being equal, the increased production mentioned above will require more labour and so lead to more employment income. The extra income will in turn lead to an increase in the demand for consumer goods and services. To assess this effect as well, the SUT would need to be incorporated into a more extensive Social Accounting Matrix (SAM).

#### Compiling or benchmarking GDP and its components

In many large, highly developed economies, balanced SUTs are at the heart of the procedures used for estimating GDP every year or even, in some cases, every quarter. The compilers do not estimate GDP by activity separately from GDP by expenditure. They put all the information they have into the SUT framework. Then, at a detailed level, they fill in the gaps or remove the discrepancies by adjusting the weakest estimates. Some countries work with more than a thousand product categories.

In other countries, separate estimates are made for GDP by activity and GDP by expenditure without the benefit of a balanced SUT. In such cases, SUTs may be constructed later for economic analysis but without changing the existing GDP estimates. The process may help to identify anomalies in the GDP estimates which may be revised after further investigation.

In several small developing economies with large informal sectors, the SUT framework has been used to re-establish “benchmark” levels of GDP and its components for a year which is then used as a new base year. Estimates of GDP can go off track because the indicators used, and the assumptions made become out of date. It is recommended that a new base year is established every five years. This provides an opportunity to re-estimate the level of GDP, to introduce an updated classification of activities (if necessary), to exploit new data sources and to improve the compilation methods.

### 6.2.3 Compiling a Supply Use Table

In what follows, it is assumed that the SUT framework is being used to establish new benchmark levels of the GDP and its components for a year.

Compiling a SUT is a complicated process. It is best carried out in three main stages.

The first stage is to assemble the necessary data and to decide on a common classification of products, designed to facilitate the compilation of a SUT. It includes the construction of correspondence (or bridge) tables, to translate the codes used in the data sources into the codes of the common SUT classification. This last step requires considerable care. Any mistakes can adversely affect the quality of the results.

The next stage is to focus on Part B of the SUT. (Part A may already exist as part of the annual national accounts. But almost certainly it will need to be re-estimated as part of the SUT process.) Part B consists, on the supply side, of the two main categories (imports and domestic output) and the adjustments for margins and taxes less subsidies. On the demand side there is total intermediate demand and the final demand categories. The compilers balance each row of table by filling in gaps and/or adjusting the weakest estimates. Not only that, but the total of intermediate demand by product must agree with total intermediate demand by activity from Part A. Some iteration will be needed to achieve this balance. Throughout the process, it is essential that the numbers are realistic.

A third stage involves introducing the detailed intermediate consumption matrix (Part C of the SUT). This is not easy because it is difficult to obtain detailed data on the purchases made by producers and many assumptions may have to be made. However, doing so may result in further changes to the balances already achieved, with better results.

### 6.2.4 What data sources are needed?

To a large extent, the data sources required for compiling a SUT are the same as for compiling GDP by activity and by expenditure. The main difference is the need for detailed information by product. Some data sources may not be available every year and so cannot be used directly in annual and quarterly estimates of GDP, except when they are available. We start with the expenditure categories of GDP:

#### Imports and exports of goods and services by product

For goods, the trade statistics from the Customs Administration are the obvious source. The products will be classified according to the *Harmonised System* (HS) or possibly the *Standard International Trade Classification* (SITC). However, some trade may take place informally across international borders, especially if there are no taxes to pay. There may also be smuggling. This is part of the “non-observed” economy. It is possible to compare the Customs data with data compiled by partner countries to determine if there is a gap.

For services, the source will be the balance of payments, usually compiled by the Central Bank. Although only the totals of imports and exports of services may be published, there will normally be details of different types of services which provide the product detail that is needed for the SUT.

However, direct spending by visiting non-residents in the local economy, mainly tourism exports, is treated as one service item in the balance of payments. This item can be very important for countries with large numbers of foreign visitors. It needs to be split up into the various goods and services that they buy, for example hotel accommodation, bar and restaurant services, local transport (international transport is recorded elsewhere), clothing, etc. The best source of this information would be a visitor expenditure survey. If not, experience from similar countries could be used instead.

#### Household expenditure by product

Statistics on household expenditure come from Household Budget Surveys or Surveys of Living Conditions. Ideally, the information should be collected over the period of a year and distinguish products in sufficient detail. Such information is also needed for use as weights for the Consumer Price Index (CPI) and for poverty analysis. The survey may have its own product classification aligned with the *Classification of Individual Consumption by Purpose* (COICOP) used in the CPI. A bridge table will be needed to convert the items into the SUT product classification.

#### Government expenditure on public administration, on education and on health

Government final consumption expenditure will normally appear in total in the annual estimates of GDP by expenditure. It needs to be split between the three service categories. The main source will be the government accounts.

#### Capital formation by product

In compiling a SUT, gross fixed capital formation will often be estimated from the supply side, based on imports and local production. This type of expenditure it notoriously hard to measure directly.

Changes in inventories are also hard to measure on a regular basis. Because the changes are relatively small overall compared to the GDP, they may be ignored in the first instance, unless there are existing sources for them.

#### Total output by product

Two simplifying assumptions can be used at first to estimate total output by product. The first assumption is that the make matrix (Part D of the SUT) is diagonal: in other words, that producers do not produce products that are not typical of their main activity. This is true of the great majority of production. Special adjustments may be made for known exceptions. Secondly, except in the case of wholesale and retail traders, the output of producers may be assumed to be the same as their sales. This means ignoring any changes in the quantity of their stocks of finished goods and of work in progress. Although not theoretically correct, these approximations reduce the need for data that is often very difficult to obtain. In the case of merchandise trade, estimates of margins are needed.

The main source of information on total sales (turnover) will either be data based on tax returns (for the formal sector) or financial data collected from enterprises in a survey. Usually the Central Bank will have the profit and loss accounts of financial institutions.

Estimates of the quantities of agricultural production are usually available, although in some cases they may be unreliable. Establishing the average prices at which farmers sell their produce is not easy. Routine losses have no value. There are often big discrepancies between the supply and use of agricultural produce. When balancing, it is likely that good quality estimates of consumption from a household budget survey will be the more reliable.

A living conditions survey may also be the source of data on informal economic activities of households. The coverage of these activities tends to be more comprehensive than surveys of informal establishments.

#### Margins

This item is often labelled “trade and transport margins”. But because there is no straightforward source of information on transport margins, we focus on trade margins only.

Information on trade margins must come from the accounts of traders. Both the value of their sales and the cost of sales will normally be shown. The difference is the margin. A percentage margin may be obtained by dividing the margin by the total sales. Alternatively, a “mark-up” can be calculated by dividing the margin by the cost of sales. Notice that the percentage mark-up should always be greater than the percentage margin.

In the margins column of the SUT, the total must be split between every product group. Ideally information on margins would be available for each type of product sold. If not, it may be available for each type of trader classified by ISIC. This can provide a guide to the mark-ups for each product group in the SUT. Of course, margins only apply to tradable goods and not all of these go through wholesalers and/or retailers.

#### Taxes and subsidies by product

The source of information by product should come from detailed government revenue data. The Customs Authority would be a source of duties charged on imported products along with the value of the imports.

