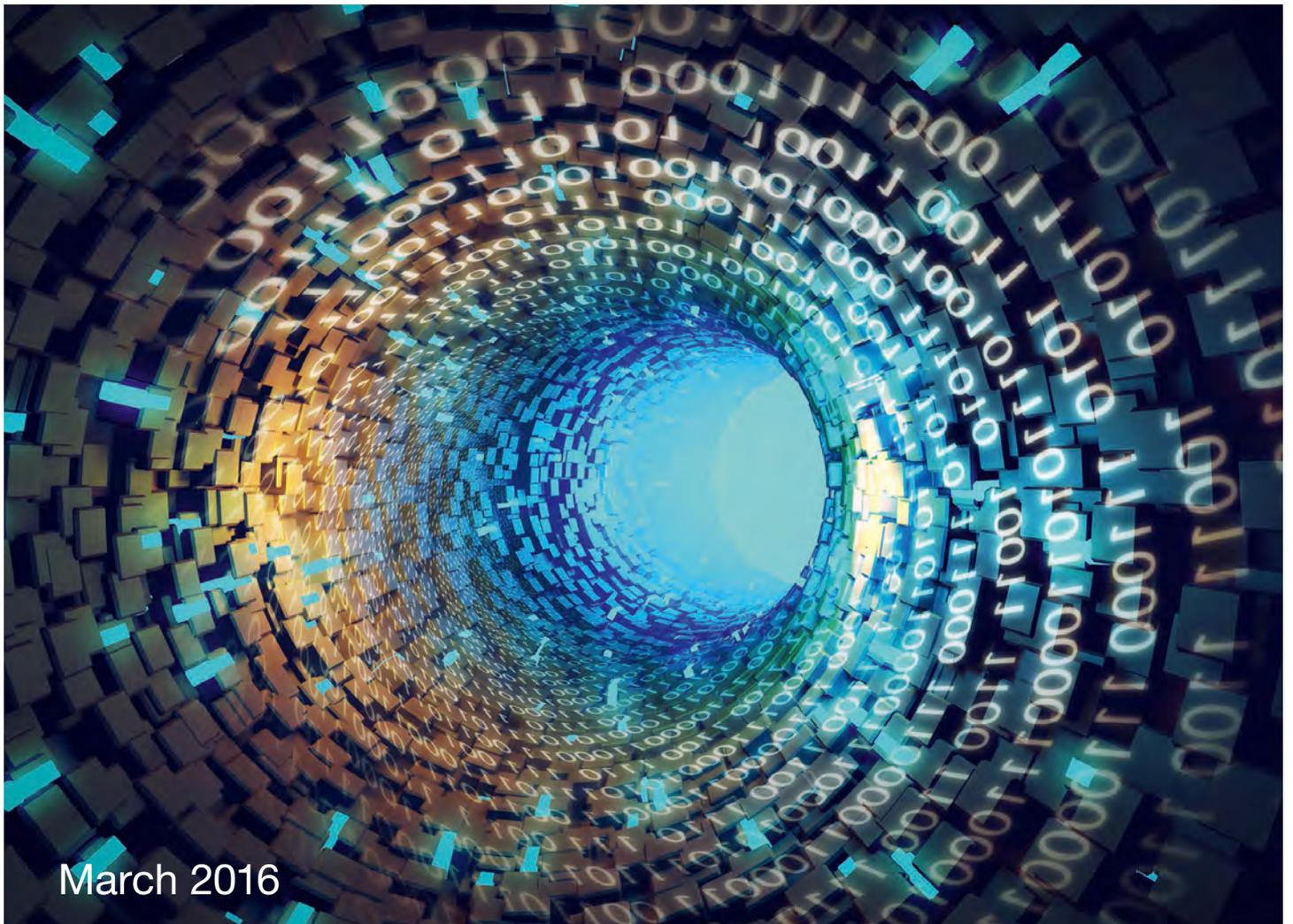


Independent Review of UK Economic Statistics

Professor Sir Charles Bean



March 2016

Independent Review of UK Economic Statistics

Professor Sir Charles Bean

March 2016

Contents

Chapter 1: Introduction and overview	1
Background to the Review	1
A vision for the future provision of economic statistics	6
Recommendations: Measuring the economy	8
Recommendations: ONS capability and performance	10
Recommendations: Governance of statistics	13
Content outline	15
Chapter 2: Measuring the modern economy – established challenges	19
Measuring GDP	19
Measuring services	35
Measuring financial inter-connectedness	42
Regional statistics	47
Measuring the labour market	50
Physical capital	58
Land market statistics	62
Addressing established statistical limitations	68
Chapter 3: Measuring the modern economy – emerging challenges	71
Value added in the digital modern economy	71
The sharing economy	91
Intangible investment	98
Accounting for quality change	106
Understanding the international location of economic activity	112
Keeping abreast of an evolving economy	116
Chapter 4: Effectiveness of ONS	121
Recent history of ONS	121
ONS resources	124
Recent ONS performance	130
Culture, Capability and Collaboration	137
Survey data sources	156
Administrative data and alternative data sources	162

Data science capability	167
Technology and data infrastructure	176
Dissemination of ONS statistics	180
Chapter 5: Governance	191
Background to the current governance arrangements	192
Independence	195
Quality assurance and improvement	201
Prioritisation	207
The role and effectiveness of the UKSA Board	210
Oversight of UKSA	217
Annex A: List of tables and charts	221
Annex B: Acronyms	223
Annex C: Terms of reference	226
Annex D: Call for evidence	227
Annex E: Call for evidence respondents	231
Annex F: Stakeholder Engagement	234
Annex G: Bibliography	238

Chapter 1: Introduction and overview

Background to the Review

- 1.1** On 10 July 2015, as part of the government's productivity plan,¹ the Chancellor of the Exchequer, George Osborne, announced an independent review of UK economic statistics. The Terms of Reference of the Review are to:
- Assess the UK's future (economic) statistics needs, in particular relating to the challenges of measuring the modern economy ('Needs');
 - Assess the effectiveness of the Office for National Statistics (ONS) in delivering those statistics, including the extent to which ONS makes use of relevant data and emerging data science techniques ('Capability');
 - While fully protecting the independence of UK National Statistics, consider whether the current governance framework best supports the production of world-class economic statistics ('Governance').
- 1.2** The Review was prompted by the growing difficulty of measuring output and productivity accurately in a modern, dynamic and increasingly diverse and digital economy. In addition, there was a perception that ONS was not making full use of new data sources and the continuously-expanding volume of information that was becoming available about the evolution of the economy, often as a by-product of the activities of other agents in the public and private sectors. Finally, frequent revisions to past ONS data, together with several instances where series turned out to be deficient or misleading, had led to a perception in some quarters that official data were not as accurate and reliable as they should be.
- 1.3** The Review has been undertaken by Sir Charles Bean, Professor of Economics at the London School of Economics and formerly Deputy Governor for Monetary Policy at the Bank of England, with the support of a small team of officials from HM Treasury, ONS and the Bank of England.² In order to provide a suitable evidence base, the Review team issued a Call for Evidence to users of economic statistics, to which there were 66 responses, and conducted more than 200 meetings with relevant organisations and stakeholders. In addition, the team also met representatives of several overseas National Statistical Institutes (NSIs) to

1 HM Treasury, (2015). 'Fixing the foundations: creating a more prosperous nation'. Available [here](#).

2 Nick Broadway, James Clarke, Mausmi Juthani, Nayeem Khan, Karina Kumar, Will Laffan, Ivan Petrella, Mario Pisani, Britta Rinaldi and Michal Stelmach.

give an international perspective on the UK's statistical system and its practices. The team also benefitted greatly from the willing assistance of many members of ONS and the UK Statistics Authority (UKSA).

- 1.4** As requested by the Chancellor of the Exchequer and the Minister for the Cabinet Office, an Interim Report, containing five strategic recommendations underpinned by eight recommended actions, was published on 2 December 2015.³ That Interim Report focussed exclusively on the first and second bullets in the Terms of Reference. This Final Report develops the analysis in the Interim Report along several dimensions, including a fuller consideration of the challenges and opportunities generated by the digital revolution, and also extends the analysis to encompass governance issues, the third bullet in the Terms of Reference.
- 1.5** This Review builds upon a number of previous reviews of various aspects of economic statistics carried out in the past 30 years, including those by Stephen Pickford, Chris Allsopp, Tony Atkinson, Kate Barker and Art Ridgeway, and Paul Johnson. The regular commissioning of external reviews of ONS statistics, together with the recurrence of some similar themes, suggests that there are long-standing issues that have not yet been addressed. These reviews are discussed in more depth in Chapter 4.

Measuring the economy

- 1.6** Economic statistics are central to monitoring, understanding and managing the economy, at both national and regional levels. Access to statistics that are accurate, reliable, relevant and timely is thus vital for policy makers. But such statistics are equally important for effective decision making in the private sector. Moreover, economic statistics provide a yardstick for assessing economic performance and are thus central to the ability of Parliament, the media and the public at large to hold policy makers to account.
- 1.7** Economic statistics constitute a very broad canvas. For the purposes of this Review, an economic statistic is simply any piece of quantitative information that is valuable to either the public or private sector for the analysis of a relevant economic issue. The primary organising framework for the statistical analysis of the economy is, of course, the National Accounts. These provide a set of interlocking accounts for the outputs, expenditures and incomes of the constituent sectors of the economy. But many other economic statistics are valuable too. These include data on: prices and pay; the supply and demand for labour; asset prices and financial transactions.
- 1.8** For some purposes, information is needed below the level of the aggregate economy. For instance, analysis of financial stability benefits from a detailed accounting of the flows of assets and liabilities between sectors and, better yet, individual firms. Similarly, effective regional policies require that information be available about economic activity at the level of the corresponding regional units.

³ The Review's Interim Report can be found [here](#).

- 1.9** An effective NSI therefore needs to be able to deliver reliably a broad range of statistics that correspond to the needs of users, to an acceptable degree of accuracy, and in a sufficiently timely fashion. It is worth stressing that this task is an extremely demanding one: a statistic is not a fact. Even when a variable is seemingly well-defined, such as the total number of people working at a particular time, in most cases it still has to be estimated, usually by sampling a fraction of the total population. Ensuring that this sample is representative is often a challenge in itself.
- 1.10** Moreover, in many cases the variable of interest is itself conceptually complex. Take, for instance, a variable such as real GDP – the total quantity of value added in the economy within a given period at a constant level of prices. This involves aggregating the outputs net of inputs, across an enormous variety of individual lines of business, appropriately adjusting for movements in the relevant price levels. This is hard enough when an economy largely produces physical goods, but becomes even harder in developed countries like the UK where services constitute a large fraction of the economy, as these are frequently specifically tailored for individual customers. And some goods and services, for instance those provided by the public sector, are often supplied free of charge at the point of delivery implying a direct measure of the value of the output is lacking.
- 1.11** Measuring the economy has become even more challenging in recent times, in part as a consequence of the digital revolution. Quality improvements and product innovation have been especially rapid in the field of information technology. Not only are such quality improvements themselves difficult to measure, but they have also made possible completely new ways of exchanging and providing services. Disruptive business models, such as those of Spotify, Amazon Marketplace and Airbnb, are often not well-captured by established statistical methods, while the increased opportunities enabled by online connectivity and access to information provided through the internet have muddled the boundary between work and home production. Moreover, while measuring physical capital – machinery and structures – is hard enough, in the modern economy, intangible and unobservable knowledge-based assets have become increasingly important. Finally, businesses such as Google operate across national boundaries in ways that can render it difficult to allocate value added to particular countries in a meaningful fashion. Measuring the economy has never been harder.

ONS capability and performance

- 1.12** ONS is the primary source of economic statistics in the UK, having been formed in 1996 by the merger of the Central Statistical Office and the Office for Population Censuses and Surveys. As a result of successive mergers, the main UK economic statistics are now produced almost exclusively by ONS. But there are other important statistics, including some used in economic policy making, that are produced by civil service departments and agencies, as well as the devolved administrations. The wider UK statistical system is consequently more

decentralised than elsewhere. Although international comparisons are not straightforward, for a country of its size, the total resources devoted to measuring economic activity appear broadly comparable to the level of spending in other developed countries, although there have been some significant fluctuations over time. Originally, ONS activities were spread across three main sites: London (mainly National Accounts); Newport (principally data collection from businesses); and Titchfield (the Census). Following the 2004 Lyons Review, however, the decision was taken to relocate most of the London operation to Newport. Some 90% of the thousand or so staff based in London subsequently left the organisation rather than make the move, resulting in a considerable – though potentially temporary – loss of experience to the organisation.

- 1.13** The overwhelming primary source of information for ONS’s economic statistics is regular surveys of businesses and households, with around one and half million survey forms dispatched annually. Relatively little use is made of administrative data, such as that held by Her Majesty’s Revenue and Customs (HMRC) and still less of other (and growing) sources of big data. That is in stark contrast to some other NSIs, such as those of Canada and Scandinavia, which rely far more heavily on such information in constructing their economic statistics. In large part, the limited exploitation in this country reflects the cumbersome legal framework governing the use of such information for statistical purposes.
- 1.14** The bulk of ONS’s economic statistics are constructed in line with methodologies laid down in internationally-agreed accords, such as the UN System of National Accounts (SNA). While these accords exist for good reason – to ensure that statistics are internationally comparable – the evolution of such accords typically lag the changing structure of the modern economy. Ideally, staff would have time to invest in exploring the consequences of changes in the economy for economic measurement and for investigating the use of alternative data sources. However, time constraints and a complex and fragmented technology estate have limited the extent to which this is possible. Instead, staff are overwhelmingly focussed on simply ‘getting the statistics out’. Relatively little attention is devoted to how the quality and relevance of the statistics, or their delivery, could be improved.
- 1.15** There is little doubt that users believe that ONS performance has deteriorated in recent years. Some of the criticism stems from the size and frequency of revisions. As documented in Chapter 2, however, this is not entirely justified. Revisions are inevitable when information accrues only gradually, unless the release of the first estimates is delayed so long as to be useless for policy purposes. And ONS’s revision performance, at least in regard to GDP, is not significantly out of line with its peer NSIs. What is of more concern is the frequency of what might be loosely classed as ‘errors’ ranging from simple processing errors to a failure to understand properly the nature of new sources of information before they were incorporated into the production of statistics. A common feature has been inadequate ‘sense-checking’ of statistics before release, with users often being the ones spotting the problems. Insufficient

analytical capability, aggravated no doubt by the loss of experienced staff following the relocation to Newport, together with the time pressures are likely to have contributed to this state of affairs.

Governance of statistics

- 1.16** The governance of UK statistics was substantially reformed under 2007 Statistics and Registration Service Act. This saw the creation of an independent body, the UK Statistics Authority (UKSA), with the statutory objective to promote and safeguard the production and publication of official statistics that serve the public good. UKSA has two main roles. The first is to oversee ONS; in effect, the UKSA Board operates as the Board for ONS. The second is the monitoring and assessment of *all* UK official statistics, only a subset of which are produced by ONS, with the rest produced by members of the Government Statistical Service in other departments and agencies. The 2007 Act was in large part a response to a perception in some quarters that there had been inappropriate political interference in the production of some statistics, potentially resulting in a more general loss of trust in official statistics. Reflecting that and the breadth of the statistics UKSA was responsible for assessing, departmental sponsorship of ONS/UKSA was also transferred to the Cabinet Office from the Treasury.
- 1.17** In order to carry out its monitoring and assessment role, UKSA established a regulatory function to assess the compliance of official statistics against a Code of Practice for Official Statistics (the ‘Code’); statistics compliant with the Code are badged as ‘National Statistics’. Although the Code covers several aspects of the production of official statistics, including quality, the main emphasis of the regulatory function, since its creation, has been on providing reassurance to users about trustworthiness in the production and release of statistics. Reflecting that, together with the context for the new governance arrangements, the assessment operation focussed heavily on independence and the processes of production and dissemination with relatively limited attention paid to the underlying quality and relevance of the statistics. More recently, the UKSA Board – and the regulatory function itself – have recognised that the function should shift its focus further towards quality.
- 1.18** In contrast, most users appear to believe that the National Statistic badge implies that a statistic is not only produced independently but also a good measure of the economic concept in question. Only recently has the regulatory function been complemented with an assessment of the underlying quality of statistics, with the launching of a new ONS programme of National Statistics Quality Reviews (NSQRs), with the first two sets of statistics scrutinised being those associated with the Labour Force Survey, and with the National Accounts and Balance of Payments. The increasing focus on quality alongside trustworthiness is very welcome but needs to be reinforced.
- 1.19** Ultimately UKSA, as the overseer of ONS, carries the responsibility for ensuring that the statistics produced by ONS are accurate, reliable and relevant, as well as their efficient production. The commissioning of this Review is an indication that at least some key stakeholders believed that this was not the case. And the

evidence collected for the Review lends qualified support to that view. A significant barrier to more effective scrutiny by UKSA appears to have been a lack of relevant, timely and digestible information flowing to the UKSA Board to help it hold ONS to account, to identify risks and to put in place proportionate solutions. It also appears that an understandable concern to maintain independence has encouraged a degree of isolation and inhibited frank discussion with users and key stakeholders regarding ONS's statistics and performance.

A vision for the future provision of economic statistics

1.20 The future provision of economic statistics should reflect the following observations:

- Reliable economic statistics are an important *public* good: while timely and relevant economic statistics are key to effective policy making, they are also central to business planning and to the electorate's ability to hold decision makers to account.
- No single set of statistics is likely to cover all purposes: different users have needs for statistics that are constructed or stratified by sector, industry or region in different ways.
- An ability to interrogate the underlying microeconomic data can help enormously in understanding the causes of significant economic problems, such as the 'productivity puzzle'.
- The methodologies governing the construction of economic statistics need to evolve along with the economy: what constitutes a satisfactory organising framework at one time may subsequently cease to be so.
- The volume of data – both public and private – that can be employed in principle in measuring the economy, together with the technological capacity for handling it, has exploded as a result of the digital revolution.

1.21 As noted above, ONS currently operates somewhat like a 'factory', focussed on generating statistics from a range of surveys for a broad set of economic variables according to prescribed methodologies, with only limited exploration and exposition of their deficiencies. Such a model is, however, increasingly ill-suited to meeting the demands of a wider range of users seeking a timely and detailed insight into a rapidly changing economy. That requires ONS to become:

- More attuned to meeting the variety of user needs.
- More candid in exposing the limitations of ONS's existing statistics and more ambitious in identifying ways of addressing them.
- More adept at understanding and interrogating its source data.
- More innovative in exploiting alternative sources of information.

- More proactive in investigating the consequences of new economic phenomena for the relevance of existing statistics.

In short, ONS should seek to be more of a service provider in the understanding of economic statistics, providing additional value beyond the mere provision of the statistics. As a custodian of much of the data, ONS should have a comparative advantage in advancing the frontier of economic measurement.

1.22 Achieving this vision will need to be supported by changes within ONS/UKSA. Specifically:

- Greater analytical capability, both in economic understanding and the ability to handle and interrogate large data sets.
- A more open and self-critical culture that encourages improvement and innovation, together with the capability to implement such improvements successfully.
- A rationalisation and upgrading of technology and systems.
- More proactive monitoring of the quality and relevance of ONS's statistics, together with well-functioning processes for addressing identified shortcomings on a timely basis.
- Enhanced transparency to facilitate better accountability.

1.23 The vision is broadly consistent with UKSA's five-year strategy for the future provision of official statistics and ONS/UKSA management has already taken some significant steps towards its realisation.⁴ But its achievement will also require support from government. First, sufficient resources will be needed. The settlement in the 2015 Spending Review provided room to take forward key enabling initiatives to raise workforce skills and improve systems, as well as close some existing statistical gaps. But the speed with which the gap between current provision and international best practice can be eliminated will be partly dependent on the availability of the necessary resources. Second, changes in the legislative framework are required to facilitate the better exploitation of administrative data for statistical purposes, while still ensuring that privacy and confidentiality concerns are met.

1.24 To further the achievement of this vision, this Review identifies a self-reinforcing package of six strategic recommendations. The rationale behind these is outlined in brief below and developed at more length in the body of the Report. These strategic recommendations in turn are underpinned or complemented by specific actions set out below and justified in the main body of the Report.

⁴ UK Statistics Authority, (2014). 'Better Statistics Better Decisions'. Available [here](#).

Recommendations: Measuring the economy

Strategic Recommendation A: *Address established statistical limitations*

1.25 Chapter 2 of this Report summarises some of the key challenges and gaps in the measurement of the UK economy. Many of these are longstanding and were highlighted in previous reviews. Issues highlighted in this Report include:

- Shortcomings in the production of National Accounts, including the absence of double-deflated volume measures of GDP;
- The scope for improving early estimates of GDP through the use of administrative data, including by making greater use of information from the expenditure and income measures;
- The need for more detailed and complete Flow of Funds statistics;
- Inadequate measurement of the service sector, including the need for more detailed deflators and volume indices that better reflect the richness of service sector activity;
- Inadequate regional statistics and the potential for administrative data to fill some of the gaps.

1.26 Addressing these established statistical gaps needs to happen alongside remedial work to address the deficiencies of economic statistics that have had their status as National Statistics suspended ('de-designation'). The statistics for UK Trade, Construction activity and CPIH are all cases in point. In addition, ONS needs to satisfy both itself and users that its other statistics are not only trustworthy but also accurate, reliable and relevant to user needs. To that end, UKSA should extend the recently introduced programme of NSQRs to the rest of the statistical estate.

1.27 Shortcomings and gaps cannot all be addressed and resolved simultaneously. Some will be more important than others, and some will be easier to fix than others. Ultimately the UKSA board is responsible for endorsing a timetable for addressing statistical shortcomings and gaps on the basis of advice from ONS management. But that prioritisation should be transparent, responsive to the views of users and key stakeholders, and based on an assessment of costs and benefits.

1.28 This strategic recommendation is therefore underpinned by the following recommended actions:

- Recommended Action 1: ONS/UKSA should develop a programme to address established statistical limitations transparently and on the basis of an assessment of costs and benefits.

- Recommended Action 2: UKSA should continuously seek to identify shortcomings in its economic statistics, both inside ONS and across departments, through a rolling programme of NSQRs, drawing on both internal and external expertise.

Strategic Recommendation B: *Become more agile in the provision of statistics that properly reflect the changing structure and characteristics of the economy*

- 1.29** Ensuring statistics accurately reflect a changing economy is one of the hardest challenges NSIs face. The basic conceptual framework underpinning the National Accounts when first devised was of an economy in which most businesses were engaged in the production of reasonably homogenous goods in a single country. The reality today is rather different, with many businesses operating across national borders and producing a range of heterogeneous goods and services that may be tailored to the tastes of individual consumers.
- 1.30** Moreover, as noted earlier, the digital revolution has not only led to rapid quality change and product innovation as a result of advances in computing power, but also to new ways of exchanging and providing services as a result of increased connectivity. Measuring this new economy poses particular challenges to established measurement approaches. Examples include: the provision of free services or content that is instead financed by bundling it with advertising; the displacement into home production of information-intensive activities previously undertaken by intermediaries, such as travel agents; the growth of the ‘sharing economy’; and the increased importance of investment in intangible knowledge-based capital relative to that in physical capital. Although hard to capture, the analysis in Chapter 3 of this Report suggests that phenomena such as these can potentially lead official data on economic activity to be understated. Further investigation is therefore warranted.
- 1.31** Moreover, this is not a one-off challenge. As the economy evolves, so does the appropriate frame of reference for statistics: it is a constantly moving target. As a result, the internationally-agreed statistical methodologies will almost always be somewhat out of date or incomplete as they are bound to lag behind the changes in the economy.
- 1.32** A progressive response to this challenge requires an NSI not only to be abreast in understanding (and explaining) the limitations of its statistics but also to lead the way in developing more appropriate measures. In partnership with relevant outside experts and institutions,⁵ ONS should therefore establish a continuing programme of research into the measurement implications of emerging economic trends, conducting one-off studies at first to gauge their potential quantitative importance. If warranted, this could then guide the development of experimental statistics capturing the new phenomena, possibly complemented by additional data collection. The analysis would help ONS to be a leader in

5 The recent appointment of three ONS Fellows represents a useful step in this direction.

developing the international standards that govern the definitions of most official economic statistics. It also provides a potentially useful input into UKSA's monitoring of the quality of ONS's economic statistics.

1.33 This strategic recommendation is therefore underpinned by the following recommended actions:

- Recommended Action 3: Institute an ambitious work programme to evaluate the quantitative implications for the measurement of economic activity associated with the digital economy.
- Recommended Action 4: In conjunction with suitable partners in academia and the user community, ONS should establish a new centre of excellence for the analysis of emerging and future issues in measuring the modern economy.

Recommendations: ONS capability and performance

Strategic Recommendation C: *Refocus the culture of ONS towards better meeting user needs*

1.34 Keeping economic statistics relevant to users in both public and private sectors means that ONS, and other producers of economic statistics, need to move away from focusing largely on the production of statistics and become more of a service provider, helping users answer their questions about the economy. Moreover, by virtue of its access to the raw data, ONS is in pole position to understand and explain the limitations of its statistics and develop alternative indicators when required.

1.35 This requires a cultural shift throughout ONS. Staff should be proactive, rather than reactive, in engaging with users and responsive to those users' needs. Staff should be more curious about what is driving their statistics, self-critical in identifying shortcomings and more open in explaining those limitations to users. Finally, staff need to be encouraged to identify ways to improve the production of their statistics, with ideas bubbling up from below. Management needs to take active steps to embed such a culture within the DNA of the organisation.

1.36 This strategic recommendation is therefore underpinned by the following recommended actions:

- Recommended Action 5: ONS should take action to ensure that the primary objective of statistical producers is to meet user needs, by encouraging staff to: understand better how their statistics are used; be more curious and self-critical in identifying statistical issues; collaborate with users and experts; and create a culture of rewarding innovation.
- Recommended Action 6: While building up the capability of its operation in Newport, ONS should also increase its London profile in order to facilitate stronger engagement with users of economic statistics, as well as expanding its engagement with users across the rest of the UK.

- Recommended Action 7: Statistical releases should contain clear and prominent commentary on the quality of those statistics, noting any significant limitations and also highlighting any scope for misinterpretation.
- Recommended Action 8: Users and commentators should be more alert to the limitations of economic statistics and economics courses should pay more attention to the problems of economic measurement.
- Recommended Action 9: ONS should continue to develop its new and greatly improved website in order to ensure that its full range of statistics can be easily accessed and viewed.

Strategic Recommendation D: *Make the most of existing and new data sources and the technologies for dealing with them*

- 1.37** The UK significantly lags many other advanced economies in its exploitation of administrative data (information held within the public sector but obtained for purposes other than the construction of statistics). This reflects both the cumbersome nature of the present legal framework governing the sharing of such data and a cultural reluctance on the part of some departments and officials to data sharing. There should be a presumption that all publicly-held data is available to ONS for the purpose of producing economic statistics, except where there is a strong reason not to, for example for reasons of national security.
- 1.38** ONS should also investigate the scope for using similar data held by the private sector, for instance on payments. It should also explore the potential for using new techniques of collecting and analysing big data, such as web scraping, text-mining and machine learning. Although these may not always be suitable as core data sources for regularly produced economic statistics, they may also be valuable for cross-checking data, filling in temporary gaps ('nowcasting'), and exploring the significance of new economic phenomena prior to undertaking more systematic measurement.
- 1.39** Greater use of this data simultaneously holds out the prospect of more timely and accurate economic statistics, and a reduction in the reporting burdens on businesses and households. Unlocking this trove of information can extend statistical samples to near-census size, increasing their accuracy and allowing statistics, such as regional data, to be finely stratified to match individual user needs.
- 1.40** Although better use of this data has the potential to transform the provision of economic statistics, ONS will need to build up its capability to handle such data. This will take some time and will require not only recruitment of a cadre of data scientists but also active learning and experimentation. That can be facilitated through collaboration with relevant partners – in academia, the private and public sectors, and internationally. It also requires rationalising and upgrading ONS technology together with a sound data infrastructure.

- 1.41** This strategic recommendation is therefore underpinned by the following recommended actions:
- Recommended Action 10: Remove obstacles to the greater use of public sector administrative data for statistical purposes, including through changes to the associated legal framework, while ensuring appropriate ethical safeguards are in place and privacy is protected.
 - Recommended Action 11: Exploit new methods for collecting data and explore the scope for using information gathered by private sector entities in the production of economic statistics, nowcasting and one-off studies of emerging measurement issues.
 - Recommended Action 12: Ensure ONS's technology and data systems are capable of supporting the flexible exploitation of very large data sets.
 - Recommended Action 13: Build ONS's capacity to clean, match and analyse very large datasets, including through the recruitment of a cadre of data scientists.
 - Recommended Action 14: Establish a new centre for the development and application of data-science techniques to the production of economic statistics.

Strategic Recommendation E: *Become better at understanding and interrogating data*

- 1.42** Shedding light on hard-to-explain puzzles often requires digging down below the surface into the underlying data. Being adept at this is key to understanding the shortcomings and limitations in the data, and also identifying new trends. An enhanced capability within ONS to interrogate the underlying microdata would better support the production of economic statistics and have the added benefit of making ONS staff better able to sense-check statistics before their release, so reducing the frequency of errors and corrections.
- 1.43** Realising this objective requires that greater economic and analytic expertise be embedded within ONS. It also requires management to create sufficient space alongside the day-to-day production process to allow such exploratory investigation, something that is not really the case at present. Finally, the supporting technology and data systems need to be sufficiently flexible and agile.
- 1.44** An ability to access and interrogate the microdata is also important for some users. An ONS that is proficient in the investigation of the microdata should also be better positioned to support the needs of such users, either through the provision of direct access to anonymised data or else by carrying out investigations on their behalf.
- 1.45** This strategic recommendation is therefore underpinned by the following recommended actions:

- Recommended Action 15: Increase the economic expertise within ONS and implement a smart and effective system for quality assurance and sense-checking across the production of all economic statistics.
- Recommended Action 16: Introduce recruitment and training schemes to raise analytical skills across ONS, including offering opportunities for specialists to progress in their careers by contributing to research and development of value to the organisation.
- Recommended Action 17: Support the greater use of microdata by ONS and approved researchers by improving the available metadata, and simplifying approval processes, while continuing to respect confidentiality issues.

Recommendations: Governance of statistics

Strategic Recommendation F: *Strengthen the governance framework so as to help support the production of high-quality economic statistics.*

- 1.46** The existing statistics governance arrangements were focussed on building public trust in official statistics, particular in the independence of their production from political interference. Although constant vigilance is certainly necessary, the Review found no evidence whatsoever to suggest that users believed this was an issue for the economic statistics produced by ONS. In that regard, the governance arrangements have been a success. The Review did identify some issues with departmental production, including a tendency to focus more on ministerial needs rather than the needs of users, and on practices around release of management information.
- 1.47** Practice could, however, be improved in some departments in regard to the release of management information relevant to economic debates. When such information is released, it is important that its provenance be clear and that it be released to all users simultaneously and not selectively. Moreover, when such information is likely to attract media or market attention, it should be treated as an official statistic and published in a manner that is compliant with the Code of Practice. This will become more important as greater use is made of management and administrative data in the production of ONS's economic statistics, as such information may be helpful in predicting subsequent official data releases.
- 1.48** While independence in production is important to maintaining public trust, it is by no means the only factor. Accuracy, reliability and relevance – in other words, quality – are also relevant. And in that regard, recent experience and user feedback has been less encouraging. Indeed, the commissioning of this Review in part reflects a concern that key economic statistics may no longer be providing as good a guide to economic developments as they should.
- 1.49** UKSA, as the overseer of ONS, ultimately bears the responsibility of ensuring that ONS economic statistics are of high quality as well as trustworthy. While the UKSA board has been less focussed on this issue than it could have been, the

information provided to the board by the regulatory arm of UKSA could have paid even more attention to quality issues and the organisational shortcomings contributing to them. For that reason, the Review believes the regulatory function should be strengthened significantly by creating an ‘Independent Regulation and Evaluation Office’ (IREO), charged not only with assessing the consistency of official statistics with the Code of Practice but also carrying out rigorous assessments of the accuracy, reliability and relevance of statistics, and of ONS’s ability to deliver them. To do this effectively, the IREO will need its own statistical expertise and to be able to call on outside experts for assistance in the execution of its reviews.

- 1.50** It is a moot point whether this Office is best situated within or outside of UKSA. The former facilitates scrutiny, whereas the latter bolsters independence. On balance, the Review believes that, at least in the first instance, it would make sense to adopt the former model, with the head of the IREO reporting to the UKSA Chair, though for it to work well it needs the rest of ONS/UKSA to welcome the associated, and sometimes uncomfortable, scrutiny. As well as providing the UKSA board with digestible and relevant information, the IREO should publish an annual public report on its activities, giving an independent assessment of the quality of ONS’s statistical estate. Such a report should also aid users, government and Parliament in holding ONS/UKSA to account.
- 1.51** UKSA has not been alone in having paid insufficient attention to dealing with quality issues. Arguably a lack of close engagement on the part of the Cabinet Office has also contributed. The Review has considered whether it would make sense to transfer departmental responsibility to HM Treasury, a key user and stakeholder, but decided that in some circumstances that might lead to concerns about interference or a lack of even-handedness. Instead, the Review suggests the establishment of a high-level stakeholder group to act as a conduit for stakeholders to make known their concerns to UKSA.
- 1.52** Greater use of administrative data in the construction of economic statistics would require the parallel development of a suitable set of policies governing their use. UKSA should ensure that such policies are developed and well understood within ONS. An independent person or body should also be appointed to reassure the public that sensitive data is used ethically and to adjudicate on any contentious issues.
- 1.53** Finally, ONS presently appears to lack good estimates of the costs of producing each statistic, including the burden placed on survey respondents. Effective planning and prioritisation is impossible without such information. This needs to be rectified.
- 1.54** This strategic recommendation is therefore underpinned by the following recommended actions:
- Recommended Action 18: The government should delegate to UKSA the power to decide that a piece of data be classified as an official statistic; high-profile releases of management information by departments should be

treated as official statistics and be compliant with the Code; UKSA should decide whether official statistics should be assessed against the Code for the purposes of National Statistic status.

- Recommended Action 19: The independence of departmental statistics Heads of Profession should be reinforced, with any abuses highlighted by the Independent Regulation and Evaluation Office (see Recommended Action 24 below); there should be a formal role for the National Statistician in the appointment and performance management of the Heads of Profession.
- Recommended Action 20: In the event of greater use being made of administrative data in producing economic statistics, UKSA should, after consultation with other departments, put in place suitable policies governing their use, together with the appointment of an independent person or body to oversee their application and adjudicate on any difficult cases.
- Recommended Action 21: UKSA should provide a more nuanced assessment of the status of a statistic than is conveyed by the binary National Statistic designation.
- Recommended Action 22: ONS should establish an effective and transparent process for prioritising and allocating resources, supported by better management information.
- Recommended Action 23: A high-level group comprising representatives of HM Treasury, the Bank of England and other key stakeholders and users should be established to facilitate frank and open discussion with the UKSA Board.
- Recommended Action 24: The UKSA regulatory function should be subsumed within a new 'Independent Regulation and Evaluation Office' (IREO) charged with assessing the trustworthiness and quality of official statistics as well as ONS's effectiveness; the head of the IREO would report to the UKSA Board and publish an annual assessment of ONS performance and the whole statistical estate.

Content outline

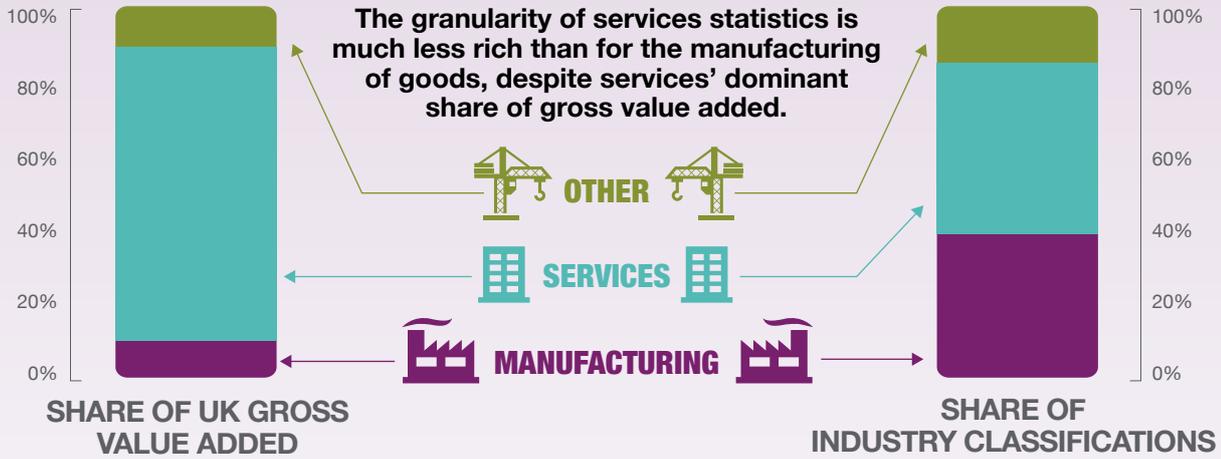
- 1.55** Underpinning these six strategic recommendations are 200 pages of observation, analysis and assessment organised into four chapters.
- 1.56** Chapter 2 discusses some important established limitations, including measurement of: GDP, and the issue of revisions; services, and financial and public services in particular; financial interconnectedness; the regional economy, the labour market, physical capital, and the land market.
- 1.57** Chapter 3 explores emerging issues, some of which relate to the potential measurement challenges posed by the rapidly-evolving digital economy. These emerging issues include: valuing the data-driven economy; the sharing economy; intangible capital; quality adjustment; and the international location of activity.

- 1.58** Chapter 4 covers the effectiveness of ONS in meeting users current and future statistics needs. It starts by setting the historical context and a chronology of recent reviews of ONS. It then explores various factors contributing to ONS's effectiveness: resourcing; recent performance; the use of survey and administrative data; analytical and data science capability; culture; technology and systems.
- 1.59** Chapter 5 covers the effectiveness of the governance framework for economic statistics, looking in particular at: independence of statistics; quality and relevance of statistics; prioritisation processes; and external scrutiny.

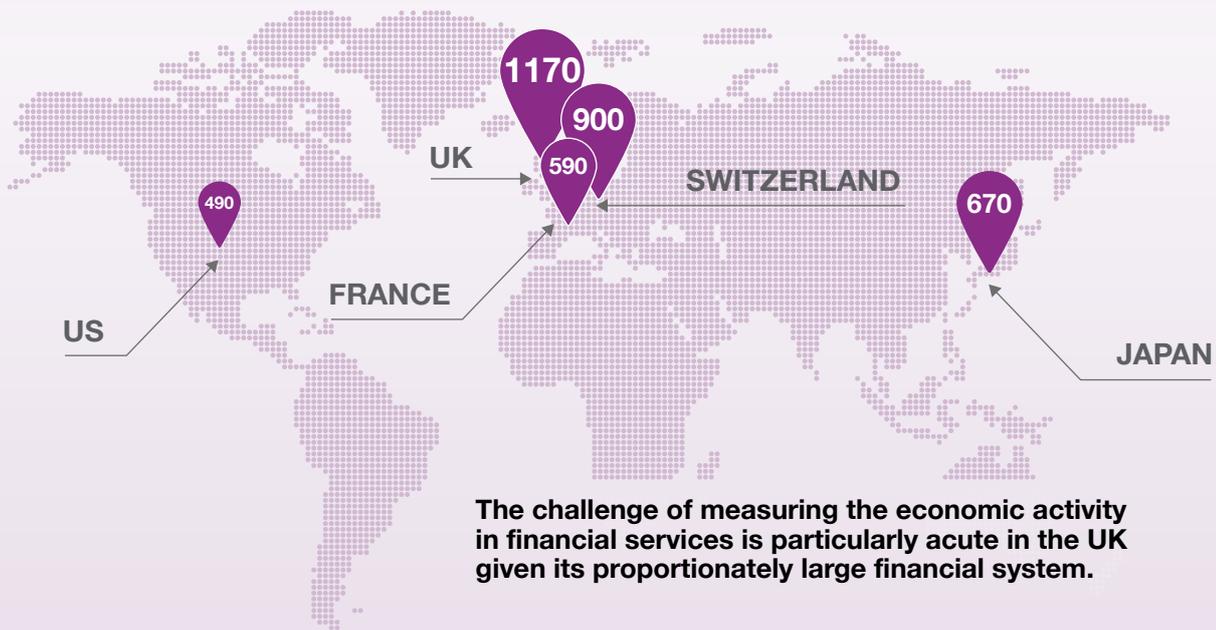
MEASURING THE MODERN ECONOMY

ESTABLISHED STATISTICAL CHALLENGES

The modern economy is a complex entity, subject to a continual process of change and development, that presents a number of established measurement challenges

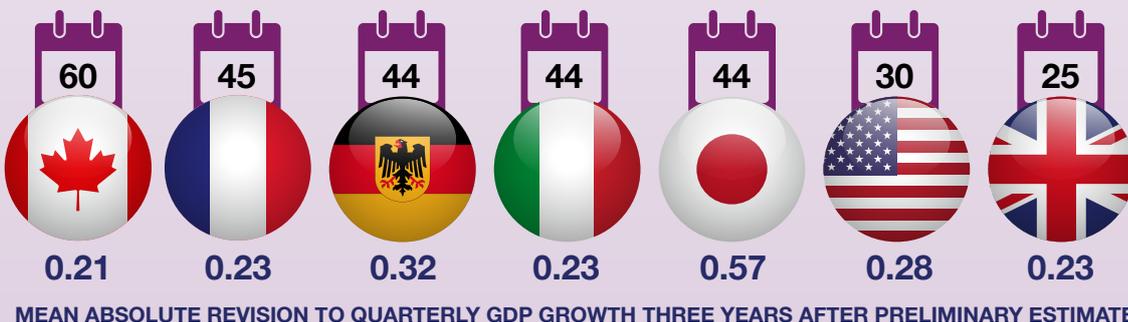


Size of financial systems as a % of GDP



The challenge of striking the right balance between timeliness and accuracy of early estimates of GDP is not unique to the UK

TIMING OF PRELIMINARY QUARTERLY GDP ESTIMATE (DAYS AFTER END OF REFERENCE QUARTER)



Chapter 2: Measuring the modern economy – established challenges

- 2.1** The modern economy is a complex entity, subject to a continual process of change and development. The challenge is to ensure that economic statistics – and the methodologies used to construct them – evolve so as to capture these changes such that they remain relevant, accurate, and timely. However, in some areas, UK economic statistics have fallen behind or not kept up with international best practice.
- 2.2** This chapter discusses a number of long-standing challenges that can limit the accuracy and relevance of economic statistics. These are: the construction of GDP; improving the coverage of services (including financial and public services); understanding financial inter-connectedness; the provision of regional statistics; capturing a dynamic labour market; measuring physical capital; and improving land market data. Most of these challenges have been identified in previous reviews of official statistics, but dealing with them remains an outstanding issue.
- 2.3** The Review does not claim to exhaustively cover all the measurement issues that users suggest warrant attention (see Call for Evidence responses). Instead the Review examines a collection of issues frequently raised by users where the Review believed it could contribute to the public debate.

Measuring GDP

- 2.4** First developed in the 1930s and 1940s, the National Accounts provide the basic framework for monitoring the evolution of economic activity, incomes and expenditure at the national and sectoral levels. Not only are they central to the decisions of policy makers but they also frame the employment and investment decisions of businesses. In the UK, the production of timely and reliable National Accounts is a key responsibility of ONS. Their production is subject to international standards which ensures comparability across countries.
- 2.5** Within the National Accounts, gross domestic product (GDP) is probably the most followed indicator, with the growth rate of GDP often seen as a summary statistic for the current health of the economy. The central role of GDP, together with its limitations as a summary statistic, came out strongly in responses to the Call for Evidence and in discussions with stakeholders.
- 2.6** Generally speaking, GDP (at current prices) provides a monetary measure of the total value added by the market economy, together with services provided, in a specific time period. Because a general rise in all prices will simply lead to an

equi-proportionate rise in this current-price measure, a more useful measure for monitoring economic developments is provided by a corresponding measure with prices held constant (GDP at constant prices).

2.7 Importantly, GDP is not a measure of welfare and does not reflect economic inequality or sustainability (environmental, financial, or other), a point recently reiterated by the LSE Growth Commission.¹ Moreover, unpaid activities, home production and other non-market services (with the exception of public services) are not captured within the National Accounts.²

2.8 Because the source of all incomes lies in the flow of value added generated by production and all production must be either consumed at home or abroad or else invested, GDP can be measured in three alternative and equally valid ways:

- Production or output (GDP(O)) – The value of the output of goods and services produced less the intermediate inputs used in their production (known as gross value added or GVA), plus any taxes (net of subsidies) on those products.
- Income (GDP(I)) – The income earned by households and businesses in the production of goods and services, plus any taxes (net of subsidies) on production and products.
- Expenditure (GDP(E)) – The value of the final expenditure by households, businesses (capital formation and inventory accumulation) and the government, plus net exports (exports less imports) of goods and services.

2.9 Although conceptually equivalent, the three approaches in practice regularly yield different estimates. Each measure is estimated from different sources and samples and is subject to both sampling and non-sampling errors.³ But because the three GDP measures are conceptually identical, it makes sense to combine all three estimates into a single measure, placing more weight on the more reliable sources of information. Even so, the final estimates will be exactly that: estimates, not the ‘truth’. This uncertainty surrounding official measures of GDP is inadequately recognised in public discourse, with commentators frequently attributing spurious precision to the estimates.

2.10 In bringing the three alternative estimates of GDP together, ONS employs the so-called Supply and Use Tables, which provide a detailed picture of inputs and outputs together with associated final product demands and supplies. However, these tables are only available around 18 months after the end of the year in question. So, for periods after the latest Supply and Use Tables, GDP is

1 Aghion, P., Besley, T., Browne, J., Caselli, F., Lambert, R., Lomax, R., Pissarides, C., Stern, N., and Van Reenen, J., (2013). ‘Investing for Prosperity: Skills, Infrastructure and Innovation – Report of the LSE Growth Commission’. Available [here](#).

2 Note that ONS produce a household satellite account, separate to the National Accounts, which attempts to account for a number of elements of unpaid home production (e.g. laundry, transport, cooking, childcare). Available [here](#).

3 For a discussion, see Manski, C., (2014). ‘Communicating Uncertainty in Official Economic Statistics,’ NBER Working Papers, No. 20098. Available [here](#).

estimated by simply grossing up the most recent balanced estimate of GDP by the subsequent growth rates implied by the GDP(O) measure alone as this is thought to provide the most accurate short-term indicator.⁴

- 2.11** The balancing process combines the three estimates of economic activity into a single estimate of GDP. However, it is important to recognise that the compilation of the National Accounts produces a comprehensive picture of activity, income and expenditure at the sectoral level. Different elements within the National Accounts will be useful for different purposes. For instance, a breakdown of production can be used to identify which industries are contributing most to the growth of aggregate output or productivity. By the same token, the expenditure accounts can be used to identify the main sources of demand growth in the economy.
- 2.12** Cross-checking consistency across the National Accounts can improve the accuracy of the various statistics. In particular, the balancing process is paramount in reconciling the different statistics of the National Accounts into a single overarching view of the economy. It is in the balancing process that expert judgement and sense-checking of the numbers takes place. However, as discussed later, the current reliance on GDP(O) may be a weakness of the UK's approach, given the lack of up-to-date information on intermediate consumption and in the absence of so-called 'double deflation'.

Revisions and the trade-off between timeliness and accuracy

- 2.13** Users want economic statistics, including estimates of GDP, which are both timely and accurate. But because the information used in estimation typically increases over time, there is a trade-off between the two. (The scope for improving *both* timeliness and accuracy through the better exploitation of administrative and private big data is a major theme of Chapter 4.) Early estimates based on incomplete information will be less reliable than later ones based on more complete information. But the longer a decision maker has to wait for the statistics, the less useful are they likely to be. The obvious solution to this problem is to provide users with a sequence of estimates, based on increasingly richer underlying information. Revisions may arise not only as a result of acquiring more data but also through the correction of errors, changes in seasonal adjustment, reweighting to a new base year and the implementation of methodological changes.
- 2.14** Although revisions are a natural consequence of more information becoming available with the passage of time, many respondents to the Call for Evidence expressed frustration with frequent revisions to GDP and related statistics. Sometimes these revisions can be large enough to result in fundamentally different pictures of the economy being provided by the initial and mature

4 ONS, 'A guide to the supply and use process'. Available [here](#). It is worth noting that this practice is not universal. For instance, headline US GDP figures are based on the expenditure approach, although the US Bureau of Economic Analysis also reports the income approach.

estimates. A risk is that such revisions threaten public confidence in the accuracy of the statistics. The remainder of this sub-section looks at two particular issues: the timing of the initial estimate of GDP, which provides the benchmark against which subsequent estimates will be judged; and the subsequent revision history from a comparative perspective.

Timing of the preliminary estimate of quarterly GDP

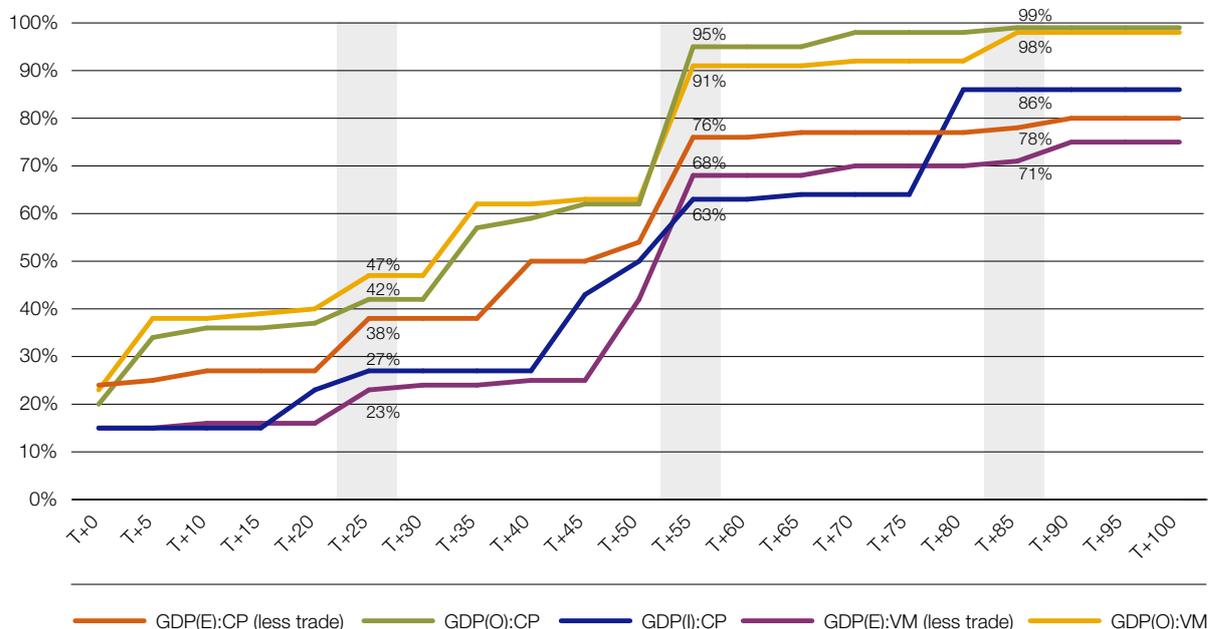
2.15 In 1993, the publication of the preliminary estimate of quarterly GDP was brought forward from seven weeks after the end of the reference quarter to 25 days (T+25) to make use of new data sources. T+25 remains the timing of the first estimate of quarterly GDP. Table 2.A shows that the UK presently publishes its preliminary estimate faster than any other G7 country.

Table 2.A: Timing of preliminary quarterly GDP estimate (days after end of reference quarter)

Canada	France	Germany	Italy	Japan	UK	US
60	45	44	44	44	25	30

Source: Lequiller, F., Blades, D., (2014). Understanding National Accounts. OECD publishing.

2.16 Chart 2.A shows how the quantity of information available for each measure of GDP increases following the end of the reference quarter. The preliminary estimate, derived entirely through the output measure, includes roughly 47% of output data for the quarter. Delaying publication from T+25 to T+35, for instance, would increase the amount of information available from 47% to around 62%. By the time the third estimate is published, 89 days after the end of the reference quarter (T+89), well over 90% of the data is available. It is worth noting, however, that it is not the additional fraction of data that a delay would make available that matters, but rather its information content. The information that presently goes into the preliminary estimate reflects predominantly just the first two months of the quarter. The extra 15% of information made available by waiting another ten days is largely for the third month of the quarter and so would be particularly valuable if there is a sharp change in the overall growth rate of the economy between the second and third months, e.g. following the collapse of Lehman Brothers in September 2008.

Chart 2.A: Availability of data for each GDP measure from the end of the reference quarter

Note: CP refers to current prices, VM refers to volume measures.

Source: Office for National Statistics calculations.

- 2.17** Could a slightly later publication of the preliminary estimate lead to a material reduction in the magnitude of subsequent revisions? European regulations presently would not prevent that, though they do require ONS to submit the second and third estimates by two and three months after the end of the quarter.⁵ There is a proposal to require the submission of preliminary estimates around a month after the end of the quarter, though that is likely only to be for the purposes of calculating an EU-wide GDP estimate. But in any case, ONS argues that delaying the first estimate by even one or two months would not lead to a substantial improvement as revisions between the preliminary estimate and third estimate are typically just 0.1 or 0.2 percentage points in either direction, with no statistically significant evidence of bias.⁶
- 2.18** Using current data sources, a delay from, say, T+25 to T+35 would yield little additional expenditure or income data. However, if — as discussed in Chapter 4 — greater use is made of alternative data sources, such as Her Majesty's Revenue & Customs (HMRC) administrative data, that might no longer be the case. So new data sources could also change the optimum date for publishing the initial estimate of GDP.

5 Eurostat, (2010). 'European system of accounts – ESA 2010 – Transmission programme of data'. Available [here](#).

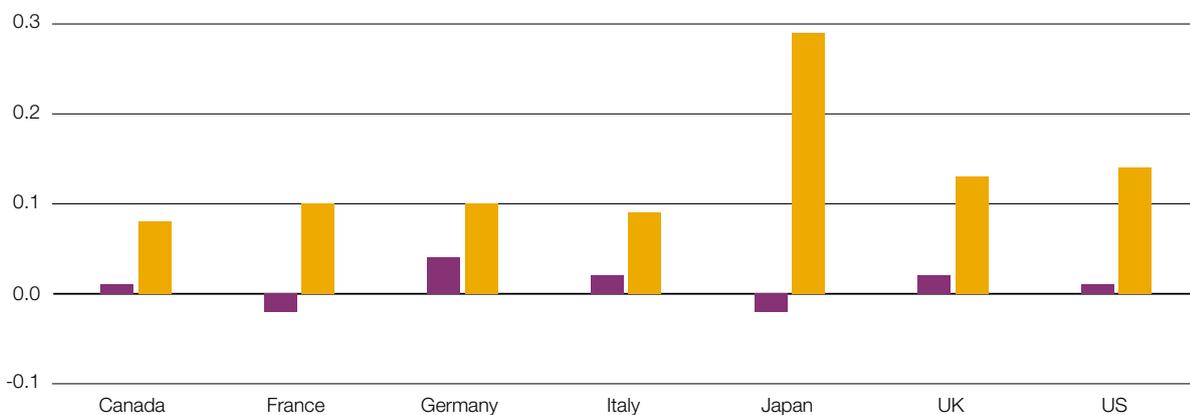
6 Walton, A., (2016). 'Revisions to GDP and components in Blue Book 2014 and 2015'. Available [here](#).

International comparisons of GDP revisions

2.19 As noted earlier, several users voiced concern about the size of revisions to UK GDP estimates. And in some quarters, there appears to be a perception that ONS's track record has deteriorated and is poor relative to its peers in other jurisdictions.

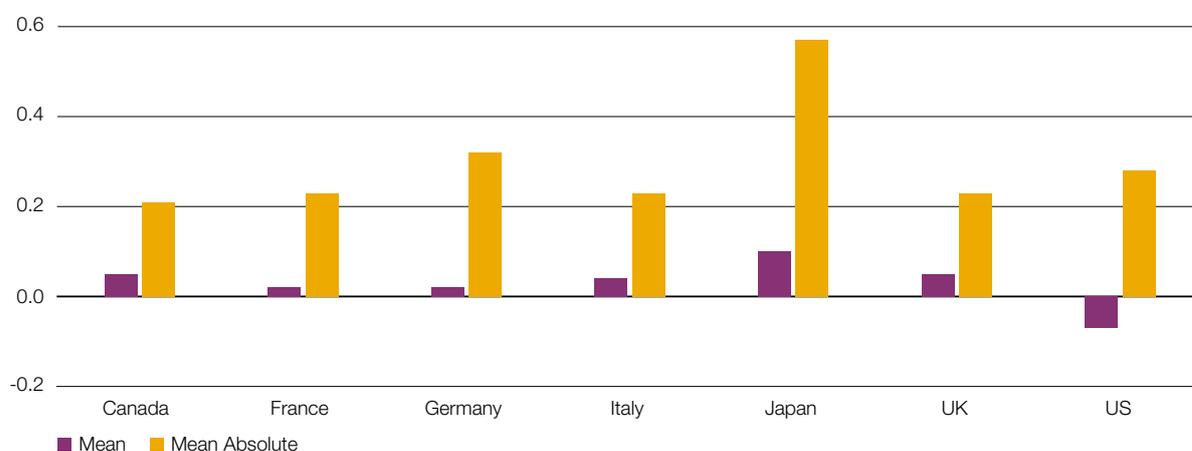
2.20 The OECD has recently examined mean revisions and mean absolute revisions to GDP (and its components) for 18 developed countries.⁷ Mean revisions — the average size of revisions to estimates within a given period after the first estimate — will reveal whether there is a tendency on average to revise the data up or down. Mean absolute revisions — the average of the revisions irrespective of sign — will then capture the overall reliability of the initial estimates. The research concluded that, for windows spanning five months to three years after the first estimate of quarterly GDP growth, the UK actually had one of the lowest mean revisions across all 18 countries, and mean revisions broadly in line with the G7 (Charts 2.B and 2.C show the results for the G7). Moreover, the mean revisions to quarterly and annual growth rates were not statistically different from zero. And as far as mean absolute revisions to quarterly growth go, the UK is again one of the best performers (see Chart 2.B and 2.C again).

Chart 2.B: Revisions to quarterly GDP growth five months after preliminary estimate, Q4 1994 to Q4 2013 (percentage points)



7 Zwijnenburg, J., (2015). 'Revisions of quarterly GDP in selected OECD countries,' OECD Statistics Brief, No. 22. Available [here](#).

Chart 2.C: Revisions to quarterly GDP growth three years after preliminary estimate, Q4 1994 to Q4 2013 (percentage points)

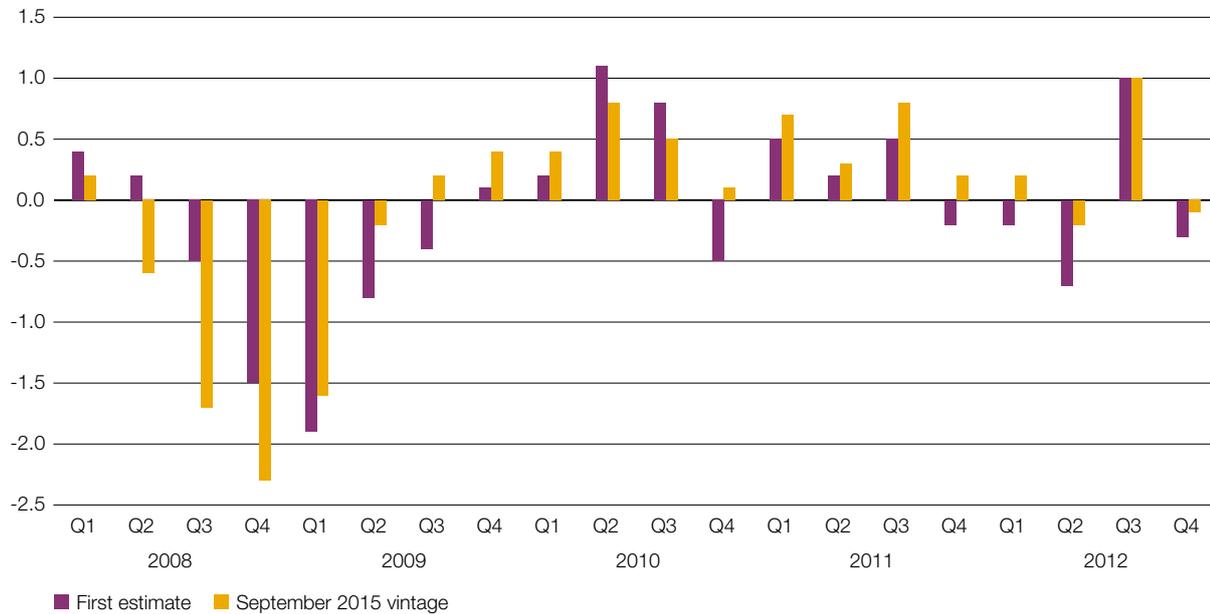


Source: Zwijnenburg, J., (2015). 'Revisions to preliminary quarter-on-quarter GDP growth estimates.'

2.21 These findings are somewhat at variance with the perception that ONS performance has been unusually poor. This could just be the result of users being unaware of the experience in other countries. Or it could reflect frustration with revisions at times of particular economic importance.⁸ For instance, Chart 2.D shows how estimates of GDP growth during the Great Recession have been revised, including large revisions around the turning points between 2008 and 2009 and the elimination of the 2012 'double-dip' recession. Recent Deutsche Bank Research has highlighted a negative correlation between the first and latest estimates of UK annual GDP growth over 2003 and 2007.⁹ Revisions to isolated but important events are likely to colour users' perception of the reliability of the statistics but would not be well captured by the mean revisions used in the OECD analysis.

⁸ Taylor, C., and Wales, P., (2014). 'Economic Review, August 2014'. Available [here](#). Figure 6 illustrates that GDP revisions are larger when output is also more volatile.

⁹ Buckley, G., (2016). 'UK Economic Topic – UK: Beware the first estimate of GDP'. Deutsche Bank Research.

Chart 2.D: Revisions to quarterly GDP growth, 2008 to 2012

Source: Office for National Statistics.

2.22 Alternatively, a belief that UK data are particularly prone to revision may reflect revisions that take place beyond the three-year window. As little new information accrues so long after the quarter ends, such revisions are likely to be the result of methodological changes. And there is indeed evidence that UK revisions are larger than in other countries when later estimates are involved. Bank of England analysis comparing average revisions between the UK T+89 estimate of quarterly GDP growth and the estimate five years later found that early estimates tended to be revised up on average.¹⁰ And European Central Bank analysis comparing the first estimate of quarterly GDP growth to the latest estimate over the period 1999 to 2006 found evidence that estimates were revised up on average, and that the mean revision was larger in the UK than in a number of other developed countries.¹¹ Citi Research has examined revisions to annual GDP growth between the first and latest estimates over 1999 to 2012.¹² Again, the authors find that the UK is subject to both the largest mean revision and largest absolute mean revision in the G7.

10 Cunningham, A., and Jeffery, C., (2007). 'Extracting a better signal from uncertain data,' Bank of England Quarterly Bulletin 2007 Q3. Available [here](#).

11 Branchi, M., Dieden, H., Haine, W., Horvath, A., Kanutin, A., and Kezber, L., (2007). 'Analysis of revisions to general economic statistics,' European Central Bank Occasional Paper Series, No 74. Available [here](#).

12 Saunders, M., Fordham, T., and O'Kelly, A., (2015). 'UK Economics Weekly: Balancing Economic and Political Uncertainties,' Citi Research.

2.23 It is not altogether surprising that methodological changes on average lead to upward revisions to GDP growth. It will frequently be the case that new industries or business models are poorly captured by the extant statistical methodology. But over time, as the new industries become better appreciated, so the methodology will be updated to capture them, resulting in an increase in measured activity. In this sense, GDP is a constantly moving target.

2.24 But why might revisions due to methodological changes be greater here than elsewhere? One can think of at least a couple of possibilities:

- A larger proportion of UK output, relative to other countries, is driven by new and innovative activities that are gradually being captured by methodological improvements (e.g. the UK has a large financial sector and some recent methodological changes have been designed to capture better value added in financial services).
- The UK has been slower than some other countries to implement the legislated European statistical standards, European System of Accounts (ESA) 1995 and 2010, with the result that recent revisions include a 'catch-up' element.
- In 2011, ONS switched from using the RPI to the CPI as the main source of deflators for the expenditure approach to GDP. This change brought the UK in line with international best practice and so introduced upward revisions unique to the UK, averaging just 0.1 percentage point per quarter over the period 1997 to 2010. Recent ONS analysis found that adjusting for this one-off methodological change brought metrics of UK revisions more in line with international experience.¹³

13 ONS, (2016). 'Economic Review: March 2016'. Available [here](#).

Box 2.A: Facilitating a historical perspective

Access to historical time series of economic statistics is important to contextualise economic developments and learn from past policy mistakes. Historical data helps users to understand how the structure of the economy has evolved, the relationships between key variables, and the impact of policy. However, methodological improvements and changes to the availability of data sources mean that there are typically structural breaks in historical time series of any length. For example, the update to the latest industrial classification, which introduced much-needed improvements to the measurement of services, also created obstacles to extending a number of time series back prior to 1997. The limited back series is a limitation on looking at more than just one recession and recovery period.

While some progress has been made in reinstating consistent historical time series, user feedback suggests further efforts are necessary. In their response to the Call for Evidence, HM Treasury remarked that, “Where historical data is available it is not always clear how methodological changes or variable and classification updates (e.g. geographies, occupations) impact the time series.” Furthermore, methodological changes need to be applied to the past with caution to ensure the revised time series remain consistent with other economic indicators at the time. Given this, it is important that ONS ensures that older vintages of data constructed according to earlier methodologies remain available to users, together with appropriate commentary about the nature of the structural breaks. Moreover, such earlier vintages also provide the basis for studying statistical revisions and the context in which historical policy decisions were made.

Where consistent historical series are not yet available, ONS should also respond to user demand by providing data series that splice data from either side of the structural break, together with appropriate commentary. Though methodologically not entirely satisfactory, many users employ similar methods themselves and provision of spliced data series would help to standardise series across users and avoid duplication of effort.

The production of GDP estimates

- 2.25** The Barker-Ridgeway Review lays out the process underlying the production of the GDP figures in some detail. The preliminary estimate of GDP is based entirely on the output approach, using turnover data as a proxy for value added. A key reason for this is the limited information on expenditure and income available at the time of release. After the preliminary GDP estimate, some of this information becomes available, which is then used to inform subsequent releases.

- 2.26** The output measure remains the dominant driver of the early estimates of GDP. Information about expenditure and income have almost no influence on the reported path of GDP until the Supply and Use Table balancing exercise that takes place during the preparation of the Blue Book some 18 months after the end of the year in question.⁴
- 2.27** There are three particular issues relating to the construction of the output measure that warrant discussion. The first is that the measures of intermediate consumption used within the balancing process are no longer reliable. The second relates to the prices used to construct the measure of real intermediate consumption. The third relates to the dominance of the output information in the construction of early estimates of GDP.

The measurement of intermediate consumption

- 2.28** The Purchases Inquiry gathers the data required for the Supply and Use Table matrix that shows industries' intermediate consumption broken down by product. Such data needs to be updated fairly regularly in order to reflect the changing structure of production. However, the Purchases Inquiry was abandoned in 2007 in order to reduce costs. For subsequent years, intermediate consumption is calculated by carrying forward appropriate input/output ratios from the last Purchases Inquiry in 2004, supplemented by information from the Annual Business Survey which contains some more timely data on businesses' intermediate consumption. The corresponding product values may also be adjusted in the light of other production, expenditure and income information. Estimates of industries' intermediate consumption consequently fall short of EU best practice of updating the supply-use information at least every five years.
- 2.29** The use of outdated information on the flows of products between sectors is a major concern when substantial changes are taking place in the production structure, and the past decade has hardly been one where that structure has stood still. Advances in information and communications technology have led to the emergence of wholly new industries. It has also changed the way existing businesses are organised, including the facilitation of outsourcing.¹⁴ Moreover, the financial crisis also might have prompted substantial changes in the way businesses operate.¹⁵ Finally, there have been significant movements in commodity prices and the value of sterling which are likely to have affected businesses' production decisions.
- 2.30** The Barker-Ridgeway Review recommended that ONS reinstates the Purchases Inquiry or else use some alternative source of information on inputs that captures the most significant changes. And in its assessment of the National Accounts,

14 See e.g. Abramovsky, L., and Griffith, R., (2006). 'Outsourcing and Offshoring of Business Services: How Important is ICT?' *Journal of the European Economic Association*, MIT Press, vol. 4(2-3), p.594-601. Available [here](#).

15 Gulati, R., Nohria, N., and Wohlgezog, F., (2010). 'Roaring Out of Recession,' *Harvard Business Review*, March. Available [here](#).

UKSA noted that ONS could go further in tackling this issue.¹⁶ ONS is currently developing a new Purchases Inquiry in order to provide updated data on product use. Under current plans, the first returns will be requested in 2016 so the new data will not be incorporated until Blue Book 2018. It is crucial that this does not slip. ONS could also usefully investigate whether alternative data sources, such as firm turnover and purchases information from HMRC VAT data, could provide additional information.

Double vs single deflation

2.31 The correct method of calculating value added in volume terms (recognised by European regulation) is by ‘double deflation’.¹⁷ Under double deflation, real value added is estimated as the nominal value of output deflated by a price index for output less the value of inputs deflated by a corresponding input price index.¹⁸ But because it lacks reliable data on input prices, in particular for corporate services, ONS presently uses double deflation only in the estimation of output for the agriculture and electricity industries. Elsewhere it applies single deflation, deflating both the nominal values of inputs and outputs by indices of output prices. By contrast, some other countries, such as the US, produce industry accounts that are fully double deflated.

2.32 It is acknowledged that current ONS practice may give rise to potential distortions in estimating both aggregate real GDP and the relative contribution of each industry to that aggregate.¹⁹ Single deflation implicitly assumes that prices for intermediate consumption rise at the same rate as for output. Single and double deflation estimates will therefore differ whenever this assumption is not fulfilled.²⁰ When the change in the input price index is greater than the change in the output price index, the growth in real value added measured by double deflation will be greater than that obtained by using single deflation (and vice versa). For instance, the rise of China as a goods producer has resulted in

16 UKSA, (2015). ‘Assessment of Compliance with the Code of Practice for Official Statistics – the UK Annual and Quarterly National Accounts,’ assessment report 299. Available [here](#).

17 European System of Accounts 2010. Available [here](#). The term ‘double deflation’ might be better expressed as ‘double indicator method’, since it also encompasses methods that are based on volume extrapolation. The essential point of double indicator methods is that separate, independent, estimates for the volume of output and intermediate consumption of an industry are made.

18 Except where direct volume indicators can be used, avoiding the need for deflation.

19 See e.g. [here](#). Also note that in presence of single deflation, the growth of real GDP measured from the output side will not equal the same growth rate measured from the expenditure side, even in the absence of errors and omissions (see Oulton, N., (2004). ‘A statistical framework for the analysis of productivity and sustainable development’. Paper prepared for the Allsopp Review of Statistics for Economic Policymaking. Available [here](#)).

20 See e.g. Stoneman, P., and Francis, N., (1994). ‘Double Deflation and the Measurement of Output and Productivity in UK Manufacturing 1979-89,’ *International Journal of the Economics of Business*, vol. 1(3), p.423-437. Available [here](#). And Cassing, S., (1996). ‘Correctly Measuring Real Value Added,’ *Review of Income and Wealth*, Series 42, Number 2. Available [here](#).

downward pressure on the prices of goods relative to services.²¹ Single deflation in the goods sector will deflate inputs only by the prices of goods, and neglect the relative prices of services. Since the majority of the inputs are services, single deflation is likely to lead to an overstatement in real intermediate consumption and an understatement of real value added in the goods sector.

- 2.33** Furthermore, differences in real value added using double deflation instead of single deflation are more striking when data become more disaggregated. Within a single industry, differences in the inflation rates of input and output prices are larger than in the aggregate. Therefore single deflation potentially results in biased estimates of output and productivity at the industry level.
- 2.34** Recent work by ONS explores the use of double deflation utilising data from the Annual Business Survey.²² This study revealed large differences compared to measures provided in the National Accounts. In particular, double deflation tends to produce more volatile estimates of gross value added than single deflation.²³
- 2.35** The difference between double and single deflated volume measures can be substantial. A study by the US Bureau of Economic Analysis shows that single deflation gives misleading results when substantial changes in prices for intermediate inputs are not passed through to output prices.²⁴ This can happen when growth is changing sharply or there are large movements in exchange rates or commodity prices. The US Bureau of Economic Analysis study finds that single deflated measures would have yielded markedly stronger growth in the US in the last quarter of 2008. The study also shows that, for particular industries, the impact of different inflation rates for input and output prices can be substantial. For instance, in computer manufacturing, the downward bias from single deflation in the quarterly rate of growth was larger than ten percentage points in some quarters.
- 2.36** Developing input price measures that would allow ONS to adopt the double deflation methodology should improve the measurement of real GDP and, since the bias arising from single deflation is different in each industry, the relative contribution of industries to the UK total. The Barker-Ridgeway Review attached high priority to developing double deflation estimates. The National Accounts Medium-Term Work Plan 2015-18 recognises that the development of annual volume-based balanced Supply and Use Tables is a key long-term objective for

21 See e.g. Carney, M., (2015). Remarks at the Economic Policy Symposium hosted by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming. Available [here](#).

22 Franklin, M., and Murphy, J., (2014). 'Labour Productivity Measures from the ABS, 2008-2012,' ONS. Available [here](#). Note that this article measures approximate value added (turnover less non-employment business costs) from business accounts which is conceptually different than gross value added as defined in the National Accounts along various dimensions.

23 This phenomenon is identified in OECD, (2001). 'Measuring Productivity – OECD Manual' as a likely consequence of double deflation and in part reflects the higher volatility in intermediate input prices. Available [here](#).

24 Robbins, C., Howells, T., and Li, W., (2010). 'Experimental Quarterly U.S. Gross Domestic Product by Industry Statistics,' BEA Briefing. Available [here](#).

the UK National Accounts.²⁵ ONS aims to have integrated Supply and Use Tables at previous year's prices into the production process by Blue Book 2018.²⁶ This will signify forward progress towards the production of double deflated volume measures, even though Supply and Use Tables at previous year's prices will be produced under single deflation at first. ONS is still considering the best approach to transition to double deflation and systems limitations mean that implementation is not planned before 2020.

Box 2.B: Bias from double deflation – some simple arithmetic

This box illustrates the source of the bias that might arise from the measurement of GDP under single deflation. To do so, a relationship between single and double deflation under simplifying assumptions is derived first for a basic two industry economy and then generalised to a more realistic environment. In what follows it is assumed that the difference between one industry's purchasers' and input prices is negligible and without chain-linking. For simplification, it is also assumed that each industry produces a single good which is either used as intermediate or final consumption.

Two industry economy

Consider a simple economy with two industries A and B and focus on industry A's value added. Define:

- Nominal gross output in industry A with $GO_{A,t}^N$
- Intermediate input supplied from industry A to industry A with $IC_{A \rightarrow A,t}^N$
- Intermediate input supplied from industry B to industry A with $IC_{B \rightarrow A,t}^N$

Nominal value added in industry A is:

$$GVA_{A,t}^N = GO_{A,t}^N - IC_{A \rightarrow A,t}^N - IC_{B \rightarrow A,t}^N$$

Single deflated value added for industry A is then defined as:

$$GVA_{A,t}^{R:SD} = \frac{GVA_{A,t}^N}{P_{A,t}}$$

Whereas double deflated value added is defined as:

$$GVA_{A,t}^{R:DD} = \frac{GO_{A,t}^N}{P_{A,t}} - \frac{IC_{A \rightarrow A,t}^N}{P_{A,t}} - \frac{IC_{B \rightarrow A,t}^N}{P_{B,t}}$$

With some simple algebra one can get an expression for the bias arising from single deflation:

25 ONS, (2015). 'National Accounts Mid-Term Work Plan 2015-2018'. Available [here](#).

26 Note that the next development of Supply and Use Tables in previous year's prices are constrained to yearly balancing process so as to fulfil the mandated requirement of ESA 2010. However, quarterly balancing process is feasible subject to modelling assumptions.

$$\frac{GVA_{A,t}^{R:SD}}{GVA_{A,t}^{R:DD}} - 1 = - \left(\frac{P_{B,t}}{P_{A,t}} - 1 \right) \frac{IC_{B \rightarrow A,t}^R}{GVA_{A,t}^{R:DD}}$$

where $IC_{B \rightarrow A,t}^R = IC_{B \rightarrow A,t}^N / P_{B,t}$. Therefore the bias depends on the relative price between the two industries and is proportional to the importance of industry B as input supplier to industry A. In order to gauge how important this bias is in practice, it is useful to make some additional simplifying assumptions. Specifically, assume that in the short run the input-output shares are constant (or that their variation is small compared to the variability of output growth and the relative prices). This would be the case if the elasticity of substitution between the input from two different industries is very low, which is likely to be the case in practice. Taking a first-order approximation of the relationship above, it is then possible to derive a relationship between the growth rate of real value single and double deflation ($g_{A,t}^{SD}$ and $g_{A,t}^{DD}$ respectively):

$$g_{A,t}^{DD} - g_{A,t}^{SD} = \omega_{B \rightarrow A} \frac{IC_A^N}{GVA_A^N} (\pi_{B,t} - \pi_{A,t})$$

where $IC_A^N = IC_{A \rightarrow A}^N + IC_{B \rightarrow A}^N$ and $\omega_{B \rightarrow A} = IC_{B \rightarrow A}^N / IC_A^N$ denotes the share of input material supplied from industry B over the nominal value of total input used in industry A's production and $\pi_{j,t}$ denotes inflation of industry j (therefore $\pi_{B,t} - \pi_{A,t}$ denotes the change in the relative price). This equation illustrates the single deflation bias. The growth of single deflated GDP is a downwardly biased estimate of the correct double deflated statistics whenever the inflation of the input industry is higher than that of the industry of interest.

Bias in a single industry in presence of multiple industries

It is possible to generalise the relation above to a multi-industry environment. For any industry i the bias from single deflation can be shown to be:

$$g_{i,t}^{DD} - g_{i,t}^{SD} = \frac{IC_i^N}{GVA_i^N} \sum_{j \neq i} [\omega_{j \rightarrow i} (\pi_{j,t} - \pi_{i,t})]$$

The size of the bias in each industry depends on two factors. First, the bias tends to be larger the larger is the value of intermediate input for each unit of value added. To give an order of magnitude to this multiplier it is useful to note that, on average, about three-fifths of gross output in every industry is used as intermediate consumption in other industries, which implies a multiplier equal to 1.5. Second, it depends on the input-output structure of the economy and

relative inflation rates.²⁷ As a result, when looking at the rate of growth of the entire economy the overall bias can be equal to zero, if biases of different signs cancel each other out when considering the entire set of intermediate inputs into production.

The bias in the information services industry

In order to illustrate the bias it is helpful to look at a specific case. For instance Patterson highlights how one industry that has displayed relatively weaker measured productivity growth in the post-recovery period is 'Information and Communication Services'.²⁸ The fact that this apparently dynamic and innovative industry displays weaker productivity growth is quite remarkable.

Focusing on Information Services (SIC 63) in 2013,²⁹ it is possible to derive the bias associated to single deflation from the formula above. The implied GVA deflator is taken as a proxy for the prices of the industry. The prices of intermediate inputs are computed from product-level deflators.³⁰ In doing so, one can match the definition of the product to industry flow of inputs in the Supply and Use Tables. Applying the formula above to this data results in a bias for this particular industry of around five percentage points. This implies that the growth rate of double deflated value added for Information Services could be almost a half higher than the measured rate of growth under single deflation (which is roughly 11%).

The dominance of output in early estimates of GDP

2.37 The Barker-Ridgeway Review noted the limited use of information relating to expenditure and income in the early estimates of GDP and the heavy reliance on turnover data. While ONS has traditionally seen this as the most reliable source of information on movements in activity in the short term, it assumes that there is a close relationship between movements in turnover and value added. We saw above that this not be the case when growth is changing sharply or there are significant movements in relative prices. Moreover, the quality of the volume measure of activity is intrinsically linked to the quality of the price indices used to

27 Input-output matrices tend to be sparse with relatively few input suppliers for each of the industries in the economy. See e.g. Acemoglu, D., Carvalho, V., Ozdaglar, A., and Tahbaz-Salehi, A., (2012). 'The Network Origins of Aggregate Fluctuations,' *Econometrica*, vol. 80(5), p.1977-2016. Available [here](#).

28 Patterson, P., (2012). 'The Productivity Conundrum, Explanations and Preliminary Analysis'. ONS. Available [here](#).

29 2013 is the last year with available data on Supply and Use Tables. We consider combined intermediate consumption matrices. Also, since 2012 is the base year, focusing on 2013 allows this simple analysis to avoid issues related to chain-linking when exploring inflation rates.

30 Product level deflators were obtained from ONS and are not publicly available.

deflate turnover. As discussed below, measuring corporate services prices is especially challenging. As a result, countries such as the US put more weight on expenditure information in constructing early estimates of GDP.³¹

- 2.38** In principle, one can envisage a system where the full breadth of data available feeds into aggregate GDP estimates based on their relative reliability, with the latter depending on the economic environment. The question is whether there is scope to improve the accuracy of early estimates of GDP by the utilisation of other sources of data on production, expenditure and income.
- 2.39** Administrative data already held in various parts of the public sector holds particular promise in this regard. For instance, monthly VAT returns to HMRC on turnover and purchases of individual businesses, matched through an improved business register, has the potential to greatly enhance the output measure of GDP, as well as the consumption component of the expenditure accounts.³² Similarly, income tax data held by HMRC presents an opportunity to derive monthly estimates of compensation of employees.³³ HMRC tax data also offers the potential to capture activities that fall below the threshold to be included in many sampling frameworks, e.g. sole traders. And investment and export statistics currently relying on survey data could potentially be improved by exploiting HMRC data on investment allowances and exports of services by UK firms to the EU. The steps needed to make this feasible are discussed further in Chapter 4.

Measuring services

- 2.40** Economic statistics are always likely to lag behind changes in the structure of the real economy. It was ever thus – Professor Diane Coyle notes that, “At the height of the industrial revolution, official statistics provided scant information about the dynamic manufacturing economy.”³⁴ When the National Accounts were first developed, manufacturing accounted for a large share of UK economic activity. Since then, the provision of services has become increasingly important, so that by 2014 services accounted for over three-quarters of gross value added and over four-fifths of employment (see Chart 2.E). Expenditure on services also

31 Landefeld, J., Seskin, E., and Fraumeni, B., (2008). ‘Taking the Pulse of the Economy: Measuring GDP’, *Journal of Economic Perspectives*, vol. 22(2), p.193-216. Available [here](#). In the US, headline GDP is entirely based on the expenditure approach. Furthermore, from mid-2015 the Bureau of Economic Analysis began publishing a new measure of U.S. output which averages GDP(E) and GDP(I), therefore excluding GDP(O) (see e.g. Council of Economic Advisers (2015). ‘A Better Measure of Economic Growth: Gross Domestic Output (GDO),’ Council of Economic Advisers Issue Brief, July. Available [here](#)).

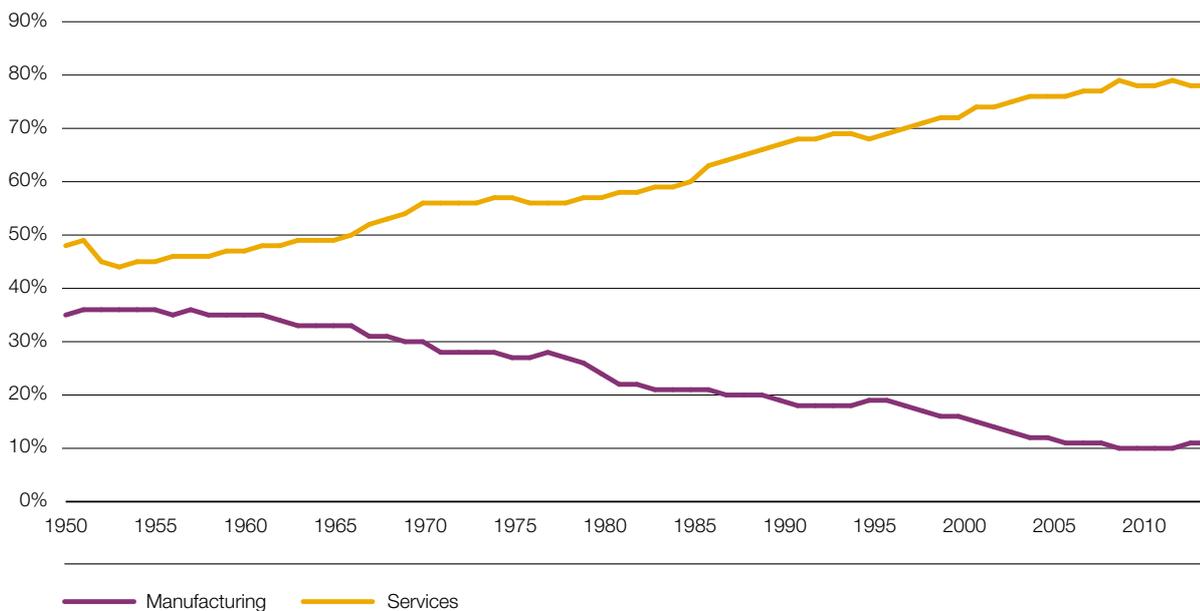
32 ONS, (2015). ‘Feasibility study into the use of HMRC turnover data within Short-term Output Indicators and National Accounts’. Available [here](#).

33 The introduction of Pay As You Earn (PAYE) Real Time Information represents a fundamental reform, requiring (from April 2013) all UK employers to notify HMRC of their liability to PAYE at the time or before they make payment to their employees.

34 Coyle, D., (2015). ‘Modernising Economic Statistics: Why It Matters’, *National Institute Economic Review* No. 234. Available [here](#).

accounts for about half of households' share of consumption. It is usually the case that official statistics adapt to such changes in the economy with some delay.

Chart 2.E: Share of nominal gross value added



Source: Hills, S., Thomas, R., and Dimsdale, N., (2015). 'Three Centuries of Data – Version 2.2,' Bank of England.

2.41 Services encompasses a wide range of activities, including people-focused services (such as healthcare and education), the handling of goods (such as retail and transport services) and the provision of advice (such as financial and legal services). Its sheer size makes the proper measurement of services critical to understanding UK economic performance. But measuring the output and prices of services is inherently more difficult than for goods as, in contrast to goods, the basic unit of production for services is often hard to define. Services are frequently tailored to a particular consumer's requirement and such customisation makes it hard to compare like with like and thus to construct an appropriate price index. This affects not only the measurement of consumer services, but also business services and thus the construction of intermediate consumption.

2.42 The 2004 Allsopp Review accorded high priority to better measurement of services.³⁵ There has been considerable progress since then, and ONS is closer to international best practice than most other NSIs in the measurement of services. For example, ONS was a pioneer in developing a monthly indicator of

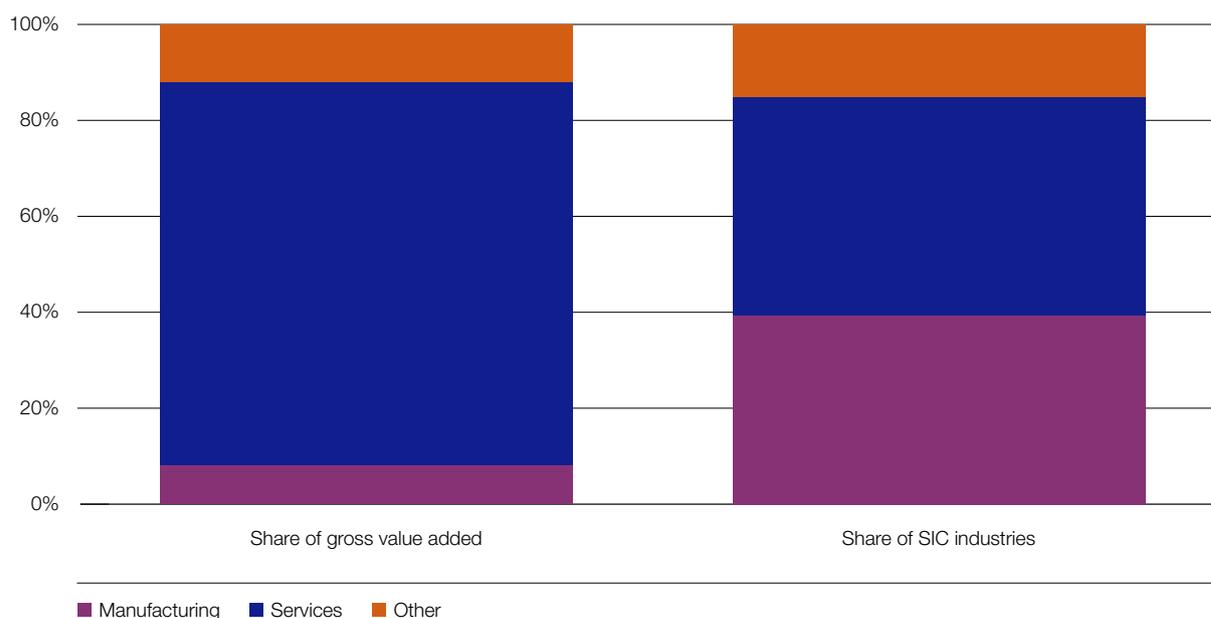
35 Recommendation 60 of Allsopp, C., (2004). 'Review of Statistics for Economic Policymaking: Final Report'. Available [here](#).

services activity (the Index of Services), akin to the long-standing Index of Production.³⁶ Even so, the recent Barker-Ridgeway Review noted that significant challenges remain.

Challenges in measuring services

2.43 To begin with, the breakdown of services is much less rich than for the production of goods. On the one hand, manufacturing is broken down into 44 industries. On the other hand, services is broken down into just 51 industries despite accounting for almost eight times the total output of manufacturing (see Chart 2.F).³⁷ Moreover, the separation between services and manufacturing is at best imprecise given that output is classified under the primary activity of the firm. Many businesses that are classified as goods producers also provide a service, such as after-sales care. In some cases, these are a significant source of revenues.³⁸

Chart 2.F: Role of services in gross value added and the Standard Industrial Classification (SIC)



Source: Office for National Statistics.

2.44 The absence of a detailed survey of services prices, analogous to the PRODCOM survey for manufacturing, is also a weakness. Inadequate detail in prices means that the corresponding output trends may be obscured. Indeed, the absence of good price indices for business-to-business services is one of the impediments to the volume balancing of the National Accounts (see earlier discussion on GDP).

36 The first publication of the monthly statistics was in 2000 as an experimental series. Available [here](#).

37 ONS, (2016). 'UK GDP(O) low level aggregates'. Available [here](#).

38 Lord Sainsbury of Turville, (2007). *The Race to the Top: a review of Government's science and innovation policies*. The Stationery Office: London.

- 2.45** These challenges in measuring services activity are likely to intensify as the economy evolves. New digital technologies, such as increasingly powerful and portable electronic devices, represent powerful enablers for the provision of services, e.g. the streaming of entertainment services (see Chapter 3).³⁹ Moreover, technological innovation also increases the scope for mass customisation to fit specific consumer preferences, leading to greater variety across services.
- 2.46** Advances in information technology also facilitate increased international trade in services and even quite specialised services can now be supplied over the internet from anywhere in the world.⁴⁰ This poses particular problems for NSIs as it becomes harder to track the destination of trade flows. For trade in goods, customs controls generate data that can be used to inform estimates of trade volumes and values. At present, ONS mainly relies on the International Trade in Services Survey in estimating services trade, but the coverage is not as comprehensive as for trade in goods. However, exports of services by UK firms to the EU also require an HMRC return. There is potential to exploit this data to improve estimates of exports of services to the EU, as well as to improve the sample frame for existing surveys.
- 2.47** The size and growing importance of the services sector provides a compelling case for devoting more resources to improving its measurement. In addition, ONS should be proactive in pressing the case for the next industrial classification system to provide a richer picture of services activity.

Measuring financial services

- 2.48** The UK has a particularly large financial services industry, accounting for 7.6% in 2012 of gross value added. However, the measurement of financial services poses particular issues. The financial industry intermediates funds from lenders to borrowers and produces, trades and settles financial contracts. However, unlike many other services providers, banks and other financial intermediaries generally do not only rely on direct fees to generate revenues but rather look to generate on the margin between what they pay for funds and what they earn on their use (the spread).
- 2.49** The 1993 System of National Accounts reform recognised this by introducing a concept of ‘financial intermediation services indirectly measured’ (FISIM), subsequently incorporated into the UK National Accounts with the 2008 Blue Book. Broadly speaking, FISIM is imputed as the interest rate margin between the lending (deposit) rate and a short-term risk-free reference rate, multiplied by

39 As argued in a recent report by the Royal Society (2009). ‘Hidden Wealth: the contribution of science to service sector innovation’. Available [here](#).

40 Coyle, D., (1997). *The Weightless World: Strategies for Managing the Digital Economy*. Massachusetts Institute of Technology Press; and Friedman, T. (2007). *The world is flat, 3.0: a brief history of the twenty-first century*. Picador, London

the value of the stock of loans (deposits).⁴¹ The chained volume measure of FISIM is then the interest rate margin in the base year multiplied by the nominal stock of loans or deposits deflated by the GDP deflator. FISIM accounts for roughly half of the gross value added of the financial service industry.

- 2.50** An allied issue is whether to treat value added in financial services as final or intermediate consumption. In line with European regulations, activity is counted as intermediate consumption (and therefore a cost of production) when the services are attributed to domestic businesses and government. But it is treated as final output (thereby adding to GDP) when provided to households and non-residents.⁴²

Challenges in measuring financial services

- 2.51** An important limitation of FISIM lies in its inadequate treatment of risk. The margin a bank charges on its loans over what it can earn by investing instead in a risk-free asset is meant to cover not just any costs of administering the loan but also the risk of default. The loan spread will therefore be higher if the perceived risk of default rises. But the existing international standards counter-intuitively treat this as an increase in the value of intermediation services provided. Several studies have shown the consequence of allowing for risk can be substantial. For instance, one study showed that the current methodology overstates imputed bank output in US by almost a half, equivalent to 0.3% of US GDP.⁴³ A similar exercise for the euro area obtained comparable figures.⁴⁴
- 2.52** Movements in the interest rates used in FISIM calculations can also generate counterintuitive effects on estimates of banking sector output. For instance, the UK financial sector recorded its fastest growth on record in the final quarter of 2008, the period just after Lehman Brothers went bankrupt!⁴⁵ But this was merely an artefact of the spike in short-term market interest rates that occurred as risk premia exploded.⁴⁶ As a consequence, FISIM measures as presently calculated are in general likely to be unreliable during episodes of financial stress.

41 This is an application of the theory of the user cost of money. See e.g. Diewert, W., (1974). 'Intertemporal Consumer Theory and the Demand for Durables,' *Econometrica* 42, May, p.497–516. Available [here](#).

42 Akritidis, L., (2007). 'Improving the measurement of banking services in the UK National Accounts' ONS Economic & Labour Market Review, Vol 1, No 5. Available [here](#).

43 Basu, S., Inklaar, R., and Wang, J., (2008). 'The Value of Risk: Measuring the Service Income of U.S. Commercial Banks,' NBER working papers, No 14615. Available [here](#).

44 Colangelo, A., and Inklaar, R., (2010). 'Banking sector output measurement in the euro area – a modified approach,' Working Paper Series 1204, European Central Bank. Available [here](#).

45 For example, see Coyle, D., (2014). *GDP: A Brief but Affectionate History*, Princeton, NJ: Princeton University Press.

46 See e.g. Brunnermeier, M. (2009). 'Deciphering the Liquidity and Credit Crunch 2007-2008,' *Journal of Economic Perspectives*, vol. 23(1), p77-100, Winter. Available [here](#).

Recognising this, in 2013 the US Bureau of Economic Analysis introduced an adjustment for risk into its calculation of FISIM.⁴⁷ There are strong grounds for exploring the implications of making a similar adjustment to UK data.

- 2.53** Another limitation of FISIM is that the *quality* of service remains predominantly unaccounted for. Some of the innovative efficiencies introduced through the new wave of financial technology (FinTech) firms may not fully pass through to the interest rate margins. More importantly, the post-crisis tightening in loan standards alongside the tightening in regulation should reduce the risk of financial instability. It is thus akin to a ‘quality improvement’ in intermediation, but this is not recognised in the calculation (this point is equally valid for the insurance industry).
- 2.54** While the UK’s approach to the compilation of financial intermediation services is governed by European standards,⁴⁸ it appears that the current practice is an area that is likely to come under scrutiny when the international standards are next revised. Until then, ONS and the Bank of England should consider alternative approaches to further improve the present calculation of FISIM, and continue to play a leading role in shaping the next generation of international standards.

Measuring public sector services

- 2.55** The effective provision of public services is a major responsibility of government and accounts for around a fifth of GDP. But NSIs face a particularly difficult problem in measuring value added by the public sector. While the ‘price’ of financial services is often only implicit, most public services are provided free or with only a token charge. Hence there is usually no price, either explicit or implicit. Moreover, there is no measure of final expenditure on such services, although there is information on costs. So the conventional approach to constructing a measure of real value added — deflating nominal output and inputs by suitable price indices and then netting off the latter— is infeasible.
- 2.56** Before discussing ways of dealing with this, it is worth noting in passing that the right approach depends on what the question is. If the interest lies in the welfare consequences of government policies or whether services are delivering value for money, then one wants a measure that looks at outputs net of the cost of generating them, i.e. a value added measure. However, if one is concerned about, say, inflationary pressures, then the value added in public services is of relatively little interest; what matters instead is the claim that the public sector

47 Hood, K., (2013). ‘Measuring the Services of Commercial Banks in the National Income and Product Accounts: Changes in Concepts and Methods in the 2013 Comprehensive Revision,’ Survey of Current Business, 93, No. 2 (February), 8-19. Available [here](#).

48 ONS is legally compliant with European legislation 549/2013 (European System of Accounts 2010, chapter 14) with respect to the calculation and allocation of FISIM.

makes on the economy's resources.⁴⁹ Indeed, this is an illustration of the more general point that how best to measure a variable often depends on how that measure will be used.

- 2.57** Historically, ONS, like most NSIs, solved the problem of a lack of both prices and final expenditure by assuming that the value of the output of public services was the same as the value of the inputs used to produce them — the 'inputs=outputs' approach. Clearly this was unsatisfactory but it was not until 1998, with the introduction of ESA 1995, that ONS began to employ proxies for the output of some parts of the public sector — specifically health, education, and social security administration — with the 'inputs=outputs' approach used for the remainder. For instance, indicators such as the number of patients seen and the number of completed medical procedures were used for measuring health output. Over the subsequent decade, the approach was extended to cover nearly two-thirds of general government consumption. However, the proxies employed were open to criticism and there was limited progress to take account of changes in the quality of services provided.
- 2.58** In 2003, Sir Tony Atkinson was commissioned by the National Statistician to undertake a review of these methods and propose improvements. The review made 54 specific recommendations and led to the creation of the UK Centre for the Measurement of Government Activity in order to pursue Atkinson's vision.⁵⁰ This resulted in significant improvements in the quantity measures of individual public services, as well as the development of quality measures for health and education. Scoping work on the measurement of the output of communal public services, such as military defence and the criminal justice system, was also carried out. By 2008, the UK was seen as the world leader in this field.⁵¹ However, budgetary constraints, a loss of expertise and a perception that the low-hanging fruit had all been picked meant that subsequent progress has been limited (see Box 4.C), while practices in many other NSIs have caught up.

Challenges in measuring public services

- 2.59** Despite the progress made immediately following the Atkinson Review, there is still scope for further improvement in measuring outputs and inputs in some parts of the public sector. Moreover the increased focus on efficiency in the delivery of public services has raised the need for reliable measures of public sector productivity. And, as in the market economy, the digital revolution is

49 Bank of England, (2004). 'Inflation Report – May 2004'. Available [here](#). Hills, B., and Thomas, R., (2005). 'The impact of government spending on demand pressure,' Bank of England Quarterly Bulletin 2005 Q1. Available [here](#).

50 Atkinson, T., (2005). 'Atkinson Review: Final Report – Measurement of Government Output and Productivity for the National Accounts,' Palgrave MacMillan. Available [here](#).

51 Statistics New Zealand, (2010). 'Measuring government sector productivity in New Zealand: a feasibility study'. Available [here](#).

changing the ways in which public services are delivered and consumed.⁵² This represents another area where more effective utilisation of data already held by other public sector bodies could pay dividends (see Chapter 4).

2.60 Users raised two particular areas where they thought progress was desirable:

- While adjustment for quality improvements is challenging even in the market sector (see Chapter 3), it is even more difficult in the public sector. For instance, in the health sector, it is not activity-type indicators, such as the number of consultations or operations, which matter; rather it is the effect of these activities on health outcomes on expected longevity or quality of life. However, it is possible to make progress in this area while also ensuring existing methods remain suitable. Even though ESA 2010 does not currently permit many elements of quality adjustments in the preparation of the National Accounts, there is scope outside of them to develop such adjustments. Some ONS work already available suggests that they can materially affect the productivity picture.⁵³
- Measures of public services output as part of the National Accounts are published on the same regular quarterly timetable as the expenditure measure of GDP. However, annual measures of public sector productivity, which reflect quality adjustments to health and education, appear roughly two years after the end of the reference year. Such a long lag reduces the value of the information in public sector planning. While the lags are in part a consequence of lags in the acquisition of the underlying information, there is perhaps scope for investigating whether other data within the public sector could be used to construct more timely preliminary estimates.

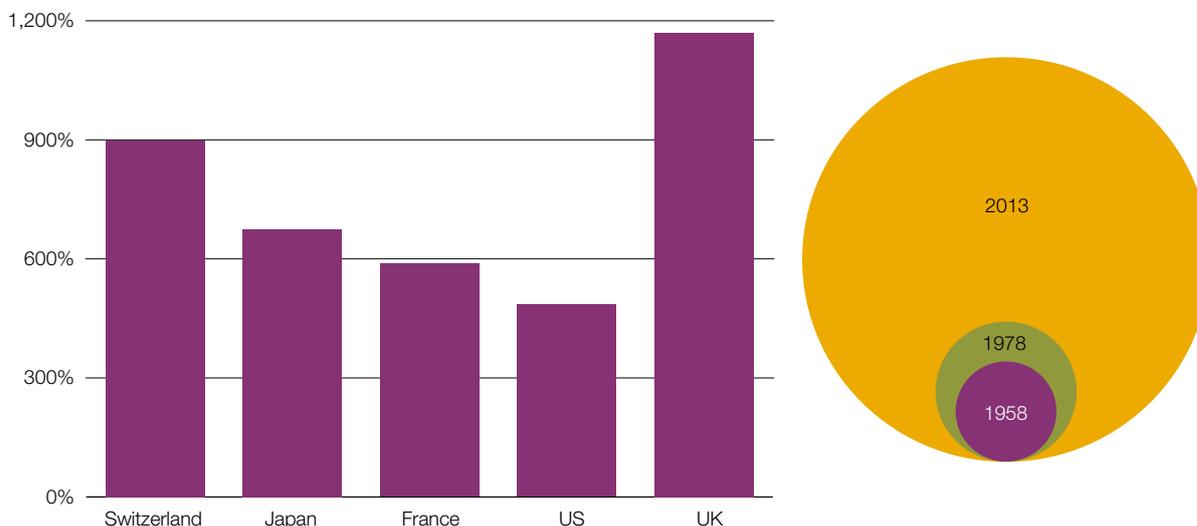
Measuring financial inter-connectedness

2.61 As already noted earlier, the UK financial system is unusually large. It has grown rapidly over the past. In particular, in terms of balance sheet size, the UK financial system is now more than five times larger than at the end of the 1970s and considerably larger, relative to GDP, than other advanced economies (see Chart 2.G).⁵⁴ The special position of London as a global financial hub is a key factor behind not only its size, but also its complexity.

52 See e.g. the work of the Government Digital Service. Available [here](#).

53 ONS, (2016). 'Public Service Productivity Estimates: Total Public Service, 2013'. Available [here](#).

54 The number would be different, without changing the qualitative picture, if we exclude derivatives from the calculation. See Chart 4 in Carney, M., (2015). 'The European Union, monetary and financial stability, and the Bank of England'. Available [here](#).

Chart 2.G: Size of financial systems as a % of GDP ^a

^a Financial system is defined as total assets of the financial corporations sector (measured on an unconsolidated basis, including derivatives) as a percentage of GDP. Data on the left panel are for 2013 for all countries but Switzerland for which data are as of 2012.

The right hand side panel reflects the relative size of the UK financial system.

Source: Bank of England Quarterly Bulletin, vol. 55(2), p. 114-129.

- 2.62** The 2007 to 2008 financial crisis underscored the costs of financial instability. Financial stress in a few, or even a single, institution can quickly spread like a virus to the rest of the economy through the nexus of inter-institutional linkages.⁵⁵ Preventing such systemic crises requires policy makers to have a good view of the risks and how they might cascade through the financial system.
- 2.63** The financial accounts that accompany the National Accounts present stock positions and flows of assets and liabilities for the constituent sectors of the economy. The 'Flow of Funds' represents a significant enhancement to these accounts by exposing the bilateral debtor/creditor relationships between pairs of sectors (including with the rest of the world). This is sometimes referred to as a 'from-whom-to-whom' presentation of the accounts. The statistics are organised and presented in a format designed to show financial flows among the sectors of an economy (as purchasers or issuers of financial assets) and corresponding financial transactions according to their type.⁵⁶ Information about financing flows is central to understanding the evolution of assets and liabilities and thus the nature of the financial vulnerabilities.⁵⁷

55 See e.g. Acemoglu, D., Ozdaglar, A., and Tahbaz-Salehi, A., (2015). 'Networks, Shocks, and Systemic Risk,' NBER Working Papers, No 20931. Available [here](#).

56 See e.g. International Monetary Fund, (2008). 'Overview of the Monetary and Financial Statistics Framework'. Available [here](#).

57 See e.g. Bê Duc, L., and Le Breton, G., (2009). 'Flow-of-funds analysis at the ECB Framework and applications,' European Central Bank Occasional Paper Series No 105. Available [here](#).

- 2.64** The UK, despite the size of its financial sector, presently possesses only an incomplete picture of the bilateral financial relationships between sectors, with an incomplete breakdown of the bilateral ‘from-whom-to-whom’ transactions and only limited detail on different subsectors within the financial sector.
- 2.65** The development of financial accounts statistics at the sectoral level has long been a requirement of international statistical regulations. Although not a legal requirement, NSIs are also encouraged to produce ‘from-whom-to-whom’ matrices for financial transactions, including details of counterparties sufficient to identify the exposure of each sector to the risks in other sectors.⁵⁸ Moreover, the development of these data has been further encouraged by global data initiatives, such as the International Monetary Fund’s Special Data Dissemination Standard Plus and the G20 Data Gaps Initiative.

UK Flow of Funds: progress to date

- 2.66** Both the Bank of England and HM Treasury responses to the Call for Evidence reiterated the need for the development of Flow of Funds statistics below sectoral aggregates. This priority has also been recognised by a recent report from UKSA.⁵⁹ Acknowledging the significant work required in extending and improving the quality of the financial accounts, the Barker-Ridgeway Review recommended that an ONS-Bank of England working group be established to set out priorities and develop a work-plan. It also highlighted that new protocols may be required to facilitate the necessary exchanges of information between organisations.
- 2.67** Progress to date was set out in a joint report by ONS and the Bank of England.⁶⁰ Work has focused on identifying current data availability based on existing data sources used in the compilation of the financial accounts. As a result, a first set of experimental Flow of Funds matrices has been produced (with time series estimates going back to 1997).⁶¹ However, the lack of a single firm identifier, as well as the limited access to the full range of administrative data available for regulatory purposes (see Chapter 4), are among the limitations to making full use of the data in matching financial flows to the agents involved. ONS and the Bank of England are currently investigating alternative data sources that could be used to improve these estimates or to fill the gaps in the sectoral matrices. Plans to deliver a full set of matrices alongside the publication of Blue Book 2019 has been identified as a priority by ONS, subject to resources being available.

58 See European System of Accounts 2010, Chapter 5. Available [here](#).

59 UKSA, (2014). ‘The Use of Official Statistics by the Financial Services Industry,’ Monitoring Review. Available [here](#).

60 ONS, (2015). ‘The UK Flow of Funds Project: introduction, progress and future work’. Available [here](#).

61 ONS, (2015). ‘The UK Flow of Funds Project: Comprehensive review of the UK Financial Accounts’. Available [here](#).

A forward looking vision

- 2.68** The access to a detailed breakdown of the institutional sectors with fine detail on assets and liabilities by specific financial instruments, including counterparty information, is essential for the effective evaluation of the risks to financial stability. This information allows a better understanding of the interconnectedness between key players in the financial system, as well as the shadow banking system,⁶² when conducting stress tests.⁶³ Moreover, risks tend to build up in the tails of distributions and are thus rarely visible at the aggregate sectoral level. Therefore the ideal Flow of Funds statistics should be constructed bottom-up, with data collected at firm level.⁶⁴
- 2.69** Enabling data to be flexibly interrogated, to reflect country-specific circumstances as well as unforeseen future questions, is critical to enabling regulators to identify new risks promptly. Therefore, a system based on data at the finest level of disaggregation is also a way of ‘future-proofing’ the financial accounts. The complexity of the system of financial linkages is in constant evolution and in a way that is also often hard to predict. As such, it provides a challenge for the production of useful statistics.
- 2.70** For example, peer-to-peer (P2P) lending and crowdfunding were virtually non-existent just three years ago, whereas today they are well-established and growing rapidly in importance. The UK alternative finance market (P2P consumer lending) accounted for approximately 3% of UK consumer credit gross lending in 2014. And while UK equity crowdfunding only represented 5% of the alternative finance raised last year, it has been growing rapidly.⁶⁵ Alternative sources of funding are a growing source of finance for firms and individuals, with the development of online technology facilitating the raising of equity or debt finance without relying on banks.⁶⁶
- 2.71** The usefulness of aggregate statistics is distinctly limited if the object is to identify misallocation of resources and the accumulation of risk. Instead what is required is an ability to view the elements of the economy with the precision of a microscope. And the benefits of granular financial Flow of Funds data would be greatly magnified if they can be linked to other similarly granular data sources, such as on spending or other financial information. For instance, one explanation of the UK’s weak productivity performance since the financial crisis is that the

62 See e.g. Adrian, T., and Shin, H., (2010). ‘The Changing Nature of Financial Intermediation and the Financial Crisis of 2007–2009,’ *Annual Review of Economics*, vol. 2(1), p.603-618. Available [here](#).

63 See e.g. Battiston, S., Delli Gatti, D., Gallegati, M., Greenwald, B., and Stiglitz, J., (2012). ‘Liaisons dangereuses: Increasing connectivity, risk sharing, and systemic risk,’ *Journal of Economic Dynamics and Control*, vol. 36(8), p.1121-1141. Available [here](#).

64 See e.g. Burrows, O., Low, K., and Cumming, F., (2015). ‘Mapping the UK financial system,’ *Bank of England Quarterly Bulletin*, vol. 55(2), p.114-129 Available [here](#).

65 NESTA, (2014). ‘Understanding Alternative Finance: The UK Alternative Finance Industry Report 2014’. Available [here](#).

66 See e.g. Goldman Sachs, (2015). ‘The Future of Finance (part 1): The rise of the new Shadow Bank’. Goldman Sachs Equity Research

allocation of capital has been impaired.⁶⁷ Being able to link up information on funding conditions, investment and profitability at the level of the firm would allow fuller investigation of this hypothesis.⁶⁸ These data would also allow policymakers to monitor the provision of finance to support productive investment, which is one of the elements of the 2015 remit for the Financial Policy Committee of the Bank of England.⁶⁹

2.72 Despite having one of the largest and most complex financial systems in the world, the UK's data on the financial sector and financial flows are compiled from less comprehensive sources than in many other advanced economies.⁷⁰ Because of this, most European countries are at a more advanced stage in producing Flow of Funds statistics from granular level data, which equips them to produce higher quality data and respond flexibly to new reporting requirements. While Portugal has a substantially less complex financial system than the UK, the Flow of Funds system constructed by the Bank of Portugal offers an example of how a detailed bottom-up approach to financial accounts statistics can be developed. A key ingredient is a legally-mandated unique tax identification number for each household and business, allowing a wealth of information to be linked.

2.73 Obtaining a high degree of granularity in Flow of Funds statistics requires significant investment in generating new data sources to complement the administrative data that is already collected for private commercial and regulatory purposes.⁷¹ The data sharing agreements between ONS and the Bank of England also need to be developed so that ONS can access this administrative data easily. Moreover, the Bank of England needs to be granted access to the underlying data, including additional metadata, required to serve all of its statutory functions. Additionally, development of the Inter-Departmental Business Register (IDBR) to include a unique identifier for businesses, fit for all administrative and statistical purposes, would support the success of a detailed

67 See e.g. Caballero, R. J., Hoshi, T., and Kashyap, A., (2008). 'Zombie Lending and Depressed Restructuring in Japan,' *American Economic Review*, vol. 98(5), pages 1943-77. Available [here](#).

68 Broadbent, B., (2012). 'Productivity and the allocation of resources'. Available [here](#).

69 HM Treasury, (2015). Correspondence from Chancellor of the Exchequer to Governor of the Bank of England on remit of the Financial Policy Committee, 8 July 2015. Available [here](#).

70 ONS, (2015). 'The UK Flow of Funds Project: introduction, progress and future work'. Available [here](#).

71 To understand the scope of the data collection it might be useful to refer to the Portuguese example. Despite the relatively smaller complexity of the Portuguese financial system with respect to the UK one, the Bank of Portugal note that their systems record monthly information from 204 institutions and with more than 285 thousand non-financial corporations and around 5.8 million private individuals registered as borrowers in the database and 23 million records on credit data are reported, on average, every month. See e.g. Bank of Portugal, (2013). 'A flexible approach to credit statistics: The use of the Portuguese Central Credit Register for statistical compilation'. Available [here](#).

Flow of Funds project in particular, as well as to the more general joining-up of business-related information presently scattered across isolated data sets (see Chapter 4).

Regional statistics

- 2.74** A frequent issue raised in the consultation with users was the need for timelier and more detailed statistics at a finer level of geographical disaggregation.⁷² This is a long-standing need, but one that has become more pressing with the increased emphasis on the devolution of decision-making power to the nations, regions and cities of the UK. In her response to the Call for Evidence, Professor Diane Coyle said, “The provision of sub-national statistics, for the devolved nations but especially for English regions and city regions is absolutely lamentable”. The lack of information to diagnose the specific economic challenges facing geographic units below the level of the UK as a whole represents a handicap for policy and business decisions.
- 2.75** The Allsopp Review was commissioned, in part, to improve the statistical information required to support the government’s objective of improving economic growth and convergence in the regions and countries of the UK. It concluded that, “The pressing need for better regional data should be satisfied,” and made a number of recommendations including a better quality and more timely measure of regional GVA and expanding the range of economic data available at the regional and local levels.³³
- 2.76** Only partial progress has been made in implementing those recommendations, often owing to their resource intensity and competing demands.⁷³ In June 2010, the government announced the abolition of the Government Offices of the Regions and the Regional Development Agencies in England. The Department for Communities and Local Government then took the decision to cease publication of statistics at the regional level from October 2012 onwards.⁷⁴
- 2.77** