Deflators and how we use them in economic estimates

Explaining the different types of deflators and how we calculate them, as well as their importance for creating economic estimates, such as gross domestic product (GDP).

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Notice

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We have corrected an error in table 2, column headed 2014, the value in row “Applying the Deflator”. The previous version read (492/120)*100 = 410p and the value in the row below read £4.10. It now reads (468/120) *100 = 390p, and the value in the row below reads £3.90.

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1 . Definition of a deflator

Estimates of economic activity, such as gross domestic product (GDP), are typically available in "nominal" or "real" terms. “Nominal” estimates reflect the cash value of output or expenditure, such as those consumers might experience in shops. These change over time, reflecting movements in prices and quantities. Users are typically more interested in the "real” estimates.

A deflator seeks to break down any change in prices into a pure price change between two time periods for a like-for-like product (for example, an identical print cartridge), and that which reflects a quality change (for example, if the printer cartridge was redesigned to contain more ink). We can capture the latter as a volume change, showing that consumers are now getting more from the product than before. This gives the data in real price terms (often referred to as real prices or constant prices).

Growth rates calculated from current price data are referred to as nominal growth rates. Nominal growth rates show how economic data change over time. However, they do not remove the effect of inflation, and can appear to grow faster than people’s real experience of the economy.

If we wanted to analyse economic data between time periods, such as the volume growth of GDP, referred to as the real growth of GDP, we would need to remove the change in prices, which is commonly referred to as inflation. If prices are increasing, then the nominal growth rate will be more than the real growth rate. If prices are decreasing, then nominal growth will be less than the real growth rate. To remove the effect of inflation, we use deflators.

A deflator is often a price index, such as the Producer Price Index or the Consumer Prices Index. Read more about these in our Producer Price Index QMI report and Consumer Prices Index article. Price indices show how the price of a good or service changes over time.

More information on the different types of deflators used is found in Section 4: GDP and deflators.

2 . The importance of deflators

When measuring the change of the UK economy over time, we try to understand if the value of goods and services produced in the UK is changing. We are therefore interested in the volume growth, which can be considered the change in the quantity of goods and services produced, consumed, or purchased in the economy. To capture changes in economic activity, we use deflators to remove the effects of pure price changes.

Example 1: Calculating a deflator

This example details the process of calculating a deflator for a specific product, in this example: a lemon.

Table 1 provides a simple example of how to calculate a deflator. The following terms are used in the table:

- current price; the price of a lemon in the year it was purchased
- base price; fixing the price in a given year, so that there are no price changes over time
- deflator calculation; (current price / base price) * 100
- reference year; the year in which the deflator equals 100

Taking the current price in each year, dividing it by the base price, then multiplying the result by 100 calculates the value of the lemon deflator in each year. Using 1998 as the reference year means the deflator in this year is equal to 100.

Table 1: Example data showing how to calculate a deflator for lemons

	1998	**2006**	**2014**	**2022**
Current Price	30p	33p	36p	45p
Price of lemon in year				
Base Price	30p	30p	30p	30p
Price of lemon in ref. year 1998				
Lemon Deflator (Current Price / Base Price) * 100	(30 / 30) * 100= 100	(33 / 30) * 100= 110	(36 / 30) * 100 = 120	(45 / 30) * 100= 150

Source: Synthetic data

In Table 2, we will apply the deflator calculated to generate the real value of lemon sales over time.

Table 2: Example data showing how to calculate real values of lemon sales using the lemon deflator

	1998	**2006**	**2014**	**2022**
Current price (CP)	30p	33p	36p	45p
Base price	30p	30p	30p	30p
Lemon Deflator	100	110	120	150
Quantity of lemons	10	14	13	12
Current price value of total Lemon sales in year	10*30p = 300p	14*33p = 462p	13*36p = 468p	12*45p = 540p
Applying the Deflator	(300/100)*100 =	(462/110)*100 =	(468/120)*100 =	(540/150)*100 =
(CP / deflator) * 100	300p	420p	390p	360p
Real value of Lemon sales	£3.00	£4.20	£3.90	£3.60
(inflation removed)				

Source: Synthetic data

This example shows that if only the current price value of total lemon sales were compared, then it looks like 2022 was the year with the most lemon sales. By applying the deflator, and comparing the real value of lemon sales, it is clear that 2006 was the year with the most lemon sales.

This example shows how important it is to account for price change over time. Otherwise, it can lead to misleading conclusions about the data. Using deflators to account for price changes over time is an essential part of understanding how economic data changes over time. For example, deflators help us understand how real wages and household spending are changing over time.

Further information on how economic data is deflated is detailed in our Chain-linking methods article.

3 . Different types of deflators

A variety of deflators are used in the UK national accounts. Price indices are the most common source of data used to generate deflators, but not all deflators are price indices. It is worth noting that price indices are not always developed with deflation in mind, and may differ in conceptual scope.

The choice of deflator should depend on the data we are looking to deflate. The deflator and its source data should match with the type of nominal data we are looking to deflate. For example, if we are looking to deflate data on household consumption, we would use a relevant consumer prices index. If we wanted to deflate data for imports of goods, we would use an import price index.

In this section, we provide examples of the main types of business and consumer price indices produced by the Office for National Statistics (ONS), with links to associated articles defining the methodology used to compile the price indices.

Consumer prices

- Consumer Price Index including owner occupiers housing costs (CPIH).
- Consumer Price Indices (CPI).

Business prices

- Producer Price Indices (PPI).
- Export Price Indices (EPI).
- Import Price Indices (IPI).
- Services Producer Price Indices (SPPI).
- Construction Output Price Indices (OPI).

Our gross domestic product (GDP) sources catalogue dataset provides detail of deflators for different goods and services used in the output approach to measuring GDP.

Another common type of deflator is the implied deflator. It divides current price expenditure by its associated volume series. This presents the average ratio between expenditure and volume. An implied deflator can be used if a specific deflator for a certain product is not available, and it can give an indicator of the real price movements. The most used implied deflator is the GDP implied deflator. The implied GDP deflator represents the broadest measure of inflation in the domestic economy, reflecting changes in the price of all goods and services that comprise GDP.

4 . GDP and deflators

Deflators are used in the publication of national accounts and official statistics by the Office for National Statistics (ONS). The Eurostat prices and volumes handbook is an important document that contains guidance on how to calculate the statistics that feed into the national accounts. It accounts for the trade-off between conceptual suitability and practical application across the European economies, given their range of requirements. The UK is currently considering how best to use this guidance after the UK's exit from the EU.

One important economic measure of the UK economy is gross domestic product (GDP), as shown in our GDP Quality and Methodology Information report. GDP is a measure of economic output carried out by all firms, non-profit organisations, government, and households. There are three approaches, or methods, of calculating GDP, as set out in our Guide to UK National Accounts article:

- the expenditure approach
- the income approach
- the output approach

Theoretically, these three approaches should all sum to the same total. Each approach uses different deflators to give GDP in real values.

Taking a closer look at the expenditure approach to measuring GDP (GDP(E)), GDP(E) is calculated as the sum of all net expenditures by households, businesses, and governments on final production. These include exports and the change in inventories, as well as less imported goods and services.
$GDP\,(E) = Final\ Consumption\ Expenditure + Gross\ Capital\ Formation\ \ (investment)$
$+ Exports - Imports$

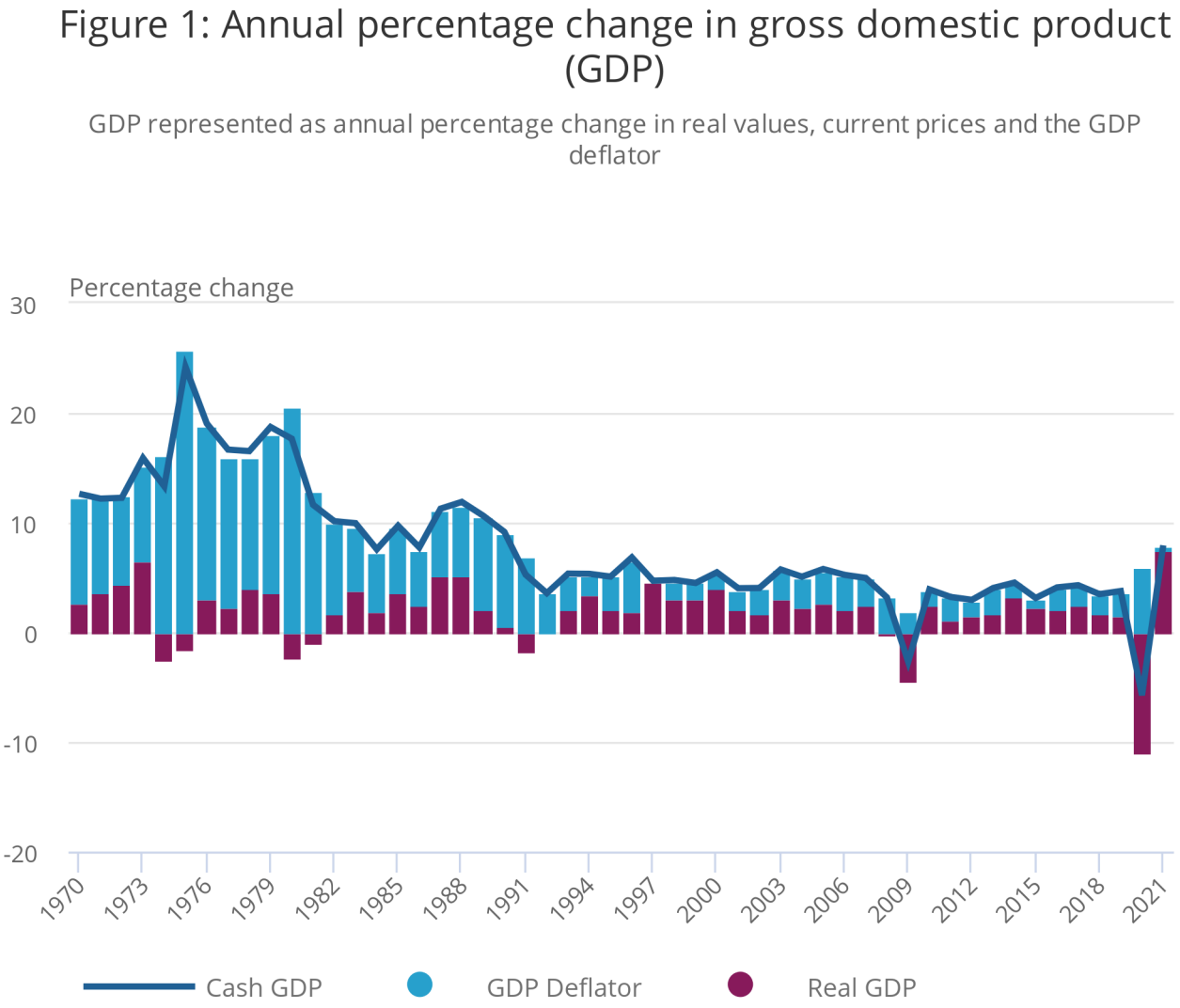
Consumer price indices, export price indices, import price indices and producer price indices are all used to deflate the different components in calculating this approach to measuring GDP.

Figure 1 shows the difference between real GDP and nominal (current prices) GDP over the past 50 years. The blue bars on the chart represent the GDP deflator, and show the difference between the nominal and real GDP values each year.

There was a large difference between nominal and real GDP in the 1970s because of high inflation at that time. In 2020, real GDP falls, but nominal GDP shows growth; this is because of an increase in prices. Figure 1 also shows that during periods of moderate inflation, real and nominal GDP are a lot closer to each other.

Figure 1: Annual percentage change in gross domestic product (GDP)

GDP represented as annual percentage change in real values, current prices and the GDP deflator



Source: ONS series YBHA, ABMI, YBGB

5 . Capturing quality change with deflators

Section 2: The importance of deflators showed how a basic product deflator can be calculated using lemons as an example. Lemons, as a product, have remained fairly similar through the years. However, when we look at all the products produced within the UK economy, we can see that many products have seen significant technological improvements in this time. Ideally, deflators reflect changes in the prices of goods and services, not changes in quality, which ensures that "like-for-like" comparisons are made.