Allocating VAT by product is not so straightforward because of the way businesses registered for VAT can claim it back if they have already paid it on the products they buy. Estimates of intermediate consumption of these taxpayers by product can play a role in this.

#### Intermediate consumption by product

Intermediate consumption by activity can be derived from the estimates of total output and overall input-output ratios for each activity. This procedure is the same as the one for estimating GDP using the production approach (Part A of the SUT). But these estimates cannot be used for Part B because the intermediate consumption *by product* is not the same as that by activity.

The total intermediate consumption (use by businesses) of paper products is one thing. The intermediate consumption of the paper-making industry is quite different.

What is the source of intermediate consumption by product? Initially, when compiling Part B of the SUT, the main source of information can be the SUT itself. It can be estimated as a residual, from all the other columns in the table. It will also be possible to relate the value of the intermediate consumption of a raw material, for example, paddy, to the value of the total output of a final product such as milled rice. The latter must in turn be related to the value consumed by households.

Finally, the third stage of the compilation process involves introducing an IC matrix (Part C of the SUT) in which intermediate consumption is classified both by product and by activity. In principle, the source of this data is the detailed accounts (the cost-structure) of all producers in each activity. In practice, businesses do not keep records of all the details needed to create the matrix. The number of product categories for which it is possible to get information is limited. Information provided in surveys are prone to all kinds of errors and needs to be carefully edited. The information is likely to be patchy, not available for all activities.

Even when little or no data is available, it may be possible to make estimates. One technique is to borrow the IC matrix of a neighbouring with similar characteristics. The row and column totals will be different, but the interior of the matrix can be adjusted to match the local marginal totals. If in some rows the differences are too great, further investigation could lead to the discovery of a significant error.

### Topics for discussion

Why is compiling a detailed SUT likely to improve the estimates of the GDP and its components overall?

At a detailed level, why will a SUT be impressionistic and not precise or exact?

### References

Asian Development Bank (November 2017): *Compendium of Supply and Use Tables for Selected Economies in Asia and the Pacific*

https://www.adb.org/sites/default/files/publication/378246/compendium-supply-use-tables-selected-economies.pdf

6.3 Measuring GDP in practice

### Objectives

This chapter aims to provide an understanding of

* The approaches to measuring GDP
* How to extrapolate a benchmark by activity
* Extrapolating expenditure components
* Annual data and quarterly estimates

### 6.3.1 Approaches to measuring GDP

#### Introduction

This module covers the compilation of GDP *at current prices*, measured according to the production approach (by activity) and by the expenditure approach. It does not deal with the measurement of GDP *at constant prices* (or in *volume* terms). In practice, the estimates are usually compiled simultaneously at both current and constant prices. Compilers often focus primarily on the latter, because the *growth rate* of the GDP is based on estimates at constant prices. This topic is covered in a sister module [Volume Measures]. First, we focus on the current price estimates of the level of GDP, which are used as a denominator in several important indicators, such as the ratios of government revenue and of debt to GDP.

#### The compilation timetable

We start with some questions for discussion:

* How soon after the end of a year does your NSO produce the first published estimates of GDP and its growth? (Some NSOs may be asked for estimates even before the end of the year, but we are not counting those.)
* Does the first estimate get revised later in the year, or when the next year’s figures are produced or maybe not at all?
* What is it that determines the dates of publication and the revisions?

The answers to these questions will be determined by such issues as:

* The demands of the key users for timely, accurate estimates
* The availability of data (there is never enough)
* The extent to which assumptions are made in the absence of data

The “key users” include international organisations. In particular the IMF has established “Data Dissemination Standards” which specify the periodicity and timeliness for GDP and other statistics.

In the larger, more developed countries it is common for the first estimate to be published within a month or two of the end of each year (and quarter). It will be based on whatever indicators are available in time. Typically, it will be refined by the end of the third month, to meet the IMF standard. Then, later in the year more detailed data may become available. But it can be more than a year later before the results of annual surveys are produced, so near-final estimates may not be available until 18 months after the year concerned. Although users don’t like it, there is general acceptance that the initial estimates will be updated several times. The revisions are analysed. Often it is found that the initial estimates understate the final results. Compilers may then make systematic adjustments to compensate for this tendency.

At the other extreme, in some economies, the initial estimates may hardly ever be revised. Users may have (or may be thought to have) the strong expectation that, once produced, the numbers will not change. (This may reflect the bottom-up approach to measurement prevalent in former centrally planned economies. When every productive unit has supplied the necessary information, the resulting total will be final.) But this view is unrealistic when the estimates are produced quickly, based only on partial information. Such estimates are bound to go off-track. Sooner or later, the whole level of GDP (and its components) needs to be re-established. When this happens, revisions may be large and stretch back several years.

#### Benchmark estimates

In many countries, “benchmark” estimates of the level of GDP and its components are established from time to time. A Supply Use Table (SUT) provides an excellent framework for establishing a benchmark from all the available information. It ensures estimates of GDP by production and expenditure are equal. The procedure is described in the [SUT Module].

After this, many of the components of GDP can be extrapolated using indicators based on partial information. For some components, complete information may be available, but this is rare. On the other hand, for others, there may be no obvious source of information at all. Initial estimates of gross value added (GVA) may be modified later using information from the financial statements of formal enterprises. But financial data is notoriously prone to errors of all kinds and great care is necessary to ensure the worst errors are identified and corrected before the data are used (see module on Data Cleaning).

#### Using the SUT framework every year

As mentioned in the [SUT module], in several large, highly developed economies, the procedures used for estimating GDP every year (or even, in some cases, every quarter) have balanced SUTs at their heart. The compilers do not estimate GDP by activity independently from GDP by expenditure. They put all the information they have into the SUT framework. Then, at a detailed level, they fill in the gaps or remove the discrepancies by adjusting the weakest estimates. This procedure is very demanding of both data and time, so it would rarely be used for the very first (quarterly or annual) estimates.

If the procedures can be well established, using the SUT framework is recommended as best way of ensuring high quality national accounts. But such systems are complex. They require high quality data sources and considerable investment in their development and maintenance, as well as training in their use. These requirements may be beyond the reach of many countries, especially those with relatively small economies.

#### Measuring GDP with limited information

In this the rest of this module, it is assumed that, for a relatively recent year, the levels of GDP and its components have been re-established because of a benchmarking process, using the supply-use framework or otherwise. It is also assumed that the users require estimates as soon as possible after the period (whether quarterly or annual).

To meet this demand, it is necessary to rely on data that can be obtained quickly and on a regular basis, and to use this to extrapolate the latest benchmark. The available data does not need to be extensive, but it must be sufficient to make reasonable estimates of the trends in each component of the GDP. Estimates produced using the methods described below are acceptable in the short term. But because of the assumptions that are made they can go off track in the longer term. A much more comprehensive exercise to re-establish the level of GDP is therefore essential at least every five years.

### 6.3.2 Extrapolating GDP by activity

Measured from the production side, GDP consists of the gross value added (GVA) of all economic activities, plus an adjustment for taxes and subsidies on products. GVA is the value of total output *less* the value of intermediate consumption. Total output is the production of goods or services because of economic activity (outputs). Intermediate consumption is the use of all goods and services in the production process (inputs).

