

Article

Developing experimental estimates of investment in intangible assets in the UK: 2016

Update on development work to measure intangible assets (knowledge assets) beyond those in the national accounts, and updated estimates of investment to 2016.

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Release date:
6 February 2019

Next release:
To be announced

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1 . Summary

This article provides an update on our workplan to review and improve the methodology used to estimate investment in intangible assets, as well providing updated estimates of investment to 2016. This follows [our previous article](#), which presented the first Office for National Statistics (ONS) estimates of investment in a broad set of intangible assets, for 12 market sector industries, from 1997 to 2015. Estimates are based on the framework and approach first developed by Corrado, Hulten and Sichel (2005) in the US and previously applied in the UK by Goodridge, Haskel and Wallis (2014).

Since our previous article, we have updated our methods for estimates of investment in own-account software and entertainment, literary and artistic originals, which will be incorporated into official estimates of gross fixed capital formation (GFCF) in the quarterly national accounts on 30 September 2019, consistent with Blue Book 2019. This is the first update to the methods for estimating investment in these assets since 2009, and follows considerable new research.

In addition, we are pursuing an ambitious workplan to develop the methodology for the broader set of intangible assets (those not currently capitalised in the national accounts, in line with international guidance). This includes the development of estimates of investment in own-account branding, improvements to the methods to estimate training investment, constructing consistent historic estimates, and the identification and development of suitable price indices. Changes to estimates of intermediate consumption in Blue Book 2019, following the incorporation of new data from the [Purchases Survey](#) and the introduction of [double deflation](#), will also impact on experimental estimates of intangible investment.

A future article in late 2019 will incorporate these changes, to provide the most accurate and up-to-date picture of intangible investment in the UK. We will also set out research on depreciation rates for intangible assets, and will present experimental estimates of stocks of these assets. This will form the basis to analyse the productivity impact of these intangibles assets in a growth accounting framework.

The present article updates experimental estimates of investment in intangible assets to 2016, consistent with [Blue Book 2018](#) but does not pre-empt the revisions in Blue Book 2019. The estimates incorporate small downward revisions to estimates of purchased software and training. We find that investment in a broad set of intangible assets was £134.3 billion in 2016, compared with £128.8 billion in 2015 in current price terms.

Capitalised assets make up just over one-third of the total – driven primarily by research and development, and software. Training and organisational capital are the largest uncapitalised assets. The manufacturing industry (Standard Industrial Classification 2007: SIC 2007 section C) invests the most in intangible assets in current price terms, over one-third of which was research and development in 2016. However, once controlling for the size of the industry (defined by gross value added (GVA)), the information and communications industry (SIC 2007 section J) is the most dominant industry. The financial services industry (SIC 2007 section K) invests the most in intangible assets per worker employed.

We invite users to contact us at productivity@ons.gov.uk with questions or comments on our development work, estimates or future plans.

2 . Introduction

Intangible assets, also known as knowledge assets or intellectual capital, are assets that do not have a physical or financial embodiment. This definition encompasses assets such as software, reputation and branding, design, and research and development, which contribute to the long-term accumulation of a business' knowledge capital. Such assets complement physical (tangible) capital, such as buildings, equipment and machinery, in driving economic growth.

Measuring intangible assets is an area of growing importance for Office for National Statistics (ONS) in its efforts to provide a more complete picture of the UK economy. Our previous article reviewed some of the literature on intangible investment in the market sector, notably work by Goodridge, Haskel and Wallis in the UK. Intangibles are increasingly seen as important in the public sector too, leading HM Treasury to recently [recommend better valuation and reporting of public intangibles \(PDF, 484KB\)](#).

Conceptual framework

Some intangible assets are already capitalised in the UK National Accounts, in line with international best practice. These are:

- software and databases
- entertainment, literary and artistic originals
- mineral exploration and evaluation
- research and development

As such, spending on these assets is treated as investment and included within official estimates of gross fixed capital formation (GFCF).

Spending on other intangibles assets, as set out in the [Measuring Capital in the New Economy: An Expanded Framework \(PDF, 362.8KB\)](#) (developed by Corrado, Hulten and Sichel (2005)), is not currently treated as investment in the UK National Accounts. Table 1 shows the range of intangible assets considered in this article, and shows their current treatment in the UK National Accounts.

Table 1: Framework for measuring intangible assets

Broad category	Type of Intangible Asset	Description (from CHS)	Capitalised in the National Accounts?
Computerised Information	Software and databases	This includes knowledge embedded in computer programmes and computerised databases.	Yes
	Research and development		Yes
	Mineral exploration and evaluation		Yes
Innovative Property	Entertainment, literary and artistic originals	This includes knowledge acquired through scientific research and development, product development and non-scientific inventive and creative activities.	Yes
	Design		No
	Financial product innovation		No
	Branding		No
Economic Competencies	Organisational capital	This includes knowledge embedded in firm-specific human and structural resources, including brand names.	No
	Firm-specific training		No

Source: Office For National Statistics

Spending on some intangibles assets, set out in the Corrado, Hulten and Sichel (CHS) (2005) framework described previously, is not currently treated as investment in the UK National Accounts, in line with international guidance to ensure consistency of reporting between countries. This is spending on goods and services that are used up in the production process, and so do not last longer than a year. Using the CHS framework we treat spending on these intangibles as investment. This would “reclassify” it from intermediate consumption to GFCF, reflecting that spending on long-lived knowledge assets contributes to production over a period longer than a year. Subject to balancing, gross domestic product (GDP) would increase by the amount “reclassified”, through increased gross value added (GVA) of the purchaser.

In other cases, the CHS framework identifies knowledge asset creation that will not be currently captured within the UK National Accounts as a transaction; this is most often the case with own-account investment (such as own-account design), where the estimates imply the production of additional output. This additional output is identified with no additional inputs, so raising GDP by the value of the own-account investment, subject to balancing.

However, the estimates presented in this article are experimental, and ONS has no current plans to incorporate these estimates of investment in intangible assets into the UK National Accounts. The main aim of this work is to stimulate further debate on the importance of intangibles in the UK economy, to provide evidence that will feed into discussions on future international statistical regulations, and to provide inputs for future experimental growth accounting work. Further details of the conceptual framework can be found in our previous article, Corrado, Hulten and Sichel (2005), and Goodridge, Haskel and Wallis (2014).

This article provides an update on work by ONS to improve the understanding and measurement of intangible assets, both inside and outside the national accounts. Section 3 details development work to methods and data sources, covering both capitalised and uncapitalised assets. Section 4 provides updated estimates of investment for 2016, incorporating revisions to source data and extending estimates back to 1992 on a consistent basis. Sections 5 and 6 analyse these estimates on an asset and industry basis, respectively. Further information is available in the accompanying datasets.

3 . Methodological developments

Office for National Statistics (ONS) is one of the world's leading National Statistics Institutes in the area of intangibles, supported by investment following the [Bean Review in 2016](#), and has an ambitious workplan to improve the understanding and measurement of intangible assets in the UK. This section details work to date, work underway, and work planned for the near future on this topic.

Own-account software

Official estimates of investment in own-account software, included as part of gross fixed capital formation (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 \(PDF, 1.3MB\)](#). 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. ONS 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, for non-wage labour costs, for non-labour costs (such as intermediate inputs, overheads, and consumption of fixed capital), and a mark-up for operating surplus. This is set out in detail for the UK in a [2007 methods article \(PDF, 350.9KB\)](#).

Estimates in the national accounts have used forecasted input data for years since 2009, following changes to industrial and occupational classifications in 2007 and 2010 respectively. To update estimates and ensure assumptions and parameters in the model were appropriate for the modern economy, we conducted detailed research in 2018 to improve on these methods.

The main data source for labour costs of relevant workers remains the [Annual Survey of Hours and Earnings \(ASHE\)](#), with [Standard Occupational Classification 2010: SOC 2010](#) codes used to identify relevant workers. To identify relevant SOC 2010 codes and the appropriate time adjustment factors for each type of worker, we conducted interviews with senior IT managers in multi-national enterprises to find out about current business practices. We also conducted detailed microdata research using the job titles returned on the survey forms, to identify new jobs that are not easily identifiable in SOC 2010, such as "data scientists". This was also important to more fully capture own-account investments in databases, a component part of the "software and databases" asset.

As a result of this research, we have updated the input data and model parameters for estimates of own-account software investment, and these new estimates will be incorporated into the quarterly national accounts on 30 September 2019, consistent with Blue Book 2019.

Entertainment, literary and artistic originals

Official estimates of investment in entertainment, literary and artistic originals, included as part of gross fixed capital formation (GFCF) and business investment in the national accounts, follow international best practice as set out in the [OECD Handbook on Deriving Capital Measures of Intellectual Property Products \(PDF, 1.3MB\)](#). 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 entertainment, literary and artistic originals GFCF](#) for the UK were for 2009. Estimates in the national accounts have been forecast since 2010.

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.

As a result of this research, we have updated estimates of investment in entertainment, literary and artistic originals, and these new estimates will be incorporated into the quarterly national accounts on 30 September 2019, consistent with Blue Book 2019.

Own-account branding

In current experimental estimates of intangible investment, own-account branding investment is assumed to be equal in value to purchases of market research services – that is, estimates of investment in purchased market research are doubled to account for own-account investment. There are no adjustments made for own-account advertising investment.

A review of the literature suggests that own-account advertising does take place, and that own-account market research is likely to be larger in value than investment in purchased market research. As a result, we have developed new experimental estimates of own-account branding investment, incorporating advertising and market research activities. The method for this follows the standard own-account investment methodology, as set out for own-account software previously.

Following consultation with academic experts, we intend to develop these estimates further, before incorporating them into a future set of experimental estimates of investment in intangible assets. We welcome user feedback on this development via email to productivity@ons.gov.uk.

Training

Current experimental estimates of investment in training by companies use data from the Investment in Training Survey, a module of the [Employer Skills Survey](#). Estimates of the full cost of training investment are modelled by the survey owners (currently the Department for Education, formerly the [UK Commission for Employment and Skills \(UKCES\)](#)), incorporating direct costs to employers of providing training (such as fees to external providers, costs of running an internal training centre) but also the labour costs of trainees and trainers (for on-the-job training).

The Employer Skills Survey is run every other year, so data are available for 2011, 2013, 2015 and 2017 for the UK. Prior to this, the survey was run only for England, and estimates of training spending are available for 2007 and 2009 for England, which are adjusted to be representative of the UK. Prior to 2007, growth in training investment is assumed to be proportional to growth in compensation of employees (CoE) by industry. However, if the “rate of training investment” changes over time, CoE will not fully capture the trend in training investment.

We have developed a new method to extend estimates of investment in training prior to 2007, based on the modelling framework developed by UKCES for the survey-based estimates. Training investment is assumed to be a function of:

- direct training costs
- total number of employees (to which a “rate” can be applied)
- the rate of training (proportion of all workers that receive training, and average duration of training per trainee)
- the average wages of trainees
- the average wages of trainers (providing on-the-job training)

Compensation of employees (CoE) provides a proxy for some, but not all of these factors – in particular, it fails to account for direct training costs, and for the “rate of training” (which is a function of the proportion of all workers that receive training, and the average duration of training per trainee). To extend training investment estimates, we therefore propose to use a model based on these factors.

Respondents to the Labour Force Survey report whether they received job-related training in the past quarter, and the number of hours spent doing this in the past quarter. These variables allow for an estimate of the trend in the rate of training by industry. This, combined with trends in the total number of employees per industry (employment in the relevant industries) and average wages of trainees and trainers, provide a good predictor of the trend in overall labour costs of training. This can be combined with trends in the turnover of the industries providing training, with weights calculated from the Investment in Training Survey results.

Initial work shows this method is feasible and produces results that are consistent over time for the market sector. We intend to develop this method further, in consultation with internal and external experts and stakeholders. Subject to satisfactory results, we will incorporate these revised estimates into a future set of experimental estimates of investment in intangible assets. We welcome user feedback on this development via email to productivity@ons.gov.uk.

Constructing consistent historic estimates

To incorporate this broad set of intangible assets into a growth accounting framework, we need to produce capital stocks estimates using a long time series of investment data. Official estimates of software investment in the national accounts extend back to 1970, and are used in estimates of [capital stocks](#) and [capital services](#). We intend to produce consistent estimates for the uncapitalised intangible assets back as far as this as well, to allow for reliable estimates of the capital stock for growth accounting.

As a first step, in this article we have extended estimates from 1997 to 1992 on a consistent basis, using three main sources:

- for branding, purchased design and purchased organisational capital – supply and use tables (SUTs) consistent with Blue Book 2006, by matching the appropriate products
- for training – published data on compensation of employees (CoE) by industry back to 1992
- for own-account design, own-account organisational capital, and financial product innovation – data from the New Earnings Survey (NES), the predecessor to the Annual Survey of Hours and Earnings (ASHE) by converting industry and occupation codes in the microdata

We intend to explore the feasibility of extending all these estimates further using earlier data sources and classifications. All the data sources listed previously have earlier vintages or predecessors dating back to at least 1970. We also plan to work with industry bodies to identify other appropriate data sources.