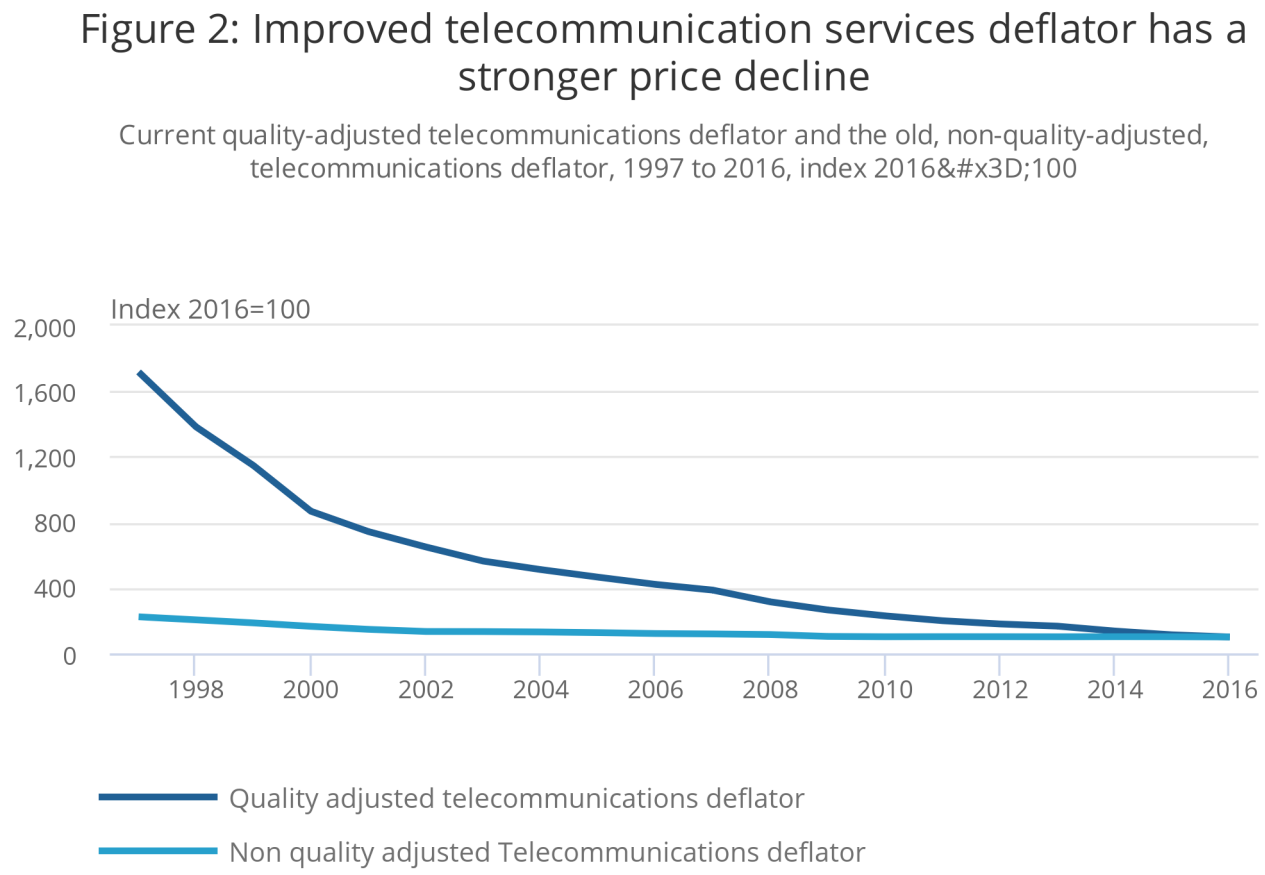
A clear example of why we need to account for quality change is to look at the difference between a mobile phone in 1998 and a mobile phone in 2022. The price of these phones has increased over time. Considering the greater functionality of modern phones when compared with a phone from 1998, there has been a significant increase in quality, and this needs to be accounted for. The aim of using quality adjustment is to remove the effects of quality change in the product over time. For products like lemons, quality change is not significant here, so is not considered when generating the deflator.

The telecommunications services deflator can be used to demonstrate how quality change is captured in national accounts deflators. The telecommunications industry has seen technological advancements, such as increased coverage and broadband speeds over the past two decades. Quality adjustment for these technological improvements results in a price decline in the telecommunications deflator.

Reflecting this, Figure 2 shows that the quality adjusted telecommunications deflator indicates a stronger price decline than the non-quality adjusted deflator. This results in faster volume growth of GDP over this period.

Figure 2: Improved telecommunication services deflator has a stronger price decline

Current quality-adjusted telecommunications deflator and the old, non-quality-adjusted, telecommunications deflator, 1997 to 2016, index 2016=100



Source: Improvements to the measurement of UK GDP including quality adjustment in telecommunications services deflator

Notes:

1. The source for Figure 2 is the Improvements to the measurement of UK GDP: an update on progress article.

6 . Related links

Double deflation and supply use framework in the UK National Accounts
Article | Released 2 December 2022
This article gives an overview of the supply use framework in the UK National Accounts including the process of double deflation. This includes the changes to the framework introduced as part of Blue Book 2021, including the volume reconciliation process and deflation. It also gives a brief history on the implementation for this process.

National Accounts, deflator strategy: November 2022
Article |29 November 2022
Strategy for improving the suite of deflators used across the UK National Accounts, and a roadmap of work to improve our measurement of key economic indicators.

7 . Cite this methodology

Office for National Statistics (ONS), released 2 December 2022, ONS website, methodological article, Deflators and how we use them in economic estimates