#### Turnover as an indicator of output

In general, the minimum information needed to estimate total output for most of activities is the turnover of (formal) enterprises.

Theoretically, output differs from turnover (sales) by the value of changes in the quantity of both the stock of finished goods and work in progress. However, in practice we ignore such differences because in most cases they are very small, and all the information needed to account for them is just not normally available. While not perfect, turnover is a readily available and in most cases very acceptable indicator of total output at current prices.

Some activities are dominated by a small number of large businesses. This might be true of the formal mining sector, of producers of modern beer and cigarettes, of refineries, pharmaceutical companies, cement manufacturers, vehicle assembly, or other specialised manufacturers, of electricity production and distribution, of rail and air transport and ports, of telecommunications, and of other major service providers.

Regular information should be available on the activities of these key enterprises can be expected to be supplied to line ministries (or regulatory authorities) if not directly to the NSO. (Care needs to be taken, when any large new enterprise is established, that it is included.) Each of these producers could be monitored over time: every month or quarter for output indicators together with annual financial statements. However, sometimes there can be an issue of cooperation, if an enterprise is unwilling to provide the data required.

Other activities may be shared among a larger number of medium-sized enterprises. Getting accurate information quickly from these may be more difficult and expensive. Obtaining turnover data directly from enough of these in a survey may be costly and difficult.

To overcome these problems, a key resource these days is the system of VAT returns which has been established in many countries. All traders with turnovers above the threshold must file regular returns to the tax authority within a month of the period concerned. These returns contain the exactly the information that you would seek in a simple monthly or quarterly survey. Exploiting this data source is the subject of [the Tax Data Module].

#### Other measures at current prices

For activities the products of which are not much used domestically but are exported, Customs data nay provide an alternative source of value and quantity information.

Where the value of output of an activity is not known, volume indicators or proxy volume measures (together with price indices) must be used instead.

A major example is the value of agricultural crop production. Crop forecasts and price indices may be used initially to extrapolate the base year value of output. Later, post-harvest surveys may in some countries provide a more objective result. Livestock production is often modelled using offtake rates known to experts in the field. Estimates of the animal slaughtering and grain milling activities may be based on the estimates of livestock and grain production respectively.

Another important example is construction, carried out by many enterprises of all sizes. Construction in each period is by no means easy to measure, especially output prices because so few buildings are identical. Often the best that can be done is to say that the volume of construction is predicted by the volume of cement and other key inputs available in the economy that are easy to measure. An approximate price index can also be derived from the prices of inputs. Input-output ratios are assumed constant. The timing of such an indicator will reflect work-in-progress (rather than the finished work). Although it is extremely rough, it should reflect the trends in construction activity (which can change quite dramatically) reasonably well. It is not clear, without substantial resources to monitor the industry, how this method could be improved. Some countries collect information on building permits, but when exactly the permits are used (if at all) is not known.

For the wholesale and retail trade activity, output is defined as the margin, which is the value of the goods sold less their current replacement cost. This activity is predominantly informal in many countries. A common method is to extrapolate the base year estimates of margins by the value of goods being produced for the market or imported. This procedure assumes (in the absence of better information) that both the proportion of goods distributed by wholesalers and retailers and the mark-ups applied remain constant.

The value of owner-occupied (and rented) housing is another challenging area. Assumptions must be made about trends in the volume (quality as well as quantity) of housing services to estimate the value using price indices of rented dwellings from the CPI. Data from population censuses and household surveys can provide trends in the numbers of dwelling of various types which may be valued differently. The estimates need to be interpolated and extrapolated between and beyond the survey periods.

#### Other types of informal activity

What about other informal (and illegal or otherwise hidden) activities? Called the “non-observed” economy, in fact many of these activities can be observed in living conditions (or other specially designed) surveys, or their existence can be inferred when balancing supply against demand. To the extent possible, the value of this production should have been included in the benchmark, in addition to the formal output. However, experience has shown that the accurate monitoring of these activities directly every quarter (or even year) is not feasible, especially in small economies. There are two main reasons: the variability in the sales of each business over time (many businesses last less than two years) and the lack of a reliable frame and population total.

In the short term therefore, assumptions must be made. Often it may be assumed that the informal sector changes in line with the formal sector or in line with the growth of the *urban* population (because the urban environment facilitates the exchange of goods and services). Whatever method is chosen, it should be documented and made available to users.

#### Estimating intermediate consumption

Given indicators of the value of total output, we need to estimate the value of gross value added (GVA) for each activity by subtracting estimates of intermediate consumption (IC). It may be possible to measure IC as well as total output directly in some cases, for example where activities are dominated by a small number of large companies as mentioned above. On the other hand, for many activities, especially in the short term, there may be no information on the value of intermediate consumption or the input-output (IO) ratio. This is a common experience.

Often in such cases it is assumed that the IO ratio at current prices of a given activity remains constant over time. Then, for each activity, estimates of intermediate consumption (and hence GVA) in the current period are obtained by multiplying the total output by the same IO ratio in the previous period. If the estimated IO ratio has not changed since the base year, this calculation is equivalent to using the output indicator to extrapolate the base-year GVA.

However, the resulting estimates of GDP at current prices are unlikely to be very reliable, especially when an increase in the price of an essential input is not immediately reflected in the price of the output. Even in the short term, with little or no change to the volume of IC, a rapid change in the price of an input (such as imported petroleum products) can affect the IO ratio at current prices. A method for modelling these effects (when there is no better information) is described briefly in Annex A.

#### Financial institutions

The output of enterprises in the financial sector is not so easy to define in terms of sales. In addition to services explicitly changed for, the output of banks includes FISIM (Financial Intermediation Services Indirectly Measured). which is not straightforward to measure using “reference rates” (the international standard method). However, total interest received minus total interest paid is an approximate measure of FISIM which can be obtained easily from their profit and loss accounts. Normally these are submitted at least annually to the Central Bank.

#### The GVA of government

The GVA of the (non-market) activities of general government (and of non-profit institutions) can be measured directly from the wages and salaries of the workers. For central government this item is normally monitored every month by the Ministry of Finance. Another source could be the system of social security contributions or of income tax deducted from pay. A difficulty may arise if substantial amounts of back pay are included in a single period but were earned in previous periods. In such a case, the additional amounts should be reallocated to the earlier periods. In principle, an estimate of the consumption of fixed capital should be added. However, this requires a long series of fixed capital formation by government that may not be available.

#### Taxes (less subsidies) on products and GDP

Timely data on the value of receipts of taxes on products will be available from the revenue authorities or from those responsible for Government Finance Statistics (GFS). In theory, tax receipts should be allocated to the period during which the liability was incurred (the “accruals” basis). However, the information needed to do this may not be readily available, but the difference is not likely to be significant. Subsidies (if any) are normally a category of expenditure shown in the government accounts. A temporary estimate may be needed if the accounts are not readily available.

Finally, the value of taxes (less subsidies) on products must be added to the estimates of total GVA to obtain the estimates of GDP.

6.3.3 Extrapolating expenditure components

The expenditure components of GDP are covered below in the following order

* Exports and imports of goods
* Exports and imports of services
* Capital formation
* Government final consumption expenditure
* Household final consumption expenditure

#### Exports and imports of goods

Timely monthly data on exports and imports of goods are normally available from the Customs authorities. Some additional information may be needed, and some adjustments made, for example to convert the overall imports from a CIF (or Customs valuation) to FOB. Although only the totals are needed for this expenditure component, for deflation to constant prices and for estimating total supply by product, the commodity detail is essential.

#### Exports and imports of services

Less easily measured, estimates of trade in services may not be as timely as those of other expenditure components. In many countries, the estimates at current prices are made by the Central Bank and passed to the NSO for national accounts purposes along with other items of the balance of payments.

A key item on the exports side is often travel credits. This item represents the expenditure in the domestic economy of non-residents (whether tourists, on business, or visiting for any reason). International airfares are not included here (use of a local carrier internationally comes under transport service credits) but internal domestic airfares should be. For this item up-to-date data on the number of visitor arrivals could be used as a volume indicator. A specially constructed price index (or the CPI) could be used to provide a value indicator.

#### Capital formation

*Gross fixed capital formation* consists mainly of new construction work and of machinery and equipment which in many countries is mainly imported. It also includes investment in livestock and cultivated plantations yielding repeat products and intellectual property, but the value of these is likely to be small in a small economy.

Unless a whole statistical unit is devoted to the subject, obtaining the data directly from the investing enterprises does not work well because large investments are infrequent and often by mew businesses not yet trading and therefore not known to the National Statistical Office. The best way is to extrapolate the benchmark values by the construction indicator and indicators of imports (and the local production if significant) of machinery and equipment.

*Changes in inventories*, or (more precisely) the values of changes in the volume of stocks and of work in progress (WIP), are not easy to estimate correctly. The necessary data are not usually readily available, although they could be obtained for specific products kept in storage tanks or silos (see [Volume Measures Module]). The information in enterprises’ annual financial statements may provide a reasonable approximation, but only later. If benchmark estimates exist, they could be extrapolated, for example in line with turnover, but this would not reflect the real movements. Another idea is to smooth out imports of certain products, which may be quite volatile in some economies. The differences between the actual imports and the smoothed version could be treated as changes in inventories.

A*cquisitions less disposal of valuables* could be derived from the foreign trade statistics.

#### Government final consumption expenditure (GFCE)

GFCE is equal to total output (GVA *plus* IC) *minus* revenue from sales of goods or services. These figures may be available from the Government Finance Statistics (GFS). If not, the Ministry of Finance can be expected to monitor major categories of government income and expenditure on a monthly basis. The categories may not accord exactly with national accounting requirements but, until more precise numbers become available, they can be used as indicators to extrapolate benchmark values.

#### Household final consumption expenditure

Few countries have the resources to carry out Household Expenditure (or Living Conditions) Surveys on a continuous basis and on a large enough scale to provide direct estimates of expenditure (which includes the consumption of households’ own production). However, although expensive, it is recommended that such surveys are carried out at least every five years. They are often undertaken principally for monitoring poverty levels, but they are also a crucial source of data for the national accounts and for CPI weights, among other things.

The 2008 SNA plays down the value of these surveys when compared to accounting data from the population of formal enterprises. It is true they have limitations. Under-reporting as well as sampling errors can be significant. But in many developing countries, not only is the economy predominantly informal but information about the formal sector is also far from complete. For these countries, high quality, regular surveys of household living conditions are a key source of data on consumption expenditure and on informal activity.

What can be done between surveys? In a formal economy, retail turnover data (supplemented with a product breakdown) is often used as a primary source, but this is not feasible where most retailing is informal. The simplest option is to estimate total HFCE as a residual. This may be done in one of three ways.

* Calculate HFCE as a residual at both current and constant prices. Then compare the implied HFCE deflator with the CPI. While they will never be the same, they should not be very far apart. If they are very different, it is likely that there are errors in the other deflators in the system
* Calculate HFCE as a residual at constant prices. Inflate the result by the CPI to get a rough measure of HFCE at current prices. There will be a discrepancy between GDP by activity and GDP by expenditure at current prices, but not at constant prices.
* Calculate HFCE as a residual at current prices. Deflate the result by the CPI to get a rough measure of HFCE at constant prices. There will be a difference between GDP by activity and GDP by expenditure at constant prices, but not at current prices.

Calculated as a residual, *changes* in HFCE since the benchmark will include all the errors in the estimated changes in every other component of the GDP. It will be the least reliable of all the estimates and get worse as time goes on. Therefore, household surveys and benchmarks are so important for re-establishing the levels of HFCE and GDP every few years.

A more sophisticated approach between benchmarks is to use the supply use framework as a mechanism for updating all components in a comprehensive and coherent way. As was stated in Section 1 above, this requires the use of more complex systems and procedures and initially may be beyond the capacity of a small office. Given the limitations of the available data, the estimates of GDP and its components are often no more than an impressionistic picture of the development of the economy.

### 6.3.4 Annual data and quarterly estimates

In the previous Sections we have not distinguished clearly between annual estimates and quarterly estimates. This is because the methods outlined above can be used both annually and quarterly. Almost all the source data could be available every month or quarter. If some data is missing quarterly, the gaps could be filled with projections. Thus, the data can be processed every quarter to give estimates of quarterly GDP and summed up to give annual estimates. This is common practice in compiling the first annual estimates.

There is a common assumption that annual estimates will be better than figures derived by adding up the four quarterly estimates. This assumption derives from the idea that the initial indicators outlined above will eventually be replaced by more reliable annual data. Often, this may not be true. But if higher quality annual data does become available later, common sources and methods are described below.

#### Sources of annual data not available more frequently

For the formal corporate sector, a potential main source of more detailed annual data will be the companies’ financial statements or questionnaires that seek accounting data. However, in many countries, the quality of the data obtained from large-scale annual enterprise surveys is often very poor.

If available in electronic form, annual Business Income Tax (BIT) returns are a similar potential source. Experience shows that making sense of data from these sources is not at all straightforward. Even in the USA, such data is known to be deficient. The Bureau of Economic Analysis makes an upward adjustment of about 30% to total before tax profits as recorded by the Inland Revenue Service, to account for misreporting.

*[Reference NIPA Handbook: Concepts and Methods of the U.S. National Income and Product Accounts, Chapter 13 Corporate profits]*

The coverage of BIT (both incorporated and unincorporated) will certainly be greater than any sample survey could be. It will also be greater than the more frequent VAT system, the coverage of which is limited by the turnover (or other) threshold below which businesses are exempt. The differences between the annual turnover from the BIT source and that of VAT registered traders are additional annual numbers. Where these numbers are not available in time for the initial annual (and quarterly) GDP estimates, they must be extrapolated (and interpolated) in the interim.

There may be value in the detailed monitoring of income and expenditure data based on the annual financial statements of (say) 20 or 50 of the largest enterprises in the country, from which good quality estimates of value added (and other key variables) may be obtained. Care would be needed to avoid double counting the same enterprises if a more general source was also being used.

