

Volume index of capital services (VICS) QMI

Quality and Methodology Information (QMI) report for volume index of capital services (VICS), detailing the strengths and limitations of the data, methods used, and data uses and users.

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1 . Methodology background

National Statistic	Experimental statistics
Frequency	Quarterly
How compiled	Sample based surveys
Geographic coverage	UK
Last revised	13 March 2020

2 . About this Quality and Methodology Information report

This Quality and Methodology Information (QMI) report contains information on the quality characteristics of the data (including the European Statistical System's five dimensions of quality) as well as the methods used to create it.

The information in this report will help you to:

- understand the strengths and limitations of the data
- learn about existing uses and users of the data
- understand the methods used to create the data
- decide suitable uses for the data
- reduce the risk of misusing data

3 . Important points

- The volume index of capital services (VICS) is the capital measure used to construct [multi-factor productivity](#) (MFP) estimates.
- The coverage of VICS only includes the UK market sector, which means that general government, households and non-profit institutions serving households are excluded.
- VICS estimates are presented in an index form; therefore, it is not possible to make assumptions about the underlying level measure itself.
- The process of constructing VICS estimates is complex, so users may wish to read the relevant section from our [Simple guide to multi-factor productivity](#) prior to reading this Quality and Methodology Information (QMI) report.

4 . Quality summary

The [volume index of capital services \(VICS\)](#) is a measure of flows of services that different types of assets provide to the production process. VICS is the measure of capital input used for calculating [multi-factor productivity \(MFP\)](#) estimates; therefore, this Quality and Methodology Information (QMI) report supports the MFP statistics. The methodology that the Office for National Statistics (ONS) uses to compile capital services estimates draws from the [Organisation for Economic Co-operation and Development \(OECD\) measuring capital manual](#).

The main data source for VICS estimates is [business investment](#), which is the largest component of [gross fixed capital formation \(GFCF\)](#). Business investment is mainly derived from the [Quarterly Acquisitions and Disposals of Capital Assets Survey \(QCAS\)](#), which is a sample-based survey that collects data on acquisitions and disposals of capital assets across the UK and has a sample size of 24,500 businesses. Deflators that are used to process the investment data are derived from various different sources such as Producer Price Indices (PPIs) and construction output prices.

VICS estimates are published as part of the quarterly MFP release, and they cover the UK market sector, 13 asset classes and 57 industries. We also publish market-sector estimates for productive capital stocks, GFCF and rate of return. The process of compiling VICS estimates uses statistical modelling in various stages, and these modelling techniques rely on different assumptions. Changing these assumptions would have an impact on the estimates. Owing to the complexity of compiling VICS estimates, it can be difficult to quantify revisions that are not linked to the input data.

Uses and users

Capital services estimates are used internally to compile MFP estimates. The external users of capital services estimates mainly consist of expert users. Capital services estimates are used by other government departments and agencies, including the Bank of England and academics, to assess the economic conditions in the UK.

Strengths and limitations

The strengths of the VICS data include:

- VICS is the recommended measure of capital input for the production process, as it measures the flows of capital services rather than a stock or “wealth” of capital
- VICS estimates are published for 57 industries and 13 asset classes, allowing users to do analysis at granular level
- VICS estimates are long-running time series, starting from 1950, and they are available as annual and quarterly estimates

The limitations of the VICS data include:

- VICS estimates are for the UK market sector only, so institutions such as general government and certain industries with non-market activity are excluded
- [business investment](#) is not an internationally defined concept, and the UK's estimates cannot be compared with those of other countries owing to definitional differences
- certain parts of the process of compiling VICS estimates use statistical modelling techniques, which means that in some cases it is not possible to link the data to a published source
- no industry by asset data are currently available

5 . Quality characteristics of volume index of capital services data

This section provides a range of information that describes the quality and characteristics of the data and identifies issues that should be noted when using the output.

Relevance

(Relevance measures the degree to which the statistical outputs meet users' needs.)

The volume index of capital services (VICS) data is mainly used for economic assessment by analysts working in academia and in different government departments, but it is also a good source of information for informing the general public.

VICS estimates provide detailed data on capital inputs from business investment that are used in the production process in the UK market sector. The publication timetable is in line with the [quarterly national accounts \(QNA\)](#), which gives users access to timely data. VICS estimates are published approximately five working days after the QNA release. The VICS dataset, published as part of the [multi-factor productivity \(MFP\) publication](#), contains data that allow users to conduct a wide range of analysis on capital services and how capital services contribute to output growth.