Price indices for intangible investment

Capital stocks estimates require not only a long time series of investment data, but also deflators to revalue the investment into the prices of the same period. Deflators exist for the capitalised intangible assets (see Table 1), and are used in the UK National Accounts. We intend to identify, and where necessary develop, appropriate deflators for the uncapitalised intangible assets.

[Previous estimates \(PDF, 2MB\)](#) have used [Services Producer Price Indices \(SPPIs\)](#) as deflators for the uncapitalised assets. However, many of the relevant SPPIs only extend back to 2010, as this was when they were first produced by ONS. Previous estimates therefore used the growth rate of the gross value added at basic prices implied deflator to extend the SPPIs.

An initial assessment suggests the product make-up of the relevant SPPIs is a good match in most cases for the uncapitalised intangible assets, supporting their use. However, these typically rise less quickly than the implied value-added deflator, suggesting that alternative series should be identified or developed for earlier years. We intend to review available options, and where necessary develop new price indices. We intend to publish further details of our findings, and constant price investment estimates, in a future article.

Changes to intermediate consumption in Blue Book 2019

Blue Book 2019 will incorporate new data on intermediate consumption from the new Purchases Survey, as well as adopting the international best practice of double deflation in the construction of the supply and use tables (SUTs). As one of the main data sources for the experimental estimates of investment in the uncapitalised intangible assets is intermediate consumption from the SUTs, this has the potential to lead to revisions to these estimates. A future article in late 2019 will incorporate these changes.

4 . Intangible investment estimates to 2016

This section provides an update to experimental estimates of intangible investment in the market sector¹ in the UK, based on the existing methodology. All estimates are in current prices. These estimates take on revisions to capitalised intangibles from Blue Book 2018, and revisions to training based on a change in the source data. They do not, however, take on any of the methodological changes outlined in Section 3, which are still under development; these will be incorporated into estimates in a future article.

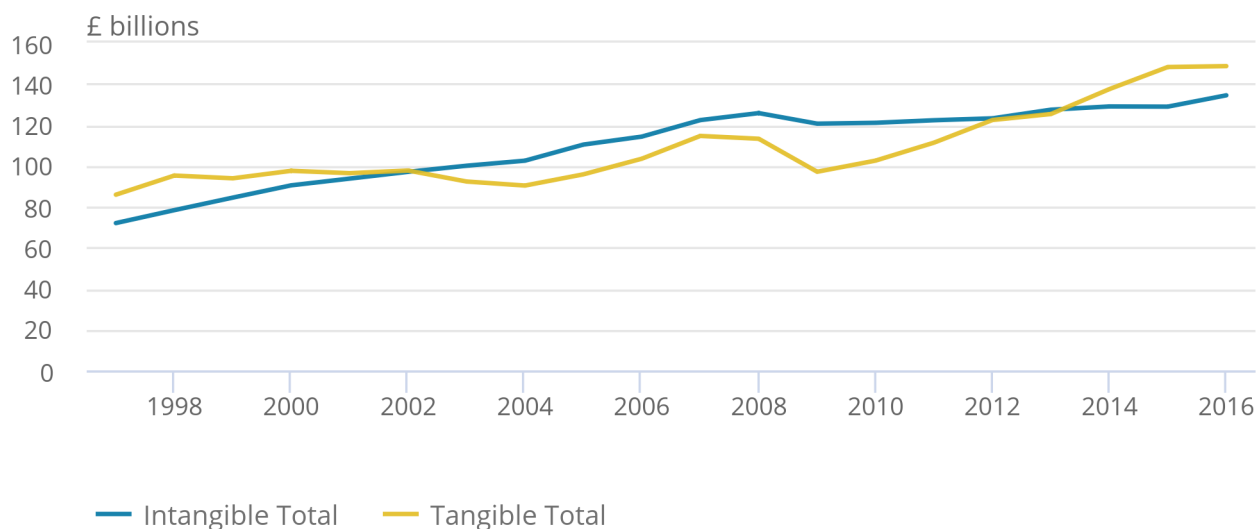
Intangible investment in the market sector in the UK in 2016 was £134.3 billion, compared with £128.8 billion in 2015 in current price terms (Figure 1). This is the largest amount spent on intangible assets by the market sector over the period. In contrast, tangible investment was £148.5 billion in 2016, compared with £148.1 billion in 2015 in current price terms.

Figure 1: Market sector intangible and tangible investment, current prices

UK, 1997 to 2016

Figure 1: Market sector intangible and tangible investment, current prices

UK, 1997 to 2016



Source: Office for National Statistics

Intangible investment fell only slightly during the economic downturn in 2008, while tangible investment fell more markedly. Between 2009 and 2015, current price tangible investment grew more quickly than intangible investment in the market sector. As a result, while intangible investment was larger than tangible investment between 2002 and 2013, since 2014 the market sector has invested more in tangible assets.

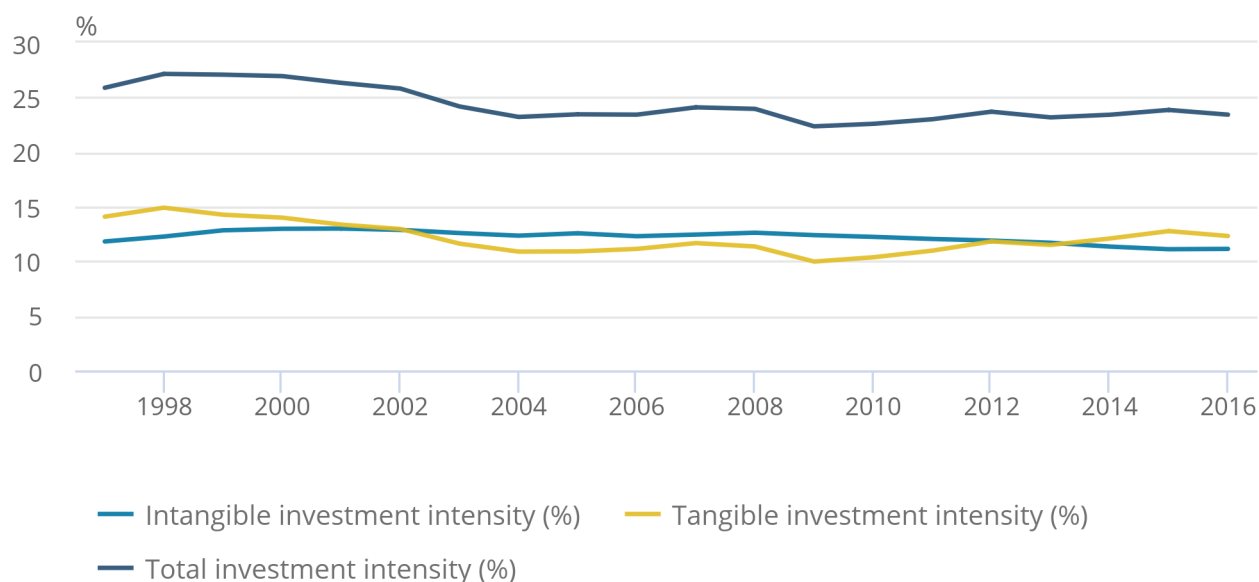
In 2016, intangible investment was 11.1% of market sector gross value added (MSGVA), where MSGVA has been adjusted for the capitalisation of additional intangible assets. This was marginally higher than in 2015, halting a downward trend since 2008 (Figure 2). Tangible investment was 12.3% of adjusted MSGVA in 2016, down from 12.8% in 2015.

