

Article

National Accounts articles: Impact of Blue Book 2019 changes on gross fixed capital formation and business investment

Summary of the main changes to Blue Book 2019 estimates of gross fixed capital formation and business investment for the years 1997 to 2016.



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Release date:
20 August 2019

Next release:
To be announced

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1 . Executive summary

This article summarises the main changes and provisional impacts on data for estimates of gross fixed capital formation (GFCF) and business investment in current (or nominal) prices and chained-volume measures (CVM or real) for the years 1997 to 2016. These changes are in line with the Blue Book 2019 consistent with the [business investment publications](#) and [quarterly national accounts \(QNA\) publications](#), to be published on 30 September 2019.

The improvements being introduced in September 2019 include:

- current price improvements to data sources
 - reviewing and improving our data sources for the intellectual property products asset, including own-account software and databases; research and development and artistic originals
 - incorporation of Northern Ireland dwellings' data
 - reviewing and including mark-ups for mineral exploration and machine tools produced by engineering enterprises
- regular current price data source updates
 - incorporation of revised Annual Business Survey benchmarks for 2015 and 2016 and new data for 2017
- CVM methodological improvements
 - improved product allocation, introduced in the new GFCF estimation system in 2017, used for the first time this year as part of the supply and use balancing process
 - further improvements to the conversion of capital expenditure and Annual Business Survey data between Standard Industrial Classification (SIC) 2003 and SIC 2007
 - alignment with the foundations of a new framework used for headline GDP, including the use of new deflators

As a result of these changes, headline GFCF annual growth, on average, between 1998 and 2016 has been revised upwards by 0.3 percentage points in current prices. Volume estimates of annual growth on average have been unrevised over this period, although there have been revisions to specific years.

2 . Introduction

Gross fixed capital formation (GFCF) is defined as investment in acquisition less disposal of non-financial assets in the UK, such as dwellings (residential buildings); transport equipment (for example, motor vehicles (if used in the production process), trailers, ships, trains, aircraft); ICT equipment and other machinery and electrical equipment; other buildings and structures (for example, non-residential buildings, roads and bridges); transfer costs and costs associated with the transfer of ownership (for example, stamp duty and legal fees); and intellectual property products (for example, investment in software, research and development, artistic originals and mineral exploration).

GFCF estimates are presented in both asset and institutional sector breakdowns, of which business investment is one component. Business investment is net investment by private and public corporations. Business investment does not include investment by central or local government, investment in dwellings, or transfer costs. Business investment is not an internationally recognised concept, and it should not be used to make international comparisons. However, GFCF is an internationally recognised standard and is therefore internationally comparable.

Each year in the Blue Book-consistent publications of business investment, we incorporate methodological and data changes that will impact on the business investment and GFCF datasets. (Data are subject to changes as part of the annual supply and use tables and GDP-balancing processes.) Revisions are therefore taken on, where applicable, back to the beginning of each dataset in line with National Accounts' revisions policy.

In Blue Book 2019, we have made considerable progress in improving how we compile estimates of GDP, where we have used the foundations of a new framework to inform headline GDP estimates. This includes:

- incorporating a wider set of more appropriate product deflators for each transaction, confronting these at a detailed level for the first time
- full integration of the institutional sectors into the balancing process of the supply and use framework
- improvements to our estimates of current price GDP by using new data sources to give information on the diversification of the services economy and the costs incurred by businesses

Further information on the National Accounts is available in [Blue Book 2019 impacts on GDP current price and chained-volume measure estimates: 1997 to 2016](#), which was published on 20 August 2019.

There are also a number of methodological improvements that will be incorporated into this years' Blue Book.

Further information on these is available in:

- [UK trade data impact assessment from new developments: 1997 to 2016](#)
- [National Accounts articles: Changes to the capital stock estimation methods for Blue Book 2019](#)
- [National Accounts articles: Improvements to the processing of Non-Profit Institutions Serving Households \(NPISH\)](#)

3 . Article scope

This article will outline the data and methodological changes that have been introduced to the gross fixed capital formation (GFCF) and business investment datasets for Blue Book 2019 and will identify provisional impacts on data at a disaggregated level.

4 . Current price data and methodological changes to gross fixed capital formation and business investment

This section will detail the main changes impacting estimates of gross fixed capital formation (GFCF) and business investment as part of Blue Book 2019. Figure 1 shows a decomposition of the change in level of nominal gross fixed capital formation (GFCF) as a result of these changes. This shows that the new estimates of software and databases had an increasingly positive impact on overall GFCF, particularly from 2009 where genuine data has replaced forecasts. Improvements to estimates of research and development reduced total GFCF in most years. The average impact of this change is negative £2.5 billion per year.

New data from the Annual Business Survey for 2016 is the largest contributor to the “other” revisions to GFCF, affecting other buildings and structures, transport equipment, ICT equipment and other machinery and equipment.

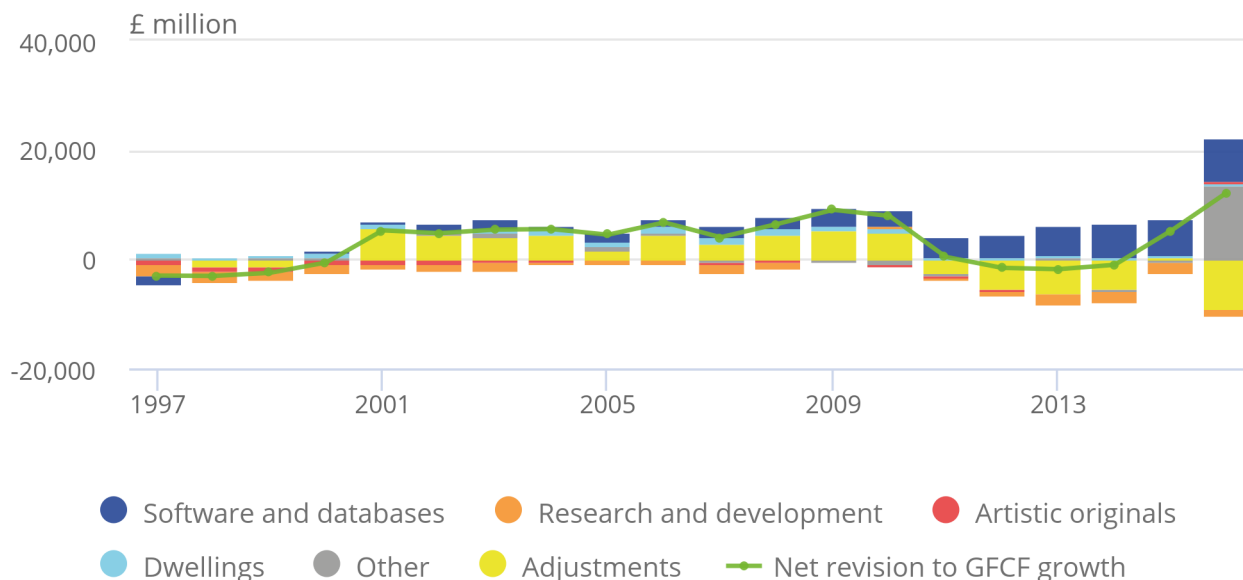
Although the changes to dwellings data had little impact on the growth rate of GFCF, Figure 1 shows that including estimates for Northern Ireland and correcting data for household expenditure on repair and maintenance of dwellings increased GFCF by an average of around £750 million per year.

Figure 1: Improvements to estimates of software and databases had an increasingly positive impact on GFCF since 2009

Decomposition of the change to the level of nominal gross fixed capital formation (GFCF), UK, 1997 to 2016

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Decomposition of the change to the level of nominal gross fixed capital formation (GFCF), UK, 1997 to 2016



Source: Office for National Statistics

Notes:

1. "Other" is treated as a residual, which captures the net effects of improvements affecting all other assets not shown.
2. "Adjustments" captures changes due to supply and use balancing, as well as quality and other adjustments.

Intellectual property products

Own-account software and databases improvements

Official estimates of investment in own-account software, included as part of gross fixed capital formation (GFCF) and business investment in the national accounts, have been updated in Blue Book 2019. This follows a range of new research that ensures the estimates better reflect activity in the economy today. Own-account software and databases investments capture investing in-house development of software and databases, for use by the organisation that produces them. This is an increasingly important type of investment, as "off-the-shelf" software products become less popular. Development of software in-house by specialists can allow the product to be more suited to users' particular needs.

Up to Blue Book 2018, own-account software investment in the national accounts used forecasted input data for the years since 2009. This followed changes to industrial and occupational classifications in 2007 and 2010 respectively. Replacing these forecasts with new data, as well as several other changes to model parameters and systems improvements, means that own-account software investment is now estimated to have been £24.9billion in 2016, around £11billion higher than in Blue Book 2018.

Our own-account software investment estimates follow international best practice as set out in the [Organisation for Economic Co-operation and Development \(OECD\) Handbook on Deriving Capital Measures of Intellectual Property Products](#). As software developed for own-final use is not traded on the market, a purchaser's price cannot be observed, and the recommended method is therefore to estimate by costs of production. We use a multiplicative model, where investment is assumed to be proportional to labour costs of the relevant workers. Adjustments are made for the proportion of time different kinds of workers spend developing software for own-final use, non-wage labour costs and non-labour costs (such as intermediate inputs, overheads and consumption of fixed capital), and there is a mark-up for operating surplus. This is set out in detail for the UK in a [2007 methods article \(PDF, 350.9KB\)](#).

To update estimates and ensure assumptions and parameters in the model were appropriate for the modern economy, we conducted detailed research in 2018. This section outlines this research and provides indicative impacts of each change to the total level of own-account software investment in the whole economy.

The main data source for labour costs of relevant workers remains the [Annual Survey of Hours and Earnings \(ASHE\)](#), with [Standard Occupational Classification \(SOC\) 2010](#) codes used to identify relevant workers. We converted the occupations and time-factors used in estimates up to 2009, on a SOC 2000 basis, to SOC 2010 using a proportional matching approach. While providing a helpful indication, this approach suffers two main drawbacks. First, errors in the microdata and small sample sizes mean the conversions are imperfect, and some unlikely occupations emerged. Second, this assumes there have been no changes in production approaches for own-account software since the previous occupations and time factors were agreed (in 2005). This seems unlikely, owing to the rapid diffusion of technology in the economy since 2005 and potential changes brought about by the economic downturn in 2008.

To identify relevant SOC 2010 codes, we conducted detailed microdata research using the job titles returned on the ASHE survey forms. The purpose of this was two-fold: first, to quality assure evidence from the conversion of previous occupations; second, to identify relevant workers with job titles that are not easily identifiable in SOC 2010, such as "data scientists". This was important to more fully capture own-account investments in databases, a component part of the "software and databases" asset.

We also conducted interviews with senior IT managers in multinational enterprises to find out about current business practices. This helped to ensure we were capturing the right workers and to inform the appropriate time factors for each type of worker. Own-account software investments are predominantly made by businesses outside of the software industry, since companies that specialise in the production of software typically make it for sale on the market, rather than using it in-house. As such, our interviews were with non-software companies, whose software-creating workers may have different characteristics and time-use than workers in the software industry. These interviews provided rich qualitative data, as well as company estimates of the time factors, which were combined with other research.

Other supporting research also came from international guidance, evidence from other countries, data from the e-commerce survey of business ICT use and academic studies.

As a result of this research, we have updated the input data and model parameters. The changes are as follows:

- use SOC 2010 occupation codes broadly consistent with the previous method (SOC 2000) for own-account software investment
- incorporate two new occupation codes to more fully capture own-account database investment
- use time factors broadly consistent with the previous method, accounting for the improved detail of related occupation codes in SOC 2010
- smooth changes in time factors between new and old estimates to remove discontinuities in the time series
- replace forecasted input data with data from the ASHE from 2009 onwards
- review and improve the implementation of the uplift factor for non-labour costs, and make it time-variant
- improve the use of the ASHE microdata for the estimation of the number of workers in each industry and their average wages
- other minor processing improvements to improve the allocation to institutional sectors based on the ASHE data and ensure consistency with the rest of the national accounts

The combined effect of these changes is to increase own-account software investment in current price terms in every year since 1997. The increases grow in size over time, particularly after 2009 when previous estimates used forecasted input data after this point. Precise estimates of the impacts are difficult to make owing to other changes to GFCF in Blue Book 2019 (described elsewhere in this article), which have knock-on effects. Figure 2 shows indicative estimates of the effects of the various methods and data changes for own-account software.

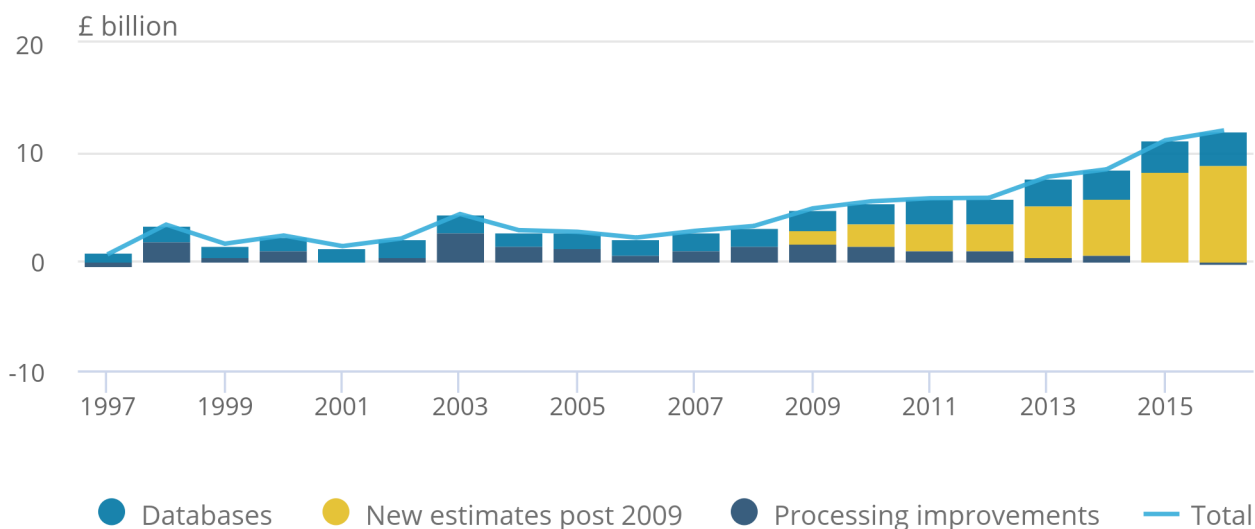
Upward revisions average over £2 billion per year between 1997 and 2008, and over £7 billion per year between 2009 and 2016. Average annual growth between 1997 and 2016 increases from 2.7% in Blue Book 2018 to around 6% in Blue Book 2019.

Figure 2: Revisions to own-account software investment estimates over £10 billion in 2015 and 2016

Total revision to own-account software GFCF and impact of methods changes, UK, current prices 1997 to 2016

Figure 2: Revisions to own-account software investment estimates over £10 billion in 2015 and 2016

Total revision to own-account software GFCF and impact of methods changes, UK, current prices 1997 to 2016



Source: Office for National Statistics

New estimates after 2009 have a considerable effect throughout this half of the time series, with the effect rising over time. Processing improvements, including improved use of microdata for the inputs, changes to the implementation of the uplift factor for non-labour costs and annual benchmarking, have a generally small upward effect, that varies year on year. The addition of occupations relating to databases increases investment by about £1 billion in 1997, rising to about £3 billion in 2016, reflecting the increased use of databases in the modern economy.

Own-account software GFCF accounts for around 10% of business investment, around 7% of GFCF and around 1% of GDP. Revisions to own-account software investment in Blue Book 2019 will contribute to higher growth in all of these. Business investment is estimated to grow around 0.1% faster per year on average between 1997 and 2008, and 0.4% faster between 2009 and 2016. The respective figures for GFCF are 0.1% between 1997 and 2008, and 0.2% between 2009 and 2016. For GDP, the impact is negligible, with no impacts on GDP growth rates to one decimal place.

Research and development improvements

The changes being introduced for Blue Book 2019 include both processing and data changes.

The estimation system used to calculate estimates of research and development has been improved. We have also taken on more up-to-date survey returns from the Office for National Statistics's (ONS's) Business Enterprise Research and Development Survey (BERD), which have affected 2013 onwards. We have also updated our forecasts for those years for which BERD data are not available, though we plan to develop our forecast methodology further in future Blue Books. We have also updated our back-cast methodology to estimate research and development of software.

There is an additional impact on the volume estimates as our method for calculating output deflators for research and development has changed to better align with the [Frascati Manual's](#) (the internationally recognised methodology for collecting and using research and development statistics) recommendation that the changing weight of components of research and development should be better reflected by using indices. On average, the impact of these changes on our research and development estimates has been to increase GFCF growth annually by 0.02 percentage points between 1998 and 2016.

New estimates of entertainment, literary and artistic originals

Blue Book 2019 also sees updates to estimates of investment in entertainment, literary and artistic originals (henceforth "artistic originals"). Similar to own-account software, this is the first update to these estimates for several years and takes account of new source data. Blue Book 2019 also introduces a mark-up for operating surplus on those components estimated using production costs (TV and film), improving consistency with international guidance.

Revisions as a result of this update are minor, with small offsetting revisions to the various components of the asset having minor impacts on the asset total. New estimates in Blue Book 2019 are on average £0.1 billion per year lower than in Blue Book 2018 between 1997 and 2016, with effects ranging from £0.5 billion lower in 2010 to £0.3 billion higher in 2005. In contrast to previous estimates, which were forecast from 2009 onwards, new estimates show rapid growth in investment since 2015. These changes have no impact on the average annual growth rates of business investment, gross fixed capital formation (GFCF) or GDP to one decimal place between 1997 and 2016.

Official estimates of investment in artistic originals, included as part of GFCF and business investment in the national accounts, follow international best practice as set out in the [Organisation for Economic Co-operation and Development \(OECD\) Handbook on Deriving Capital Measures of Intellectual Property Products](#). Investments in TV and radio programmes, films, and other artistic originals are measured by costs of production, while investments in music and literary originals are measured from the income side.