We review user feedback frequently and take any suggestions into account when reviewing development goals for VICS statistics, to make sure that the coverage of VICS statistics meets users' needs. We hold an annual user forum to discuss recent development work and to gather feedback. We also work with the [Economic Statistics Centre of Excellence \(ESCoE\)](#) and academics to improve our VICS estimates.

Accuracy and reliability

(Accuracy is the degree of closeness between an estimate and the true value. Reliability is the closeness of the initial element value to the subsequent estimated measure.)

VICS estimates are compiled using the latest data available in each quarter. VICS estimates are based on the latest published data on business investment from the national accounts, which are deflated using deflators that are derived from various sources such as Producer Price Indices (PPIs). The deflator source data vary across assets to ensure that the price movements are captured accurately. The investment dataset that is used to calculate VICS estimates contains quarterly market sector gross fixed capital formation (GFCF) data by industry and asset, and the deflators dataset has quarterly deflators by industry and asset. Both of these input datasets can be revised, and these revisions may cause revisions to VICS estimates.

There is no simple way to measure the “true” value of capital services. This implies that it is difficult to estimate the difference between the “true” value and an estimated value of capital services. This also means that certain parts of the processing use assumptions and statistical modelling techniques to construct the final published VICS estimates. Changing these assumptions and modelling methods would cause revisions to VICS estimates. The nature of the data processing to compile final VICS estimates makes it difficult to quantify errors that are not linked to the input data.

The Office for National Statistics (ONS) has various procedures in place to ensure that errors are minimised. The data are checked in various stages of the processing, and the outputs are normally peer reviewed before being published. If errors are found in the data after publication, a notice will be attached to the publication to inform users and datasets will be revised in line with the [Code of Practice for Statistics](#).

Output quality trade-offs

(Trade-offs are the extent to which different dimensions of quality are balanced against each other.)

The VICS uses other published data sources; therefore, the quality of VICS estimates depends on the quality of other published statistics. Changes to VICS estimates that can be traced back to changes in the input data are covered in the revisions section of the [quarterly MFP release](#). This section also links to the relevant articles published by the providers of the input data.

To maintain the reliability of VICS estimates, the ONS currently publishes VICS statistics for 57 component industries. Owing to the detailed breakdown, this requires that some industries are suppressed as the sample size is not large enough to produce reliable estimates. VICS estimates currently cover 13 asset classes, but there are other assets that could be included. The assets currently included in VICS are consistent with the [European System of Accounts 2010 \(ESA 2010\) definitions](#). The ONS is currently investigating new methods that would allow us to incorporate new asset types to our VICS estimates.

Coherence and comparability

(Coherence is the degree to which data derived from different sources or methods, but referring to the same topic, are similar. Comparability is the degree to which data can be compared over time and domain.)

The VICS is the only measure for capital services produced by the ONS. The closest estimates to VICS is [capital stocks](#). The main difference between these two estimates is that capital stock is a stock measure at a point in time and it measures the value or “wealth” of capital. Capital services in turn is an estimate of flows of services that different types of asset provide to the production process. Both of these estimates use largely the same data sources, but the processing is different in terms of the choice of age-price and retirement profiles and further modelling in the case of capital services. Capital stocks and capital services estimates are comparable to a certain extent as capital services are derived from net capital stocks, but they are weighted differently to create a suitable measure of capital input into production.

The VICS processing assigns user cost weights to the assets used in production to reflect how intensively these assets are used in the production process. When comparing the growth rates of capital stocks and VICS, the magnitude of growth rates differs as short-lived assets such as software have a proportionately higher weight in the VICS than in capital stocks estimates. Therefore, they make a proportionately larger contribution to growth in capital services than in capital stocks.

The VICS time series starts from 1950. Since the start of the series, there have been changes to industry classifications. Changes to the [Standard Industrial Classification \(SIC\)](#) framework reflect changes in the economy where new industries have been introduced, and some industries that used to be classified separately have been included within other industries. SIC 2007 is the latest version and is currently used to compile VICS estimates.

The asset coverage has also changed over time as more assets were included in the asset boundary. [ESA 2010](#) has introduced research and development into the asset boundary. Currently, there are 13 asset classes included in VICS estimates. The data are available for 11 out of the 13 asset classes from 1950 and for the remaining two, the data are available from the 1970s. This is because of the practicalities related to measuring these two assets, as computers and software were not measured in the national accounts before the 1970s.