Figure 2: Tangible and intangible investment as a share of adjusted market sector gross value added

UK, 1997 to 2016

Figure 2: Tangible and intangible investment as a share of adjusted market sector gross value added

UK, 1997 to 2016



Source: Office for National Statistics

Notes:

1. Gross value added (GVA) has been adjusted for the capitalisation of additional intangible assets.

Total investment (intangible and tangible) as a share of adjusted MSGVA has fallen from its peak in 1998, when total investment accounted for 27.1% of total adjusted MSGVA, to 22.3% in 2009. Since then, total investment has grown steadily to 23.8% in 2015, before falling slightly in 2016. Recent weakness in business investment is not shown in Figure 2, as it only covers years to 2016.

Revisions

Estimates in this article take on revisions to the capitalised intangible assets in Blue Book 2018, and revisions to source data for the uncapitalised intangible assets. Revisions of particular note are:

- training – following an improvement in the modelling methodology by the Department for Education, we have taken on revised estimates for 2011, 2013 and 2015, resulting in changes also in 2010; this reduces estimates by £4.5 billion in 2015, and less in other years; years before 2011 are unaffected by this change, although are revised slightly due to revised data on compensation of employees in Blue Book 2018
- purchased software – revised downwards slightly as a result of balancing² adjustments in Blue Book 2018
- other assets – most assets have minor revisions across the time period, as a result of changes to source data in Blue Book 2018

Notes for: Intangible investment estimates to 2016

1. The definition of the market sector in this article includes sections A to K, M to N and R to T in the Standard Industrial Classification 2007: SIC 2007. It excludes real estate (L), public administration and defence (O), education (P) and health and social work (Q). Note that this is different to the standard ONS definition, which is based on any unit selling at an economically significant price is operating in the market. Not all of P and Q are non-market, and there are non-market parts of other industries. L is excluded due to the future focus on growth accounting.
2. As part of the Blue Book process, the three approaches to measuring gross domestic product (GDP) are compared and balanced using input-output tables. This process ensures that the three approaches are consistent and economically plausible.

5 . Analysis by asset

The breakdown of intangible investment by asset over time is shown in Figure 3. These estimates are all in current prices. Uncapitalised assets are dashed, while capitalised assets are in solid lines.

The assets that make up the “economic competencies” group (Table 1) – organisational capital, branding, and training – make up over half of total intangible investment (Figure 3). Training has been revised down a little in recent years in this article, as described in Section 4, but market sector investment in training (£29.5 billion in 2016) remains higher than any other intangible asset. Market sector investment in organisational capital, which is approximately three-quarters own-account, was second largest, at £26.3 billion in 2016.

Investment in branding in the market sector was very stable between 2014 and 2016 at just over £15.0 billion per year. Investments in design (mostly purchased) added a further £15.1 billion in 2016 to total intangible investment in the market sector.

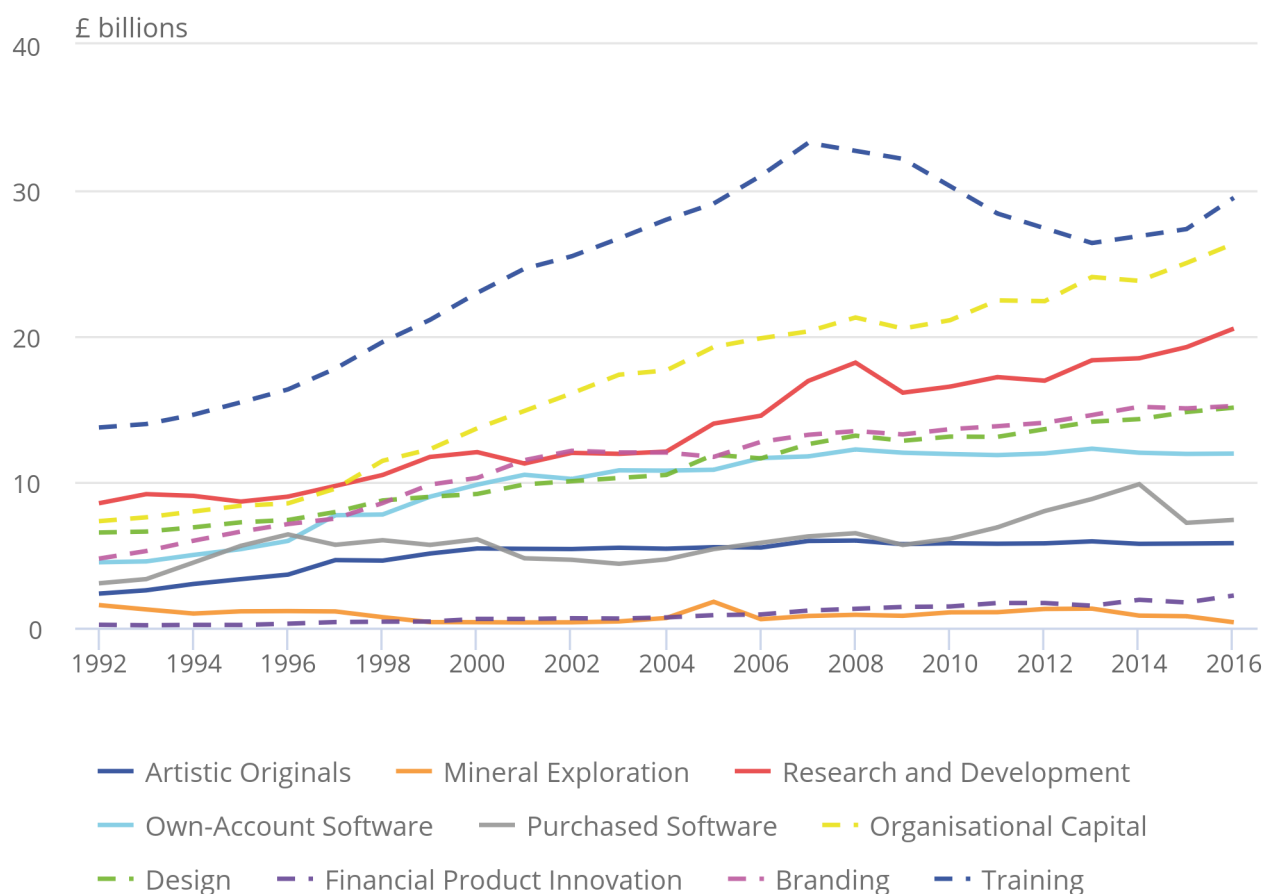
Of the capitalised assets, software and research and development were by far the largest contributors. Software investment in the market sector was £19.3 billion in 2016, while research and development added £20.5 billion. Investments in entertainment, literary and artistic originals and mineral exploration were smaller and were concentrated in certain industries.