More detailed figures on government expenditure will typically be available after some time. The income and expenditure of commercial banks will also become available annually if not quarterly (sometimes the quarterly numbers are year-to-date and so require splitting into quarterly estimates). These should replace any temporary estimates.

#### Constraining quarterly estimates to annual estimates

Where it is clear that the annual data for the same item are superior to those compiled quarterly, a mechanism is needed to re-align the quarterly data so that they add up to the new annual figure. This process is also known as “benchmarking” (quarterly to annual), not the same as compiling benchmark or base year estimates every few years. Where it is known that the differences are small and the estimates only approximate, it may be enough to divide them by four and add the result to each quarter. If a more sophisticated procedure is considered necessary, there is a tool called XLPBM available from the IMF. A disadvantage is that this tool results in revisions to several previous periods.

#### Seasonality

Quarterly (and monthly) data may be affected by seasonal factors, which can make comparisons with the previous period misleading. The simplest solution, especially if the series is volatile in an unpredictable way, is to compare the most recent period with the same period the year before, or even to make a moving average of the latest four quarters and compare that with the same average in the previous period. This smoothing will be preferable whenever there is random volatility.

If more sophisticated methods are deemed necessary, tools for seasonal adjustment are available and specialised training for those needing to use them is advisable. In brief, a series of data, at least five years long, can be partitioned into a trend component, a seasonal component and an irregular component. A seasonally adjusted series is the sum of the trend and irregular components. The results depend on the choice of model and on implicit forecasts of the series. The seasonal component will change over time depending on chosen parameters. The results can be expected to change every time a new period is added, causing revisions to several previous periods. The uncertainty is greatest at the end of the series.

### 6.3.5 Summary

In this Module, given benchmark estimates in a recent base year, we have focussed on measuring GDP at current prices with a minimum of timely data. In practice, estimates are usually made simultaneously at current and constant prices. Measurement of GDP at constant prices is covered in the [Volume Measures Module] using the same data sources. These are:

* Indicators of turnover for formal activities (data from VAT returns is best)
* Volume indicators for agricultural production, construction
* Government financial operations and tax revenues
* Price indices
* Foreign trade statistics

Because of the short cuts and assumptions made, best practice demands that a new benchmark be established at least every five years. Some variables may be updated annually.

The primary reference for estimating GDP quarterly is the IMF Quarterly National Accounts Manual, available from the IMF website. Readers are however advised that this manual is not designed for small economies with minimal statistical resources.

https://www.imf.org/external/pubs/ft/qna/pdf/2017/QNAManual2017text.pdf

#### **Discussion Questions**

(See also the exercises at the end of the [Volume Measures Module].)

How long is it since a new benchmark (or base year) was established in your country?

If this is more than five or six years, what plans exist to re-establish the benchmark for a more recent period?

**Box 6.1: Modelling IC at current prices**

It is often the case that the value of intermediate consumption at current prices is not known, at least not as quickly as total turnover at current prices. In this situation, it is usually assumed that the IO ratio is fixed at current prices. This may work reasonably well if price movements are well behaved. However, there are times when they do not, such as when the price of petroleum products changes a lot.

For example, electricity prices will not be adjusted immediately to account for a change in the replacement cost of the petroleum used to produce it. If the latter increases, the GVA at current prices may decrease, at least in the short term. But in many cases the IO ratios in volume terms the ratios can reasonably be assumed to remain constant (see [Volume Measures Module]). By using an intermediate consumption matrix from a supply use table (SUT) and the average price changes of the supply (imports and local production) of each product, it is possible to derive a price index for the IC of each activity. Estimates of IC at current prices can then be obtained by reflating the estimates of IC at constant prices derived from the estimates of total output at constant prices. When more reliable estimates of IC at current prices become available by direct measurement, these modelled estimates can be replaced.

**

# 6.4 Volume measures of GDP

### Objectives of the module

This chapter aims to provide an understanding of:

* GDP growth rates and the choice of base year;
* Volume measurement in practice;
* Compiling GDP by activity at constant prices;
* Short term indicators;
* Compiling expenditure components at constant prices.

### 6.4.1 GDP growth rates and base years

#### The GDP growth rate

While the level of GDP at current market prices is important for many things, it is the GDP growth rate that is always in the news (and often set as a target of economic policy), whether it is 15%, 8%, 2% or even -3%. It is usually published and quoted to the nearest 0.1% (in other words with one decimal place) but in reality it cannot be measured with such precision.

The GDP growth rate (unless otherwise specified) refers not to the change in the GDP at current prices from one year to the next, but to the change *at constant prices*. Growth rates are calculated by dividing the estimate for the year in question by the estimate for the year before, subtracting 1 and expressing the result as a percentage.

The value of all goods and services can, in principle, be split between the price and the quantity. As we know, GDP can be measured from the production point of view as total output *less* intermediate consumption, or from the expenditure point of view as total final consumption *plus* capital formation *plus* exports *minus* imports. All of these components of GDP are made up of goods and services. So, again in principle, the value of every item in every component can split between a price and a quantity, and the changes in value can be split between changes in price and changes in quantity. By multiplying the quantities of a good or service in every period by its price in a particular period (normally a *base year*) we obtain its value “at constant prices”. Then aggregating these constant price values over all items and all components gives us an overall measure of GDP *in volume terms* for every period.

In the SNA, the word *volume* is used in preference to *quantity* because of the issue of *quality*. Suppose there are two versions of the same car, one standard and one deluxe. If people switch from buying the standard model to the deluxe model, the number of cars sold may not change, but value of sales and the average price paid will have increased, even if the prices of each model remained the same. This kind of increase in value is not considered to be a change in price but an increase in volume. [more about this later]

#### Interpreting the growth rate

Thus, GDP growth is the change in value, but with the inflation in prices taken out. It is the change in the *volume* of domestic product. It could also be said to be the *real* growth in domestic product, but this term *real* is usually reserved to describe the change in something else: the *purchasing power* of the GDP, considered as income and not as the volume of goods and services produced. In an open economy there can be a big difference between changes in *real income* and changes in *production* (GDP) in volume terms.

People often misinterpret GDP growth as indicating an increase in real income. Usually the two are closely aligned, especially in a large economy with relatively small reliance on the rest of the world. But in a small, open economy, changes in the *terms of trade*, the change in export prices relative to the change in import prices, can make a difference to real income.

#### The choice of base period

A volume measure of GDP it is not unique in the way that GDP at current prices is. It all depends which period is chosen as the base period. *This base period is the one in which the estimates at constant prices are equal to those at current prices.*

If all prices changed by exactly the same amount from one period to the next, it would not matter which of the periods was chosen as the base period. But this never happens. Prices change in many different ways depending on the supply and demand for the different products. Overall growth rates calculated using one base period will be different from those calculated using another. It all depends on *relative prices*, because they affect the relative importance of each item in the total.

It is generally accepted that the base year chosen should be as up-to-date as possible to reflect current economic conditions. (The base year should also be one for which special efforts have been made to re-establish the levels of GDP and its components at current prices.) But it would not make sense then to change the growth rates of ten or twenty years previously. So, when we adopt a new base year we “chain-link” the previous numbers by rescaling.