Despite these changes to the classification frameworks used in VICS, we can compare VICS estimates over time, as the ONS has mapped changes between the old and new classifications to avoid any discontinuities. We continue to assess the validity of this mapping to ensure it meets users' needs.

Concepts and definitions

(Concepts and definitions describe the legislation governing the output and the classifications used in the output.)

All the statistics produced by the ONS are [official statistics](#). Official statistics can either be experimental statistics or National Statistics. VICS is an [experimental statistic](#), which means that the estimates are still being developed.

The industry classification used to compile VICS estimates is [SIC 2007](#), and the asset breakdown is consistent with the [System of National Accounts 2008 \(SNA 2008\)](#) and [European System of Accounts 2010 \(ESA 2010\)](#). Our methodology for measuring capital services draws from the methodology set out in the [Organisation for Economic Co-operation and Development \(OECD\) measuring capital manual](#).

Table 1 describes the assets that are currently included in VICS estimates. For further information on the asset classes, see [ESA 2010 Annex 7.1](#).

Table 1: Volume index of capital services asset breakdown

Asset hierarchy		Description
Fixed Assets	Other buildings and structures	Other buildings are buildings that are not dwellings. Examples would be industrial buildings, commercial buildings, educational buildings and health buildings.
	Other structures	Other structures exclude residential structures. Examples of other structures would be harbours, log-distance pipelines and power lines.
	Land improvement	The value of actions that lead to improvements in the quantity, quality or productivity of land. It also includes actions to prevent the deterioration.
Machinery and equipment	Transport equipment	Transport equipment contains any equipment used to move people and objects and it includes assets such as motor vehicles, ships, trains and aircrafts.
	ICT (excluding telecoms)	Computer hardware such as computers, laptops and computer screens.
	ICT (telecoms equipment)	Telecommunications equipment such as phones.
	Other machinery and equipment	Other machinery and equipment consists of assets such as engines, ovens and agricultural equipment that are not classified elsewhere.
Cultivated and biological resources		Cultivated assets include for example dairy cattle and livestock for breeding.
Intellectual property products	Research and development	R&D is the value of expenditure on creative work to increase the stock of knowledge. This knowledge can be used to produce new goods and services.
	Mineral exploration and evaluation	This is the value of expenditure on exploration for petroleum and natural gas and for non-petroleum deposits and the subsequent evaluation of the discoveries made.
	Computer software and databases (purchased)	Examples are computer programs, development of computer programs and databases that are purchased by the firm.
	Computer software and databases (own account)	Own account software and databases contain the same elements as purchased. The difference is that these assets are created for own use within the firm.
	Entertainment, literary and artistic originals	Examples are original films, recordings, manuscripts, tapes which drama performances, radio, television programmes and sporting events are recorded and embodied.

Source: Office for National Statistics – Volume index of capital services

Accessibility and clarity

(Accessibility is the ease with which users are able to access the data, also reflecting the format in which the data are available and the availability of supporting information. Clarity refers to the quality and sufficiency of the release details, illustrations and accompanying advice.)

VICS statistics are published as part of the [quarterly MFP release](#), and they are available on the ONS website. Where relevant, datasets have an index tab that explains the content and links to relevant ONS articles for more information. The quarterly MFP release also has a section covering the [latest trends using the VICS statistics](#).

Our recommended format for accessible content is a combination of HTML web pages for narrative, charts and graphs, with data being provided in usable formats such as CSV and Excel. Our website also offers users the option to download the narrative in PDF format. In some instances, other software may be used or may be available on request. Available formats for content published on our website but not produced by us, or referenced on our website but stored elsewhere, may vary. For further information, please refer to the contact details at the beginning of this report.

Timeliness and punctuality

(Timeliness refers to the lapse of time between publication and the period to which the data refer. Punctuality refers to the gap between planned and actual publication dates.)

VICS data are published quarterly alongside the [MFP release](#). This timetable is usually one week after the publication of the QNA and around 14 weeks after the reference quarter.

For more details on related releases, the [official statistics release calendar](#) is available and provides 12 months' advance notice of release dates. In the unlikely event of a change to the pre-announced release schedule, public attention will be drawn to the change and the reasons for the change will be explained fully at the same time, as set out in the [Code of Practice for Statistics](#).