[Previous estimates of artistic originals GFCF](#) for the UK were for 2009. Estimates in the national accounts have been forecast since 2010. New estimates in Blue Book 2019 use broadly the same methods as in the previous estimates but use new and updated data sources to update estimates. More details on the methods are in [Film, television & radio, books, music and art: estimating UK investment in artistic originals](#).

To update these estimates, we have undertaken a detailed research programme, collecting new and existing data from relevant industry bodies and royalty collection companies. We are grateful to all organisations that have participated in this programme, in particular, the Publishers Association. The data sources are briefly described here:

- TV programmes – estimated by production costs; data from Ofcom on spending by category of TV programme for the Public Service Broadcasters (BBC, ITV, Channel 4 and Channel 5), with S4C added separately using company accounts data; only programme categories considered long-lived are included
- radio – estimated by production costs; data from the BBC on spending by category of radio programme; only programme categories considered long-lived are included
- film – estimated by production costs; updated using an indicator of film production values from the British Film Institute, extending the previous series constructed using film-level data by [Goodridge \(2014\)](#)
- music – estimated from the income side; data from royalty collecting societies and industry bodies on income accruing to artists, performances, songwriters and record labels from music originals
- books – estimated from the income side; data from royalty collecting societies and a survey of publishers (supported by the Publishers Association) on income to authors and publishers from literary originals
- miscellaneous artwork – estimated by production costs; following a similar method to own-account software, wages of selected occupations are included and adjusted for time on other activities and non-labour costs

To improve consistency with international guidance, Blue Book 2019 introduces a mark-up for operating surplus for TV and film, which are both estimated by production costs. The mark-up rate was estimated using data from the financial accounts of the BBC, ITV, Channel 4 and Channel 5. Individual mark-ups were estimates for each of the public service broadcasters and weighted together according to their shares in total expenditure on long-lived TV programmes. Mark-up for Channel 4 is very low, since they are non-profit; the BBC does record some profit through its commercial Worldwide arm. The resultant mark-up rate for TV, across all broadcasters, averages 8.7% annually between 1997 and 2017, and it has been increasing in recent years to 14.3% in 2017. A mark-up of 15% is applied for film following similar rates on other assets, owing to a lack of data for film production studios.

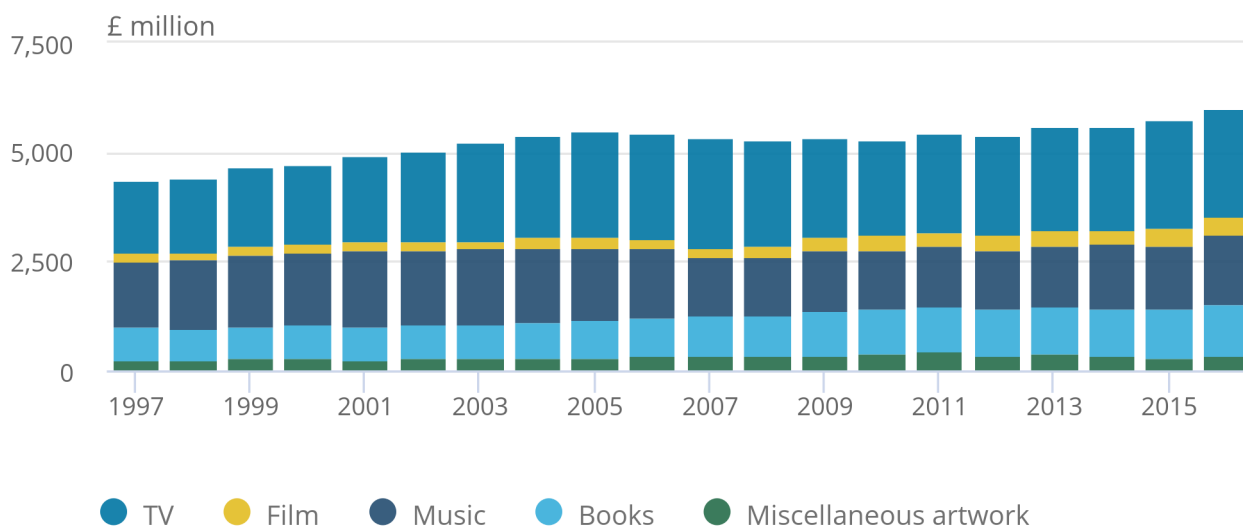
Figure 3 shows the breakdown of investment in artistic originals between 1997 and 2017, consistent with Blue Book 2019. TV is by far the largest category, accounting for around 40% of the total. Music and books make up most of the remaining investment, with film and miscellaneous artwork much smaller components.

Figure 3: Investment in artistic originals is dominated by TV and music

Entertainment, literary and artistic originals GFCF, UK, current prices, 1997 to 2017

Figure 3: Investment in artistic originals is dominated by TV and music

Entertainment, literary and artistic originals GFCF, UK, current prices, 1997 to 2017



Source: Office for National Statistics

Revisions in Blue Book 2019 are minor: small downward revisions to books, and mixed revisions to other components, are offset by the incorporation of a mark-up for TV and film. Impacts on headline measures of business investment, GFCF and GDP are negligible.

Other current price data changes to GFCF and business investment

Incorporation of Northern Ireland dwellings data

To date, estimates of private sector dwellings data have been based upon those sourced from the Office for National Statistics's (ONS's) own volume of construction estimates for Great Britain.

To achieve UK coverage, we are now incorporating Northern Ireland dwellings data for private new housing and private repair and maintenance from the Northern Ireland Statistics and Research Agency (NISRA), who publish quarterly construction data on a current price not seasonally adjusted basis from 2000 onwards.

We have back-cast estimates for the years 1997 to 1999 to fully align with availability of gross fixed capital formation (GFCF) data, using data from the Ministry of Housing, Communities and Local Government (MHCLG) for permanent dwellings started and completed, by tenure in Northern Ireland for 1978 onwards.

This change has had minimal impact on GFCF growth in current prices.

Mark-ups for mineral exploration and machine tools produced by engineering enterprises

A mark-up is broadly defined as the difference between the cost of a good and its selling price. As including mark-ups for mineral exploration and machine tools is a requirement of the [European System of Accounts 2010](#), to which our estimates adhere, we are incorporating mark-ups for these assets for the first time in our Blue Book 2019 estimates.

For mineral exploration, we have derived a mark-up by using data from the Office for National Statistics's (ONS's) Annual Business Survey estimates [Standard Industrial Classification \(SIC\) 71, Sub-class 71.12/2: Engineering-related scientific and technical consulting activities](#) and the Mineral Exploration Asset sourced from the [Quarterly Acquisitions and Disposals of Capital Assets Survey \(QCAS\)](#) data for mineral exploration and evaluation. For the years for which Annual Business Survey data is not yet available, mark-ups from the last available Annual Business Survey data point will be carried forward until those data become available.

Pre-2008, the mark-up is estimated to have been 26%, and it varied up until 2015 at which point it became 17%. This has been carried forward.

For machine tools produced by engineering enterprises, we first estimated the split of machine tools produced for own use and not for own use based upon data available from the Annual Business Survey and calculated for each industry for the years 2014 onwards, the date from which detailed data are available. A different method was used for the years prior to 2014 because of the differing survey questions asked previously. For each industry, the percentage of machinery for own use was calculated, with the exception of SIC 29: Manufacture of motor vehicles, trailers and semi-trailers where the average for the years 2008 to 2013 was used for 2014 to 2016, owing to the high percentages seen for those years, which could be due to the capitalising of research and development.

A sensitivity analysis concluded a mark-up of 20% was appropriate as it is the closest percentage to the average mark-up applied for the mineral exploration asset, and because a unique industry that only creates machine tools produced by engineering enterprises could not be identified.

These changes have had minimal impact on gross fixed capital formation (GFCF) growth.

Updated and new Annual Business Survey data (2015 to 2017)

In compiling estimates of gross fixed capital formation (GFCF), the Annual Business Survey is used each year to create annual benchmark figures for investment by many industries. Benchmarks previously used for 2015 and 2016 have been revised, which has raised the level of GFCF in these years. The Blue Book 2019-consistent GFCF dataset will also include 2017 benchmarks for the first time.

Further improvements to the conversion of capital expenditure and Annual Business Survey data

In February 2017, we introduced a new gross fixed capital formation (GFCF) estimation system, which contained methodological and processing improvements developed in line with the five-year strategy for the [UK National Accounts, 2015 to 2020](#) published in July 2015 and recommendations from the Bean Review. Further information on the methods changes introduced in the new GFCF estimation system at that time can be found in the article, [Changes to the Gross Fixed Capital Formation methodology and processing](#).

One of the changes introduced at that point was an improvement to the conversion of capital expenditure and Annual Business Survey data. Converting data collected by our business surveys prior to 2008 was necessary because in Blue Book 2011, we began to present the [UK National Accounts on Standard Industrial Classification \(SIC\) 2007](#) instead of the previous SIC 2003 basis. To present our accounts on a consistent basis, we needed to apportion data on the old basis to the new basis.

This method did not provide full coverage, however. Though we were able to make partial improvements to this conversion process in February 2017, in Blue Book 2019 we have taken this a step further. Fully reconciled estimates for industries using information from historical supply and use tables where more source product detail was available have been used to derive quarterly information. The estimates are then aggregated from a classification of products by activity (CPA) to asset. This has resulted in an improved asset breakdown for GFCF.

Improved gross fixed capital formation product allocation used in the supply and use balancing process

In Blue Book 2019, the improved product allocation introduced as part of the gross fixed capital formation (GFCF) estimation system improvements implemented in February 2017 has been used in the supply and use balancing process for the first time. When we introduced those changes to the GFCF estimation system in 2017, we said we would use the improved product allocation when we could in the balancing of GFCF in the supply and use tables in volume terms. This would align us with the Office for National Statistics's (ONS's) goals to balance the national accounts in volume terms through supply and use tables. As this concept is being introduced for the national accounts in Blue Book 2019, we are now able to incorporate those changes. Having greater amounts of detail at product level means that balancing decisions should be made less complex as the uses of products can be narrowed down.

This approach has many advantages. It permits thorough reconciliation of GFCF with other transactions in the economy and provides consistency between price types and the classification of products by activity (CPA) classification. From a processing point of view, statistical functions such as unchaining, chaining and benchmarking are applied at an appropriate level. It also ensures that price indices implicit in the industry by asset and by sector data are specific to the types of capital good used by the institutional units engaged in that activity. This direct relationship between product-level balancing and price indices has facilitated the balancing of GFCF estimates in the previous year's prices (PYP) and current year's prices (CYP) terms and so balancing GFCF in the supply and use tables in volume terms.

Alignment with the new framework used for producing the national accounts

In Blue Book 2019, the national accounts will be based on the foundations of the new framework used to inform headline GDP estimates as described in [Blue Book 2019 indicative impacts on GDP current price and chained-volume measure estimates: 1997 to 2016](#).

One of the main features of the new framework is that it allows consistent deflation across different types of transactions in the UK national accounts where they are related to the same product, following the principle that the buyer and seller pay the same price in a transaction at basic prices. The implication of this is that the core elements of both the supply and use tables need to be on the same price basis. As the supply and use tables are measured in basic prices and purchasers' prices respectively, adjustments need to be applied – and on the same price basis, these can be deflated to the previous year's prices (PYPs) using a common set of deflators for each product. Further information on the new framework can be found in the [National Accounts articles: Transformation of GDP in Blue Book 2019](#), which was published on 11 October 2018.

This means that gross fixed capital formation (GFCF) has benefitted from the research done to identify the best deflator at product level for each transaction in the UK. The information used to assess the deflator choices was based on a range of quality considerations, such that those judged most appropriate would be used in this new framework.

5 . Impacts of Blue Book 2019 changes on gross fixed capital formation and business investment

Impact on current price estimates of gross fixed capital formation and business investment

This section analyses the impact of the changes introduced in Blue Book 2019 on current price estimates of gross fixed capital formation (GFCF) and business investment. As a result of the changes discussed in this article, the largest revision to nominal GFCF was positive £12.3 billion in 2016. This was largely due to updated data from the Annual Business Survey, as well as new estimates of own-account software. In growth terms, the average revision over this period was positive 0.3 percentage points.

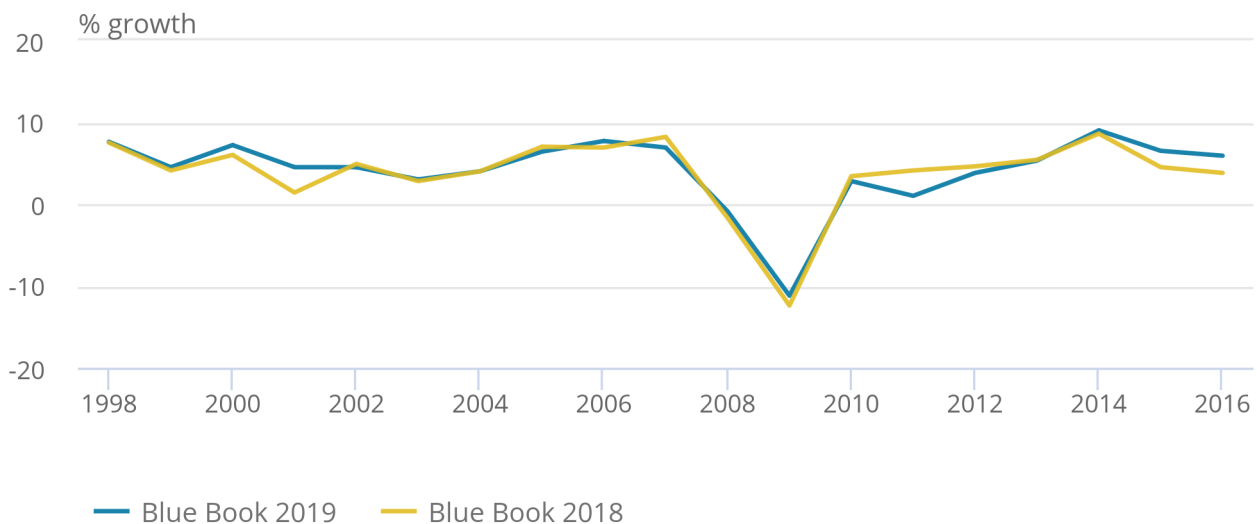
Figure 4 shows the previously published level and growth rate of GFCF as of Blue Book 2018 and the new estimates consistent with Blue Book 2019. Between 1998 and 2016, revisions to GFCF contributed an average of 0.1 percentage points per year to revisions to total GDP, ranging from negative 0.5 percentage points in 2011 to positive 0.5 percentage points in 2001. The largest contributor to revisions in both of these years are revisions to supply and use balancing.

Figure 4: Between 1998 and 2016, revisions to GFCF growth range between negative 3.1 and positive 3.0 percentage points

Annual GFCF growth, current prices, UK 1998 to 2016

Figure 4: Between 1998 and 2016, revisions to GFCF growth range between negative 3.1 and positive 3.0 percentage points

Annual GFCF growth, current prices, UK 1998 to 2016



Source: Office for National Statistics

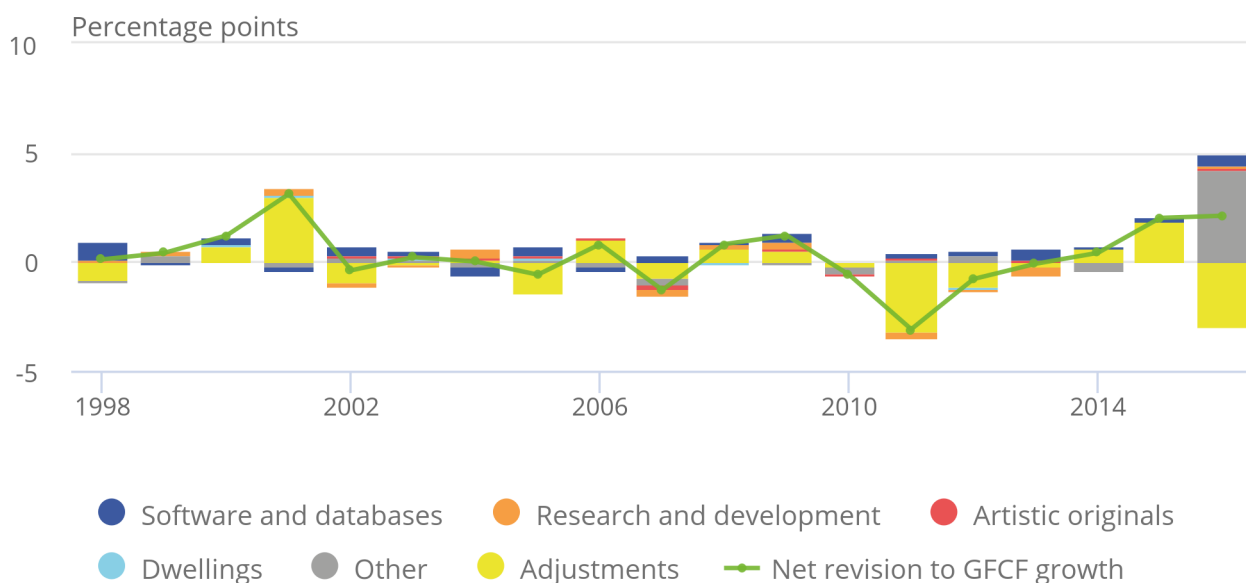
Figure 5 shows the contributions to revisions to GFCF growth by asset. The assets singled out in Figure 5 have been chosen because they map closely to the larger changes detailed in [Section 4](#). Impacts of changes such as Annual Business Survey benchmarking, updated Annual Business Survey data and the new product allocation are difficult to visualise at this level because they affect multiple assets. As a result, the effects of these changes, along with revisions owing to the inclusion of a mark-up for mineral exploration and machine tools produced by engineering enterprises, can be taken to be the “other” category.

Figure 5: Improvements to estimates of software and databases made the largest average contribution to revisions to GFCF growth

Contributions to revisions to annual GFCF growth, by asset, current prices, UK, 1998 to 2016

Figure 5: Improvements to estimates of software and databases made the largest average contribution to revisions to GFCF growth

Contributions to revisions to annual GFCF growth, by asset, current prices, UK, 1998 to 2016



Source: Office for National Statistics

Notes:

1. "Other" is treated as a residual, which captures the net effects of improvements affecting all other assets not shown.
2. "Adjustments" captures changes due to supply and use balancing, as well as quality and other adjustments.