***Exercise***

1. Calculate the growth rates for 2016 onwards
2. Rescale the constant price series to 2010 prices
3. Verify the growth rates remain the same

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|   | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|  **GDP at current prices**  | **1,206** | **1,440** | **1,739** | **2,092** | **2,658** | **3,057** |
|  **GDP at constant 2015 prices**  | **1,206** | **1,319** | **1,440** | **1,551** | **1,724** | **1,832** |
|  *Growth rates*  |  |  |  |  |  |  |
|  **GDP at constant 2020 prices**  |  |  |  |  |  |  |
|  *Growth rates*  |  |  |  |  |  |  |

While this procedure retains the growth rates, additivity is lost when all the components of GDP are rescaled in the same way. This means the components no longer add up to the total GDP for earlier years. Many developed countries update the base year every year. They measure growth at previous year’s prices and then link the results together to present continuous series.

### 6.4.2 Volume measurement in practice

When compiling GDP we normally prepare the estimates at both current and constant prices at the same time. It is also common practice to use spreadsheets to compile series of estimates using the same methods in every period. In doing so, it is strongly recommended that the spreadsheets are all designed in a common format, in which a single column is used for each period, making it easy to copy the formulas from one column to the next.

From time to time, the method may change because a better indicator becomes available (or because a source no longer exists and a new method has to be devised). To achieve this there must be at least one period in which the old and the new indicators overlap. Then the “rule of three” (see box) can be used to maintain a continuous series when the source of the data changes. In what follows, it is assumed a whole series is being compiled, starting with a base year.

**Rule of three**

New Existing

 X

 Y

A Z

B Z\*B/A

C Z\*C/A

#### Values and indicators at a basic level

Although we have talked about splitting the values of goods or services into prices and quantities at a detailed level, this is just the theory. Fortunately, because we focus on measuring change, we don’t have to split them in practice. In what follows we denote the value of an item *i* in period *t* by *vit*, the price by *pit*, and the quantity (volume) by *qit*. We may drop the *i* to make it easier to read.

At a basic level, there are three ways in which the constant price estimates can be calculated, which (in theory) give exactly the same result. The first is to multiply quantities in every period by a base year price (*p0\*qt*). This is identical to extrapolating the base year *value* (*v0*) of the item using a *volume indicator* or *volume relative*. A volume relative (*qrt=qt/q0)* is the volume in period *t* divided by the volume in period *0* (the base period). The third (most common and preferred) method of estimating values at constant prices is to divide the current value (*vt*)of an item by a *price “deflator”* (*pt/p0*) that reflects the change in price of the item. No knowledge of quantities is necessary for this method.

***Exercise: Write the above methods as formulae and show they are identical***

In essence, there are two main ways of computing estimates at constant prices, depending on the available data sources:

* Deflating values (or value relatives) by appropriate price relatives.
* Multiplying base year values by volume (quantity) relatives or proxy volume indicators.

A good example of a product, the volume of which is exceptionally difficult to define, let alone measure, is construction work. Almost every construction project is different. Construction companies are often reluctant to disclose the value of the work. (This may be because of the competitive tendering process.) However, a proxy volume index can be developed using information on the availability of input materials. The assumption is that if the volume of cement available (production *plus* imports *minus* exports) increases, so does the volume of construction work.

#### What is the basic level?

The basic level is the most detailed level at which volume measures (and values) are calculated. This will vary according to the availability of detailed data. In some areas the data may be quite detailed (for example, estimates of the quantities harvested of each crop) but in others there may be little detail (for example, overall estimates of the output of construction activity).

At the basic level, the choice of base year makes no difference whatsoever to the growth rate of a single item. When comparing any two periods *t* and *t-1* (say) the growth rate in volume terms is always the same (*qrt/qrt-1 ≡ qt/qt-1*). It only makes a difference to the aggregates.

#### Deflation procedure

When deflating values, it is first necessary to prepare appropriate deflators, corresponding to the item being deflated. (As far as possible, the price indices should be measured by collecting the prices of exactly the same item over time, or otherwise excluding any changes in quality. [see prices module])

Typically, the prices will be observed more frequently than the value data. Also, the base period of the price indices will be a particular month or quarter, not the same as the national accounts (NA) base year. There is more than one way to do this, but the best procedure is to follow these three steps for each item:

* Make a series of average price indices with the same periodicity as the current price values to be deflated.
* Divide the current price values by this deflator. This gives a provisional volume series (the level of the series is arbitrary).
* Using the rule of three, re-reference this volume series so that it equals the current price series in the NA base year. (This is done by dividing the provisional volume series by its value in the NA base year and multiplying by the NA base year current price value.)

This procedure ensures that, whatever the periodicity, the base year current and constant price values are identical. It can also be used for quarterly series.

***Exercise: Calculate the constant price series using the above procedure***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|   | **Row** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
| **Sales by clothing manufacturers** | **1** | **4506** | **4929** | **5466** | **5968** | **6672** | **7597** |
| **Clothing price index (Dec 2013=100)** | **2** | **102.3** | **106.7** | **110.0** | **111.1** | **116.6** | **125.4** |
| **Deflated = 100\*(1)/(2)** | **3** |  |  |  |  |  |  |
| **Rescaled to 2015 prices** | **4** |   |   |   |   |   |   |

The situation can arise in which one may have estimates of value for (say) the production of meat in every period, while the available price indices refer to beef, pork and chicken as well as an overall price index for meat. How should we proceed?

The simplest would just to use the overall price index for meat as the deflator.

If the shares of the overall value were known in the base period (but not every year), one could assume that these shares stay the same in every period. With this assumption one could split the values into more detailed components and deflate them separately.

Some people say you should prepare a Paasche price index to deflate the values. While this is theoretically true, to do so precisely you would need the current values of every sub-item in every period. It is mathematically identical to splitting the values into sub-series and deflating each one by its corresponding price relative. In other words, it would just mean having more detailed basic level items.

***Exercise (advanced):***

A Paasche price index (PI) is a current weighted harmonic mean of price relatives

$PI\_{t}=^{1}/\_{\sum\_{i}^{}\left\{w\_{i,t}\*\left(^{1}/\_{pr\_{i,t}}\right)\right\}}$ where $w\_{i,t }=^{v\_{i.t}}/\_{\sum\_{i}^{}v\_{i.t}}$ and $pr\_{i,t}=^{p\_{i,t}}/\_{p\_{0,t}}$

Prove that dividing the total value Vt $(=\sum\_{i}^{}v\_{i,t})$ of the items *i* by the Paasche deflator PIt is identical to $\sum\_{i}^{}^{v\_{i,t}}/\_{pr\_{i,t}}$ , the sum of the items individually deflated.

#### Aggregates and implied deflators

When you add the basic level series at constant prices together, you get aggregates at constant prices. These aggregated volume measures will differ depending on the choice of base period, not only in terms of the level but also in terms of the growth rates. If you divide the aggregate series by the base year number (and multiply by 100) the result is a series of Laspeyres volume indices.