Figure 3: Market sector investment by intangible asset, current prices

UK, 1992 to 2016

Figure 3: Market sector investment by intangible asset, current prices

UK, 1992 to 2016



Source: Office for National Statistics

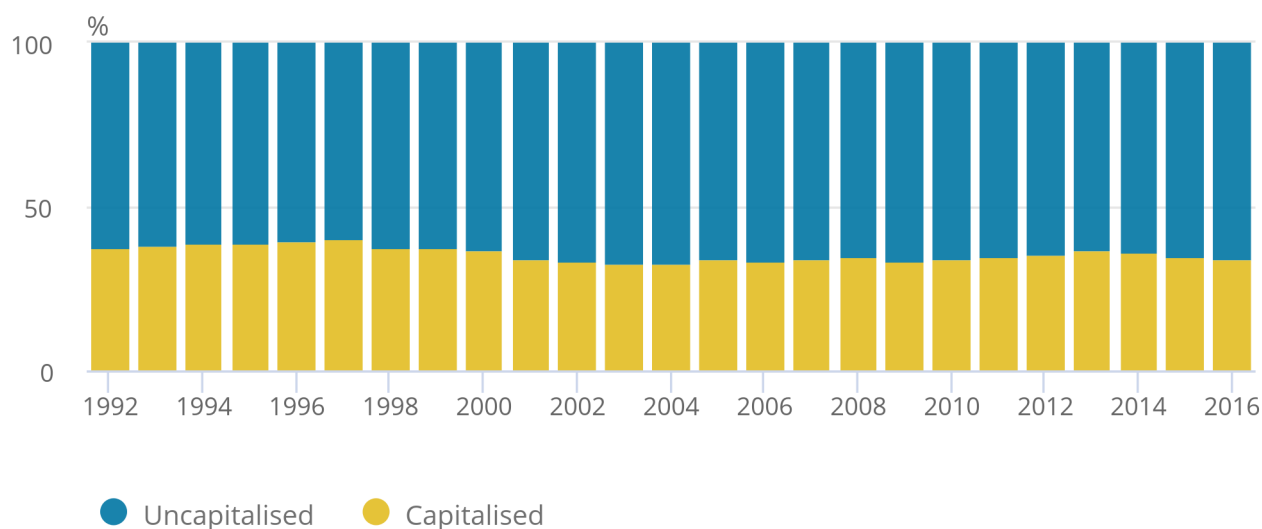
Capitalised assets made up just over one-third of total intangible investment between 1997 and 2016 (Figure 4). This means that, in 2016, there was an estimated £88.3 billion of investment in intangible assets in the market sector, in addition to the £46.0 billion in the UK National Accounts. This suggests that a majority of investment in intangible assets remains to be capitalised, as it lies outside of the current international guidance on the measurement of investment.

Figure 4: Capitalised and uncapitalised intangible investment

UK, 1992 to 2016

Figure 4: Capitalised and uncapitalised intangible investment

UK, 1992 to 2016



Source: Office for National Statistics

6 . Analysis by industry

Intangible investment is not evenly distributed across industries. Some industries invest more than others, even after controlling for their size, measured by the industry's gross valued added (GVA). In Figures 5 and 6, GVA has been adjusted for the capitalisation of additional intangible assets. The most "intangible intensive" industries (those that invest most in intangibles relative to their size) are typically services industries (Figure 5).

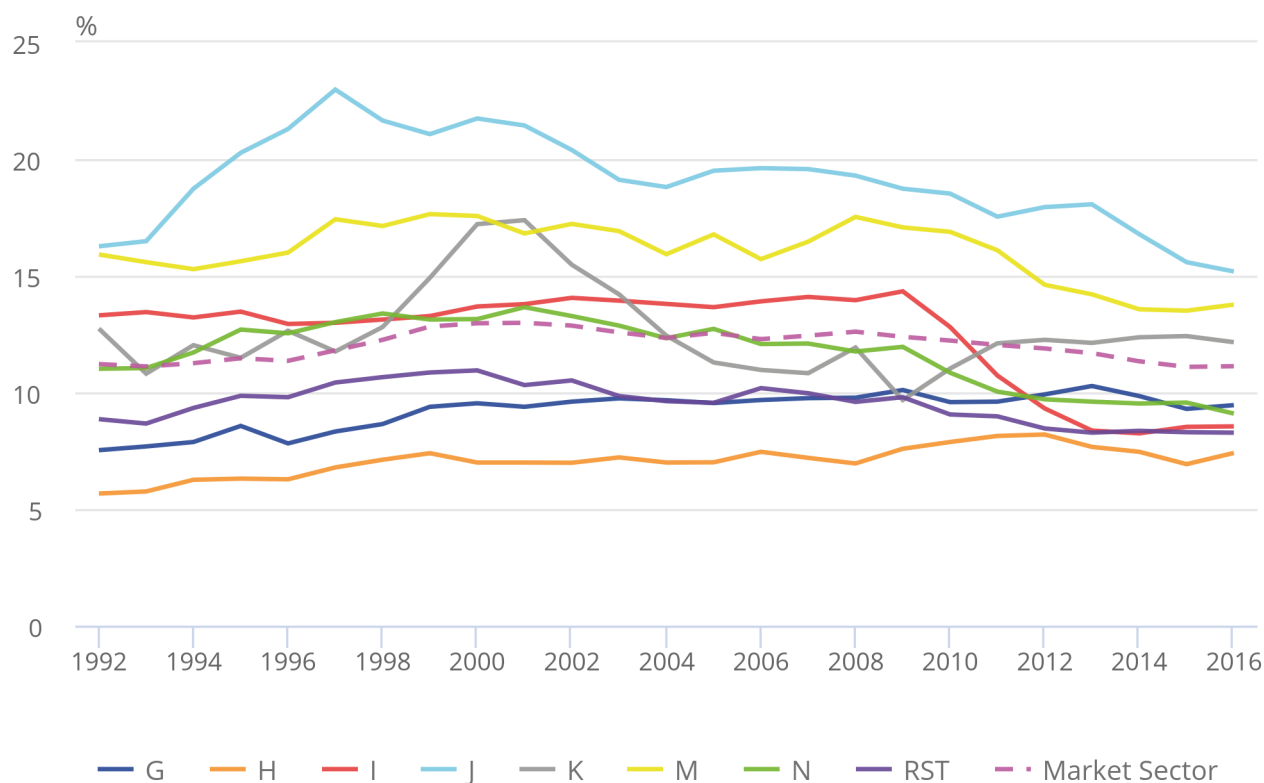
The most intangible intensive industry in 2016 was the information and communications industry (SIC 2007 section J), for which intangible investment was equal to 15.2% of GVA in 2016. However, this has been declining persistently over time, from a peak of 23.0% in 1997, driven by strong increases in current price GVA and slower increases in current price intangible investment. Intangible intensity in most industries has been stable or slowly declining since around the time of the economic downturn.