The positive 2.1 percentage points revision to GFCF growth in 2016 is largely due to updated data from the Annual Business Survey. This is the first time that GFCF data for 2016 has been benchmarked to the Annual Business Survey, and this affected other buildings, ICT equipment and other machinery and equipment, and transport equipment within the “other” series.

The contribution of supply and use balancing, and quality and other adjustments, has been isolated so that the impacts of changes to methodology and data sources can be observed more clearly. This reveals that some of the largest revisions can be partially attributed to revisions to supply and use balancing. This is particularly notable in 2001 and 2011, where the net contribution of data and methodology changes is 0.0 percentage points, while the overall revision to GFCF growth in these years was positive 3.0 and negative 3.1 percentage points respectively. More information about the improvements to the supply and use balancing process can be found in the article, [Blue Book 2019 impacts on GDP current price and chained-volume measure estimates: 1997 to 2016](#).

Software and databases made the largest average contribution to revisions to GFCF growth, adding 0.2 percentage points per year between 1998 and 2016. This largely reflects the improvements that have been made to estimates of own account software.

Revisions due to the new system for estimating research and development had an average impact of positive 0.02 percentage points on GFCF growth between 1999 and 2016. The largest positive contribution from this change to GFCF revisions to growth was positive 0.4 percentage points in 2009, when research and development and software and databases were the main contributors to a 1.2 percentage points upwards revision.

The impact of revisions to artistic originals from 1998 to 2016 ranges between positive 0.1 and negative 0.2 percentage points, adding an average of 0.02 percentage points to GFCF growth per year. Over the same period, the inclusion of dwellings data for Northern Ireland contributed between positive 0.1 and negative 0.1 percentage points to GFCF growth and averaged 0.0 percentage points per year.

As a result of Blue Book 2019 changes, business investment growth has been revised up by an average of 0.5 percentage points per year between 1998 and 2016. The largest upward revisions to average business investment growth are in the most recent years, where improved estimates of software and databases and updated Annual Business Survey data are among the improvements that have contributed to the increase in average business investment growth.

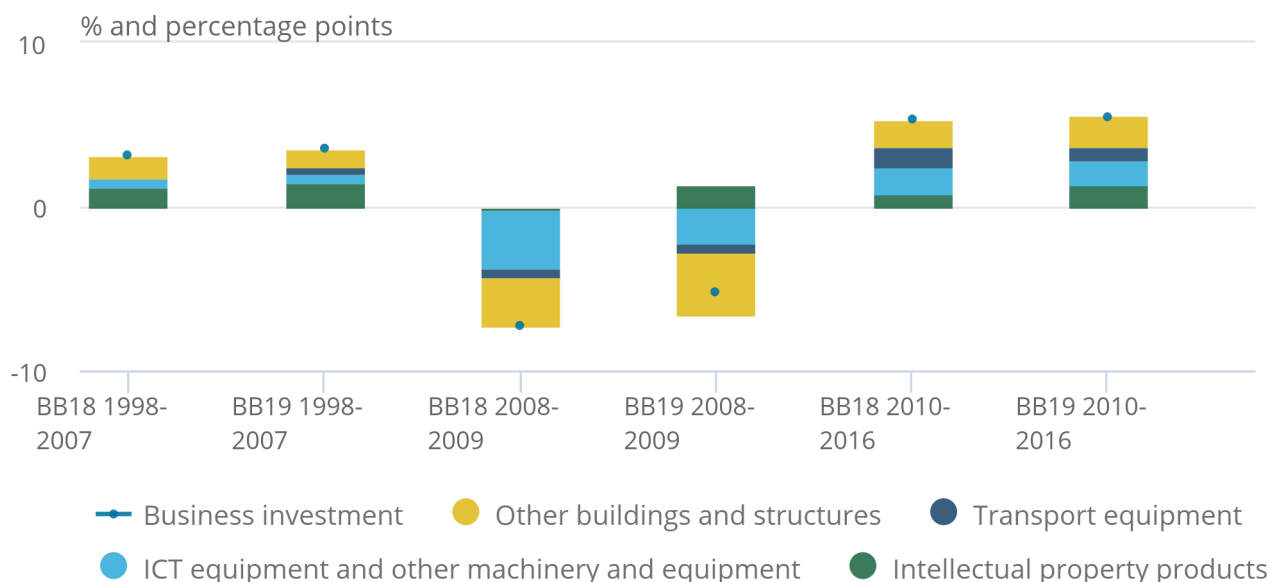
Figure 6 shows how the composition of average annual business investment growth has changed as a result of the revisions in Blue Book 2019. Business investment growth has been revised up on average before, during and after the economic downturn between 2008 and 2009. The fall in business investment during the economic downturn between 2008 and 2009 is now estimated to have been smaller, with average growth over this period being revised up by 2.1 percentage points to negative 5.2%. Average business investment growth has also been revised up between 2010 and 2016. This can be attributed to several factors, including improvements to Annual Business Survey benchmarking throughout the period and new Annual Business Survey data in 2016, which affected all assets within business investment.

Figure 6: Business investment growth has been revised up on average between 1998 and 2016

Composition of average annual business investment growth, current prices, UK, 1998 to 2016

Figure 6: Business investment growth has been revised up on average between 1998 and 2016

Composition of average annual business investment growth, current prices, UK, 1998 to 2016



Source: Office for National Statistics

The contribution of intellectual property products (IPP) to average business investment growth increased in each of the three periods shown. The largest of these revisions is in 2008 to 2009, where the contribution from this asset was revised up to positive 1.4 percentage points from negative 0.2 percentage points. This can be largely attributed to the improvements to IPP, in particular the replacement of forecast data for own-account software with genuine data from 2009 and improvements to estimates of research and development.

Impacts on gross fixed capital formation volume measure

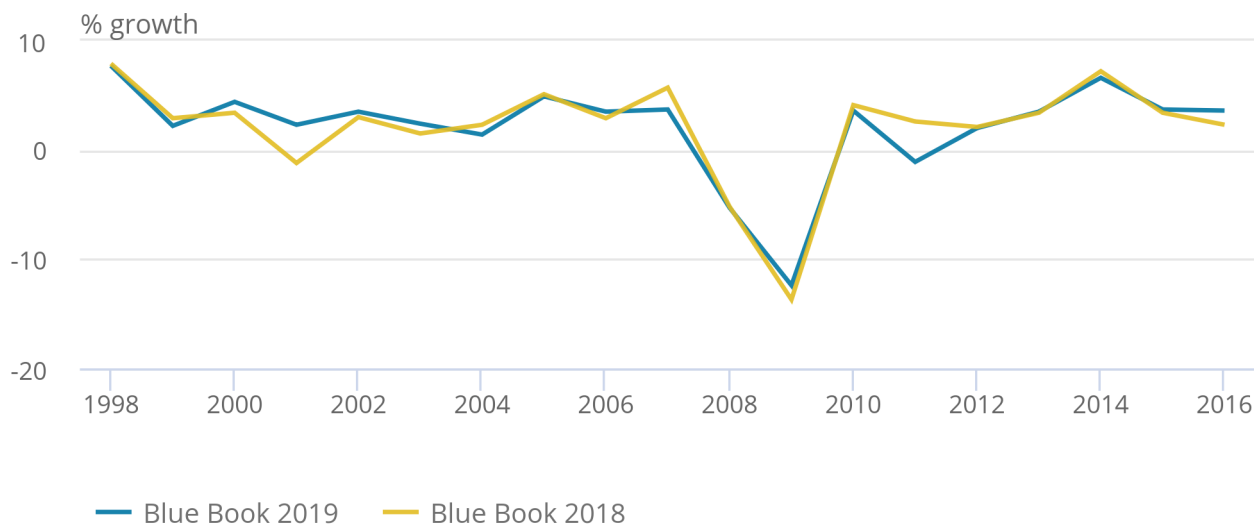
In addition to current price revisions to gross fixed capital formation (GFCF), there are additional revisions to volume estimates that reflect the improved GFCF product allocation used in the supply and use balancing process and the new framework used to inform headline GDP estimates described in [Section 4](#). Due to the interconnectedness of the changes to volume estimates of GFCF, the effects of these improvements have not been isolated in this article. Figure 7 shows the level and growth rate of the chained-volume measure of GFCF as previously published in Blue Book 2018 and the new estimates incorporating changes as part of Blue Book 2019.

Figure 7: Between 1998 and 2016, revisions to real GFCF growth range between negative 3.6 and positive 3.5 percentage points

Annual GFCF growth, chained volume measure, UK 1998 to 2016

Figure 7: Between 1998 and 2016, revisions to real GFCF growth range between negative 3.6 and positive 3.5 percentage points

Annual GFCF growth, chained volume measure, UK 1998 to 2016



Source: Office for National Statistics

The average revision to real GFCF between 1997 and 2016 is £13.4 billion per year, while the average growth rate remains unrevised. GFCF contributed an average of 0.0 percentage points to revisions to real GDP, with contributions ranging from negative 0.6 percentage points in 2011 and positive 0.6 percentage points in 2001.

Impacts on GFCF implied deflator

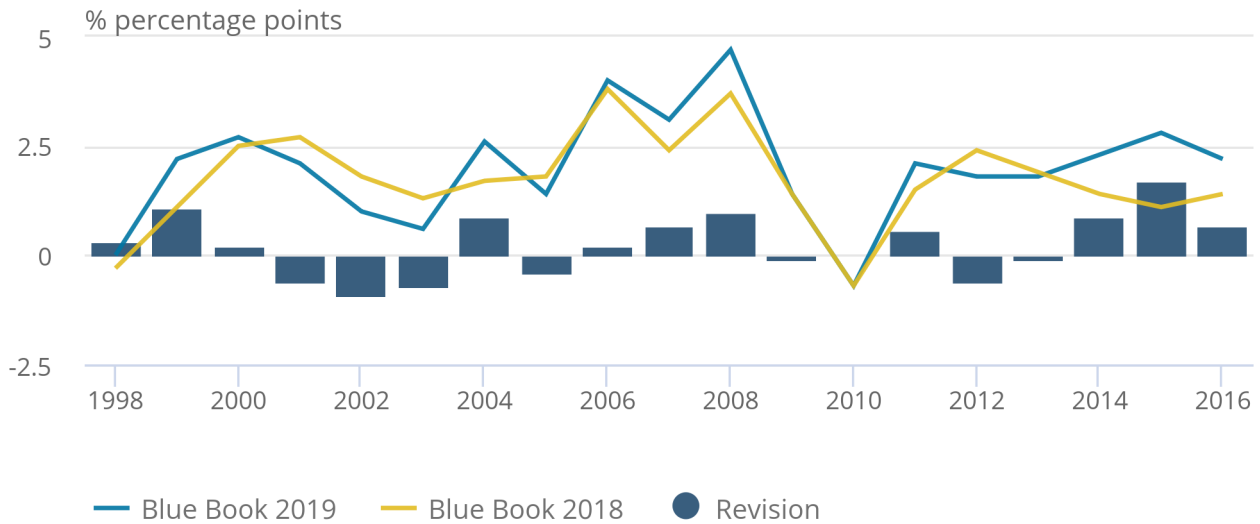
Owing to improvements to current price and volume measures of gross fixed capital formation (GFCF) described in [Section 4](#), there are revisions to the GFCF implied deflator, that is, the relationship between the current price and chained-volume measures of GFCF. The average revision to the growth rate of the GFCF implied deflator between 1998 and 2016 is 0.3 percentage points. Revisions to the implied deflator reflect years where revisions to the chained-volume measure of GFCF are not equal to the current price revisions.

Figure 8: Revisions to GFCF implied deflator growth average 0.3 percentage points between 1998 and 2016

Implied GFCF deflator, annual growth, UK, 1998 to 2016

Figure 8: Revisions to GFCF implied deflator growth average 0.3 percentage points between 1998 and 2016

Implied GFCF deflator, annual growth, UK, 1998 to 2016



Source: Office for National Statistics

6 . Acknowledgements

The authors would like to thank Ellis Best, Marc Evans, Josh Martin, Joe Murphy (Australian Bureau of Statistics) and Laura Requena for their research, methods development, and implementation of the many improvements and updates included in the Blue Book 2019-consistent gross fixed capital formation (GFCF) estimates.