Here is an example of the aggregation of two products. The price of Product A increased by 10% between 2015 and 2020, while the price of Product B increased by 30%. In this example the differences in the growth rates are relatively small, but in certain circumstances they can be much larger.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|   | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
| **At constant 2015 prices** |  |  |  |  |  |  |
| Product A | 1,633 | 1,858 | 1,885 | 2,030 | 2,320 | 2,495 |
| Product B | 2,427 | 2,440 | 2,733 | 2,876 | 3,050 | 3,146 |
| **Total** | **4,060** | **4,298** | **4,618** | **4,906** | **5,370** | **5,641** |
| *Growth rate* |  | *5.9%* | *7.4%* | *6.2%* | *9.5%* | *5.0%* |
| **At constant 2020 prices** |  |  |  |  |  |  |
| Product A | 1,796 | 2,044 | 2,074 | 2,233 | 2,552 | 2,745 |
| Product B | 3,155 | 3,172 | 3,553 | 3,739 | 3,965 | 4,090 |
| **Total** | **4,951** | **5,216** | **5,627** | **5,972** | **6,517** | **6,835** |
| *Growth rate* |  | *5.4%* | *7.9%* | *6.1%* | *9.1%* | *4.9%* |

***Exercise: For each product (not the total) verify that the constant price series has been simply rescaled.***

As we know from index number theory, dividing a (current price) value index by a Laspeyres volume index results in a Paasche-style price index. Dividing current price aggregates by constant price aggregates is also in the form of a (current-weighted) Paasche price index. These indices also depend on the choice of base year.

### 6.4.3 GDP by activity at constant prices

Value added is not itself a good or a service. It is the difference between the value of a good or service produced (output) and the values of various good and services used in the process (intermediate consumption).

GVA at constant (basic) prices is therefore defined for each activity as the total output (TO) at constant prices *minus* intermediate consumption (IC) at constant prices. GDP at constant (market) prices is total GVA at constant prices together with a valuation adjustment for taxes and subsidies on products at constant (bas year) rates. It is also equal to the total final uses of goods and services at constant prices *less* the cost of imports of goods and services at constant prices.

#### Total output at constant prices

The turnover (sales) of an enterprise is the most readily available variable and the starting point in commercial accounting. In principle, it is an objective, observable value. The great majority of non-agricultural enterprises are engaged in one kind of activity, whether it is mining, manufacturing certain types of goods, building work, trade, transport, food services, telecoms, financial services, or business or personal services. They are classifiable by ISIC. Usually their products are of one kind. Often we do not have further details. With the exception of commercial (wholesale and retail) trade, turnover (sales) is closely related total output (TO).

With one or two exceptions, it is not too difficult to identify a price index (or indices) that represents the price changes of the sort of products the enterprises produce. Where available, the values of turnover can be deflated by these indices. Elsewhere, especially for (near-) homogeneous products such as cement, beer, rice, electricity…) quantities of production may be available. In such cases, given base year values for total output (or sales), estimates at constant prices can be made for every period.

Commercial trade is an exception, in that output is defined as the value of the trade margin which is the difference between the value of sales and the current replacement cost of the sales. The volume of the trade margin and the volume of the goods sold by a trader are considered to be identical. It is just the (base year) value that is different. Total output of commercial trade at constant prices can be estimated from base year margins and volume indicators of traded goods. The latter can be derived from production and imports.

Measuring the volume of total output both accurately and quickly is the key to high quality estimates of GDP growth. Unfortunately, all kinds of issues make this the most challenging part of the national accountant’s job. [more on this elsewhere??]

#### Intermediate consumption (IC) at constant prices

The measurement of intermediate consumption, to match the figures of total output, is a totally different story. There are several reasons for this.

* The value of IC in any period is not as readily available as turnover
* Purchases are not necessarily made in the same period and at the same replacement price as they are consumed.
* IC is made up of many different products (inputs), in particular the raw materials, fuels, utilities, packaging, transport costs, ITC services, accountants’ fees etc.
* The shares in the costs of each type of input will not be exactly known. Sharp price movements (especially of petroleum products) can alter these shares significantly.
* Our objective is to measure GVA at constant prices. Unless IC is relatively small compared with TO, errors in the volume of both IC and TO are likely to dominate the estimates of GVA and so mislead users of the figures.

For these reasons, attempting to construct deflators for the IC of an activity, even if the current price figure is known, can lead to meaningless results. There have been cases where the volume of GVA for an activity has gone from positive to negative. What can this mean? It implies that the volume of inputs has outstripped the volume of production.

***Discussion: Can you imagine a situation in which the volume of inputs outstripped the volume of production? How likely would this be in reality?***

In fact, the strange results referred to above simply reflected the inadequacy of both the estimated values of IC and the constructed IC deflators.

In order to make sensible estimates of IC at constant prices, national accountants have to resort to a model. The most sophisticated model, commended in the SNA, is to compile the estimates within the comprehensive framework of a detailed balanced supply use table (SUT) at both current and constant prices. Only the most advanced countries with a rich supply of data are able to do this adequately.

However, there is a very simple solution that is perfectly acceptable. It is to assume (in the short term) that the ratio of IC to TO (the input-output ratio) remains constant in volume terms. Put another way, the volume of IC is assumed to follow the same path as the volume of TO. If the volume of output increases by 10%, then the assumption is that 10% more inputs are required. It means in turn that the volume of GVA has increased by 10%.

Examples

A KWH of oil-fired electricity requires a given quantity of petroleum, whatever the prices.

To make 10% more cloth you need 10% more thread.

To build twice as many buildings you need twice as much cement.

To cook half as many meals requires half as much food and half as much fuel.

This relationship between the growth of output and that of GVA in volume terms, even if not 100% accurate, has the advantage of simplicity and makes the estimation procedure transparent. It is known as the single indicator method.

However, we should be alert to special cases where the assumption of a fixed ratio may not be valid. One example is agriculture, where the volume of output may be affected by excellent weather conditions or on the other hand by drought, irrespective of the actual volume of pre-harvest inputs. A slightly more sophisticated model could be used. Another example is electricity. The cost structure of hydro-electricity is very different from that of oil-fired generation. A switch from one type to the other would invalidate our assumption if it was an overall ratio. Again, a rather more sophisticated model would be better.

#### GVA in total and GDP

GVA at constant prices for each activity is obtained by subtracting the estimates of IC at constant prices from those of TO at constant prices, or (in most cases) by simply extrapolating the base year GVA by the TO volume indicators.

GDP is calculated by adding taxes and subtracting subsidies on products. It is not possible to construct prices indices suitable for deflating the taxes and subsidies at current prices. The correct method is to identify the volume indices of the products on which the taxes or subsidies fall and use these to extrapolate their base year values. If a new tax or subsidy is imposed on a product at some time after the base year, then it will not feature in the estimates at constant base year prices.

### 6.4.4 Short term indicators (STIs)

Countries in which manufacturing is an important activity may produce industrial production indices (IPIs). The indices may also cover mining, electricity, water and (possibly) construction. Indices of retail sales are also common in countries in which sales are dominated by very large formal enterprises with many outlets. Some countries produce indices for services.