6 . Methods used to produce the volume index of capital services data

How we collect, process and analyse the data

The volume index of capital services (VICS) data are derived from the gross fixed capital formation (GFCF) data that are published as part of the [business investment](#) release. The Office for National Statistics (ONS) methodology draws from the methods set out in the [Organisation for Economic Co-operation and Development \(OECD\) measuring capital manual](#).

We use the perpetual inventory model (PIM) to derive estimates for productive capital stocks of fixed assets and for consumption of fixed capital. The PIM relies on the assumption that stocks of assets can be calculated from cumulative investment flows that are corrected for efficiency loss and retirement. The output of the PIM depends on assumptions used to calculate the estimates.

One of these assumptions is the choice of age-price and age-efficiency profiles. Owing to the nature of the growth accounting framework, a geometric age-efficiency profile is used to calculate productive capital stock and consumption of fixed capital (depreciation) as it greatly simplifies the user cost calculation. Using a geometric age-efficiency profile also means that age-price and age-efficiency profiles are identical, enabling us to calculate rate of return endogenously. An in-depth explanation of age-price and age-efficiency profiles can be found in the [OECD measuring capital manual](#).

The user cost is the cost of using an asset in the production process. The user cost is also defined as the effective "rental price" of the asset. It is calculated for each type of asset-industry combination separately. The calculation of user cost includes compensation for holding gains or losses on the asset, compensation for the depreciation (wear and tear) of the asset, the rate of return, and tax adjustments to take into account taxes and subsidies on production. The tax adjustments are used to represent the post-tax value to the owner. To reduce the volatility caused by changes in prices, the holding gains component of user cost is smoothed over four quarters (backwards two quarters and forward one quarter). The following formula is a simplification of the user cost formula used for calculating VICS estimates.

User cost = Net capital stock × (Depreciation + Rate of return – Holding gains) × Tax adjustments

Depreciation rates are derived from the geometric age-efficiency profile using the declining balance rate method, which takes into account the average service life of an asset. For more detailed discussion on depreciation, see the [OECD measuring capital manual](#).

Rate of return or discount rate can either be calculated endogenously or exogenously. VICS calculations use the endogenous rate of return, which is calculated using the following formula where user cost could be seen as the capital income:

$$\text{Rate of return} = \left(\frac{\text{User cost} - \text{Depreciation} \times \text{Net stock} - \text{Holding gains}}{\text{Net stock}} \right)$$

The endogenous rate of return assumes that the user cost exhausts the gross operating surplus (GOS), capital share of mixed income and net taxes on production; therefore, there are no excess profits. VICS uses the single rate of return for the UK market sector.

The final stage of the processing is to create the VICS estimates. These are calculated by multiplying a quarter-on-quarter log change in the productive capital stock by a two-period average user cost weight by asset within industries.

VICS estimates and more information on log changes

VICS indices are compiled using the Törnqvist index formula. Log changes are used in VICS calculations because they have the property of being additive, which makes it possible to calculate contributions to growth. Calculating quarter-on-quarter natural log changes also means that the magnitude of change remains the same regardless of which way the quarters are compared. The only thing that changes is the sign. The ONS has published a simple [guide to multi-factor productivity \(MFP\)](#), which has an example for calculating VICS estimates.

How we quality assure and validate the data

The ONS has quality management systems in place to quality assure the data at different stages of the processing. The input data used to calculate VICS data are first quality assured by the internal data provider. Then, more checks are used throughout data processing to further quality assure our estimates before final publication.

How we disseminate the data

All VICS data and analysis produced by the ONS are published on the ONS website as part of the [quarterly MFP release](#).

Publication dates are planned in advance and pre-announced on the statistics release calendar on the ONS website around 12 months before the agreed release date.

7 . Other information

Assessment of users' needs and perceptions

Please email your feedback on volume index of capital services (VICS) outputs to productivity@ons.gov.uk. Any proposals or comments from those who use VICS outputs will be considered in the final proposals for future development work on VICS outputs.

International standards

A number of countries produce estimates for capital services. While these estimates measure the same concept, they might differ in terms of the methodology used. The [Organisation for Economic Co-operation and Development \(OECD\) measuring capital manual](#) sets out international guidelines for measuring capital services, but the way these guidelines are implemented may vary across different countries. This implies that international comparisons of capital services are limited because of these possible differences in methodology. The methods that the Office for National Statistics (ONS) uses to compile estimates for VICS are well established and internationally recognised.