Figure 5: Intangible investment as a share of adjusted gross value added, services industries

UK, 1992 to 2016

Figure 5: Intangible investment as a share of adjusted gross value added, services industries

UK, 1992 to 2016



Source: Office for National Statistics

Notes:

1. Industry key:

- G = Wholesale and retail
- H = Transportation and storage
- I = Accommodation and food services
- J = Information and communication
- K = Financial services
- M = Professional and scientific activities
- N = Administrative services
- RST = Arts, household and other services

2. Gross value added (GVA) has been adjusted for the capitalisation of additional intangible assets.

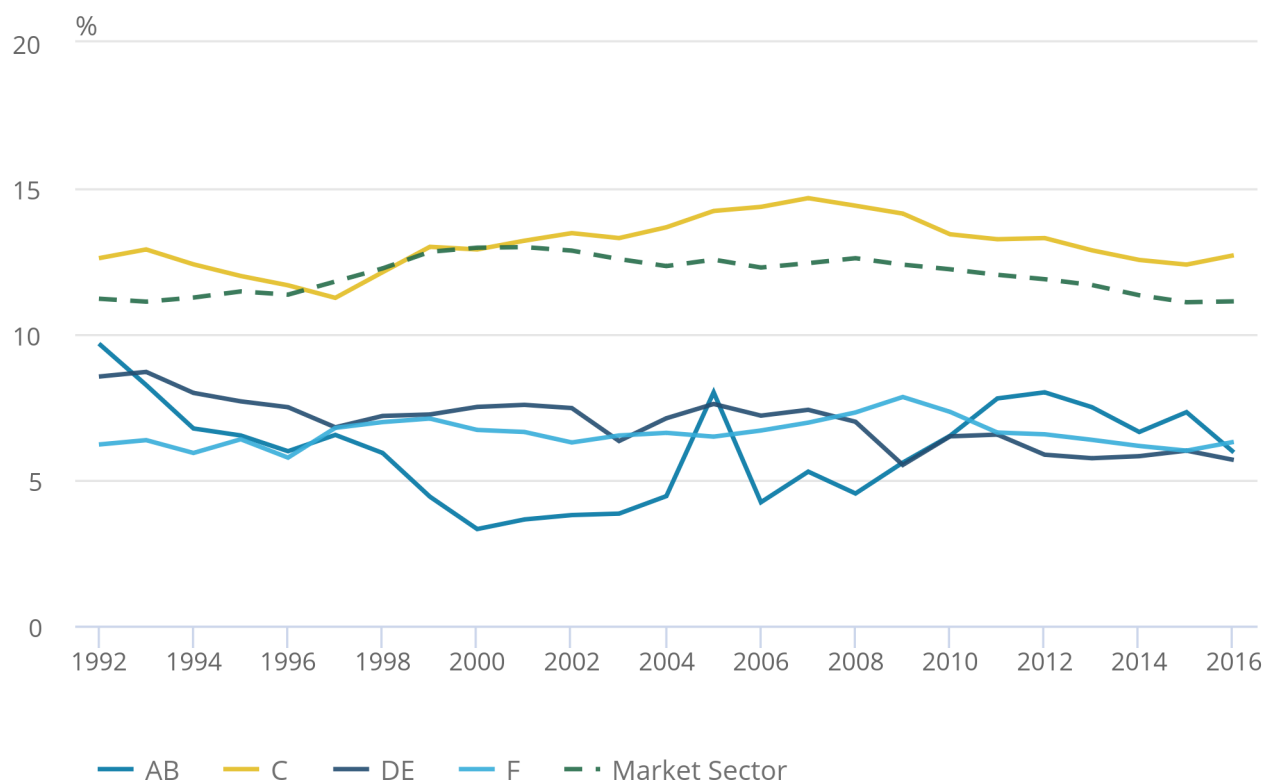
Production industries are relatively less “intangible intensive” (Figure 6), relying more heavily on tangible capital (Table 2). Of these industries, the manufacturing industry (SIC 2007 section C) is the most intangible intensive, driven primarily by investment in research and development.

Figure 6: Intangible investment as a share of adjusted gross value added, production industries

UK, 1992 to 2016

Figure 6: Intangible investment as a share of adjusted gross value added, production industries

UK, 1992 to 2016



Source: Office for National Statistics

Notes:

1. Industry key:

AB = Agriculture, forestry and mining
C = Manufacturing
DE = Electricity, gas and water supply
F = Construction

2. Gross value added (GVA) has been adjusted for the capitalisation of additional intangible assets.

Another way of assessing “intangible intensity” is to examine intangible investment per worker for each industry. This differs from the measures used in Figures 5 and 6 as the industrial breakdown of GVA is not the same as the breakdown of employment across the economy, reflecting different production models.

The market sector as a whole invested approximately £5,600 per worker in 2016, up from £5,500 per worker in 2015, but below the peak of £5,700 per worker in 2013. This measure has been broadly stable since the economic downturn (Figure 7).