The indicators usually focus on volume changes, although values may also be of interest. At basic level the indicators may be deflated turnovers or the volumes of (near-) homogeneous products produced or sold. In theory the volume of sales differs for the volume of output by the changes in the stock of finished goods and of work-in-progress. However, this difference is of secondary importance and can be ignored. It is usually small, and merely a matter of a short timing lag between the production and sale.

Aggregated indices of production are usually produced by combining the basic level volume indices using base period GVA as weights. It is easy to demonstrate that this formulation is identical to the one just discussed in the context of GDP. The only differences may be the frequency, the timeliness and the coverage. It is a decision for each country whether there is a need for such indicators in addition to the estimates of GVA by activity which provide essentially the same information.

Short term indicators are usually compiled on a monthly basis. They are typically based on very simple regular surveys that ask key enterprises for the value of monthly turnover (sales) within days of the end of each month. They are normally published within 3-4 weeks of the end of the period.

An issue that is often overlooked is the inclusion of new enterprises. In a developing economy a large part of the growth in the economy is accounted for by new businesses opening up. Unless they are included, the indices are in danger of understating growth. Enterprise surveys in which the sample is kept fixed for any length of time quickly become useless.

Estimates of GDP are required to cover the whole economy, including the informal sector. The coverage of short-term indicators is necessarily limited. At most they will cover the formal sector (for example, those enterprises registered for VAT). The output of informal activities is so variable and difficult to measure that the costs of trying to do so on a regular basis with the necessary degree of precision are prohibitive. National accountants are therefore obliged to make assumptions about informal sector output, at least until it is possible to reassess their contribution to the economy in a special exercise.

### 6.4.5 Expenditure components at constant prices

In principle identical to GDP by activity in total, GDP at constant prices can also be measured from the expenditure point of view. We consider each component briefly in turn.

#### Household final consumption expenditure

Ideally estimates of the value of household final consumption expenditure (HFCE) at current prices will be available at a detailed level for every period. If so, basic heading indices from the CPI can be used as deflators. This is to be preferred over deflating total HFCE by the all items CPI, because the CPI is a Laspeyres base-weighted price index rather than a current-weighted deflator (which is what we get implicitly using the ideal method).

However, in many countries there is little data upon which to base the detailed current price estimates. In such cases, in practice, HFCE may be estimated as residual. This can be done at both current and constant prices. Alternatively, the residual at constant prices could be reflated by the CPI to provide a figure at current prices (or vice versa, not recommended).

#### Government final consumption expenditure

Estimating government final consumption expenditure (GFCE) in volume terms can be problematic. Often the solution is to deflate the current price estimates by the all items CPI, as all the information needed to do it properly will not be readily available when it is required.

#### Gross fixed capital formation

Most often gross fixed capital formation (GFCF) is measured using the commodity flow approach and this can be done at both current and constant prices. Measuring the volume of capital equipment (mostly imported) can be problematic because the equipment goods are all different shapes and sizes. The weight in kilograms or tonnes may not be a good indication of “volume”. This issue is covered in the section on imports below.

#### Changes in Inventories

Consistent estimates of the levels of inventories and of work-in-progress (WIP) at the beginning and end of every period are rare. Even when some values exist from annual commercial accounts, they require careful analysis to be usable. Different accounting conventions exist concerning their valuation. In principal, for national accounts purposes, inventories should be valued at current (replacement) cost. But historic cost or other conventions are often used. The deflation of these values into constant prices is the first step in measure the change in the physical level of stocks. But what deflators to use may not be at all obvious. This topic will not be discussed further here.

However, it should be possible to obtain data for the stock of bulk goods such as cereals or petroleum held in silos or storage tanks. The data required is the quantity of the product remaining in the store at the end of every period. The change in quantity in each period can then be easily obtained and valued at base year as well as (average) current prices.

#### Exports and imports in volume terms

Both exports and imports of goods and services are important to the economy, especially to a small economy. Like the production of an enterprise, the exports of a small country are typically focused on a few key products such as export crops, minerals, specific manufactures, tourism services… Imports, on the other hand, may cover a wide variety of goods and services, that are not available from local production.

Export prices of key commodities may be collected from exporters, or from Customs records (if they can be relied upon). In principle, to be consistent, the same price index should use to measure both the volume of the exporters sales (on the production side) and the volume of exports (on the expenditure side).

For tourism, or more widely the expenditure of non-residents in the domestic economy, the value of travel credits is normally available from the balance of payments (although this source may not always be reliable). So, volume estimates can be estimated by deflating the value by the all items CPI or preferably a specially constructed deflator, featuring the prices of hotel accommodation, food and bar services, local transport, etc. Volume estimates could alternatively be estimated using indicators of visitor-days, ideally classified by categories of visitors having different levels of expenditure per day.

It is not so easy to measure the prices of imports in a comprehensive way. Several countries do not have indices of import prices, although these are vital for measuring GDP in volume terms. Customs data is an obvious source. But although quite finely classified by the Customs Harmonised System (HS), unit values (the value per unit of quantity) tend to be excessively variable because of differences in quality. However, in a few countries, systems for processing Customs data have been developed that limit that variability and produce results that appear reasonable.

Research in the developed world has shown that the direct collection of a sample of prices of closely specified imported items gives much better results than unit values. This method has therefore been adopted by many countries and is considered best practice. But it requires considerable resources, both technical and financial, and may not work well in a small economy, if for example the sample is too small and goes out of date, etc.

Another method has been used, for example in the case of equipment goods that are varying all the time. Deflators are constructed by taking the inflation indicators (such as the CPI) from the countries of origin of the goods and adjusting them by movements in the exchange rates.

#### The implied GDP deflator

Some people may think that we construct a GDP deflator in order to calculate GDP at constant prices from the estimates of GDP at current prices. Of course, this is not the case. The deflator emerges as a result of all our calculations at both current and constant prices.

The (implied) GDP deflator is often seen by users as an alternative measure of inflation to the Consumer Price Index (CPI). What is the difference? There are two main differences

* The CPI measure the change in prices that affect households and their expenditures. The GDP deflator measures the inflation originating within the country. It includes changes in export prices but excludes changes in the price of imports.
* The CPI is closer conceptually to the HFCE deflator. (It could be the same.) But the construction of the indices is quite different. The all items CPI is a base-weighted Laspeyres index, while the GDP deflator (and, ideally, the HFCE deflator) and current-weighted Paasche indices

In some circumstances, the GDP deflator may go up while the CPI and the HFCE deflator may go down. If the price of imports falls markedly but traders take advantage of the situation to increase their margins and profits, the CPI may fall, but not by as much. The fall in import prices may be partly but not completely offset by an increase in the GDP deflator.

### **Exercises**

* Write down the formula for the overall implied total output (TO) deflator (TO at current prices divided by TO at constant prices) and using the summation sign Σ in three ways:
	+ using the letters *p* and *q* to represent prices and quantities with suffixes *i* for basic level items and *t* for time period (0 for base period)
	+ using the letters *v* (for value) and *q* only.
	+ using the letters *v* and *p* only.

What kind of average is the overall deflator in terms of the individual price relatives?

* Go through the main GDP components and compare what is written above with the methods actually used in your country to estimate them at both current and constant prices. Write short notes on the methods and identify where improvements could be made.