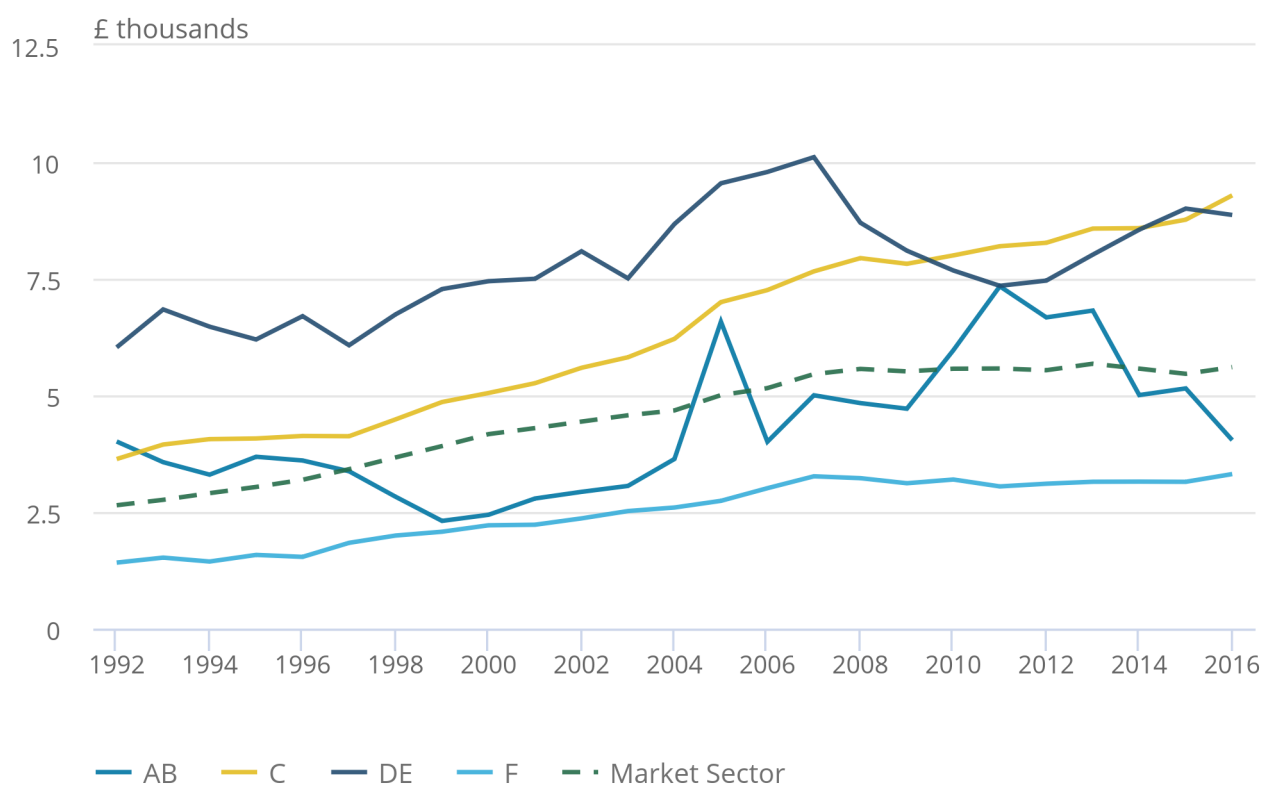
The utilities industries (SIC 2007 sections D and E) invested £8,900 in intangibles per worker, almost on par with the manufacturing industry (SIC 2007 section C). In contrast, Figure 6 shows manufacturing to be far more intangible intensive than utilities. This reflects differences in production models in these industries, since the utilities industry is more capital intensive, generating higher GVA per worker than manufacturing.

Figure 7: Intangible investment per worker, production industries

UK, 1992 to 2016

Figure 7: Intangible investment per worker, production industries

UK, 1992 to 2016



Source: Office for National Statistics

Notes:

1. Industry key:
 AB = Agriculture, forestry and mining
 C = Manufacturing
 DE = Electricity, gas and water supply
 F = Construction

Unlike for the measure based on GVA in Figures 5 and 6, the distinction between production and services industries is less clear cut when comparing against employment. Amongst the services industries, the financial services industry (SIC 2007 section K) invested the most in intangible assets (£15,900) per worker in 2016. This was the highest of any industry in the market sector. The financial services industry is the only industry that invests in financial product innovation, but the majority of its investments are in organisational capital (primarily reflecting a large number of highly paid managers), branding, and software.

The information and communications industry (SIC 2007 section J) and the professional, scientific and technical industry (SIC 2007 section M) invested more than average in intangible assets per worker in 2016. Other services industries are much less “intangible intensive” by this measure. These findings are broadly consistent with Figure 5, based on GVA.

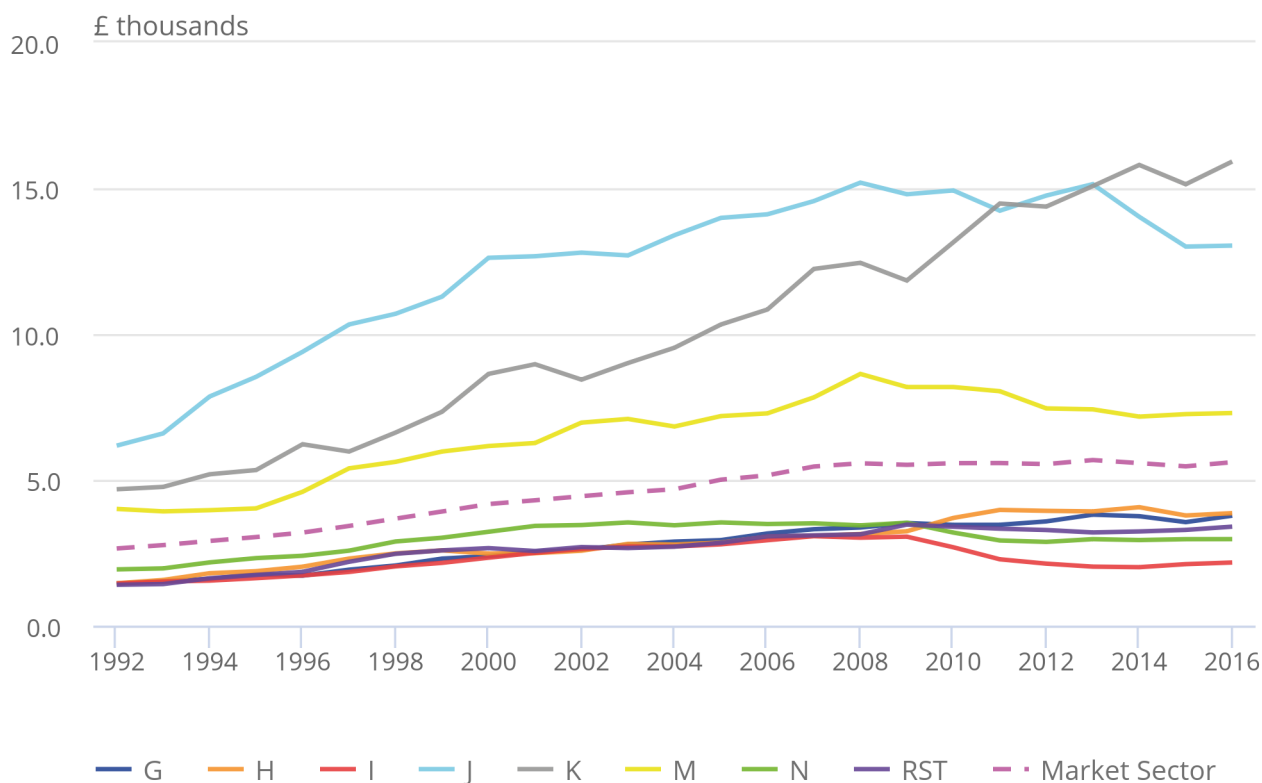
In contrast to Figure 5, intangible investment per worker has been rising over time in most industries. This may reflect the fact that intangible investment and GVA are measured in current prices here, while employment is a volume measure. A future article will include constant price estimates of intangible investment, allowing volume change to be observed more directly.

Figure 8: Intangible investment per worker, services industries

UK, 1992 to 2016

Figure 8: Intangible investment per worker, services industries

UK, 1992 to 2016



Source: Office for National Statistics

Notes:

1. Industry key:
 G = Wholesale and retail
 H = Transportation and storage
 I = Accommodation and food services
 J = Information and communication
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 RST = Arts, household and other services

Table 2 shows investment in intangible and tangible assets for 12 market sector industry groupings. It also shows the ratio of intangible to tangible investment by industry – that is, for every £1.00 spent on tangible assets, how much is spent on intangible assets? The market sector as a whole invested about £0.90 in intangible assets for every £1.00 spent on tangible assets in 2016, although this was reversed prior to 2014. Over the past two decades investment in intangibles and tangibles was broadly balanced on average in the market sector (average ratio from 1997 to 2016 shown in the final column of Table 2). Industries with the highest ratios are described as “intangibles leaning”.

The most “intangible leaning” industries were mainly in the services industries, both in 2016 and over the past two decades. In particular, the financial services industry (SIC 2007 section K), the information and communications industry (SIC 2007 section J), and the professional, scientific and technical industry (SIC 2007 section M) have the highest ratios of intangible to tangible investment. This finding is consistent with Figures 5 to 8.

The transportation industry (SIC 2007 section H) was the most “tangible leaning” of the services industries, relying heavily on tangible capital, in particular transport equipment. Within the production industries, the agricultural and mining industries (SIC 2007 sections A and B) and the utilities industries (SIC 2007 sections D and E), were more “tangible leaning”, but the manufacturing industry (SIC 2007 section C) was more “intangible leaning”.

Table 2: Intangible and tangible investment by industry, 2016 and period average

Industry	Intangible investment (2016)		Tangible investment (2016)		Ratio of intangible to tangible investment	
	£bn	% of total	£bn	% of total	2016	Average
AB	1.8	1.4%	9.3	6.3%	0.20:1	0.22:1
C	23.9	17.8%	15.6	10.5%	1.53:1	1.68:1
DE	2.8	2.1%	17.8	12.0%	0.16:1	0.18:1
F	7	5.2%	22.3	15.0%	0.31:1	0.38:1
G	18.6	13.9%	15	10.1%	1.24:1	1.33:1
H	5.9	4.4%	21.2	14.3%	0.28:1	0.28:1
I	4.9	3.6%	6.2	4.2%	0.78:1	1.34:1
J	17.8	13.3%	9.1	6.1%	1.97:1	2.02:1
K	17.3	12.9%	7.5	5.1%	2.31:1	2.46:1
M	19.6	14.6%	8	5.4%	2.44:1	4.48:1
N	8.2	6.1%	10.6	7.1%	0.78:1	1.20:1
RST	6.2	4.7%	5.9	4.0%	1.06:1	1.23:1
MS Total	134.3	100.0%	148.5	100.0%	0.90:1	1.01:1

Source: Office For National Statistics

Notes:

1. Industry key: AB = Agriculture, forestry and mining C = Manufacturing DE = Electricity, gas and water supply F = Construction G = Wholesale and retail H = Transportation and storage I = Accommodation and food services J = Information and communication K = Financial services M = Professional and scientific activities N = Administrative services RST = Arts, household and other services MS Total = Market sector total

Notes for: Analysis by industry

1. Employment data taken from productivity jobs by industry, averaged over the four calendar year quarters, and aggregated where necessary. The number of jobs and workers in an industry are not always the same, as a result of people having more than one job, but is referred to as “workers” in this article for interpretability.

7 . Next steps

This article has updated estimates of intangible investment to 2016, based on the existing methodology, taking on revisions to source data. However, Section 3 details the ambitious workplan on the measurement of intangible assets planned by Office for National Statistics (ONS), including some completed work due for incorporation into future official estimates of gross fixed capital formation (GFCF).

In a future article in late 2019, we will update estimates to at least 2017, based on the latest available data and incorporating methodological improvements described in Section 3. These include:

- updates to the methods for GFCF in own-account software and entertainment, literary and artistic originals, which will be included in the quarterly national accounts on 30 September 2019, consistent with Blue Book 2019
- revisions to experimental estimates based on revised intermediate consumption data in the supply and use tables consistent with Blue Book 2019
- new estimates of own-account branding investment
- revised estimates of training investment for years before the Investment in Training Survey data are available
- investment time series extended further back on a consistent basis
- price indices for experimental intangible investment, and constant price investment estimates

In addition to developing estimates produced using the Corrado, Hulten and Sichel (2005) framework, we are continuing work to reconcile differences between these estimates and survey-based estimates. The [Intangible Assets Surveys \(PDF, 1.83MB\)](#), carried out in 2010 and 2011 by ONS and Nesta, produced estimates for some assets that were notably different to “macro” based estimates. This was particularly true for design and organisational capital, indicating further work is needed in these areas.

We invite users to contact us via email at productivity@ons.gov.uk with questions or comments on our development work, estimates or future plans.

8 . Authors

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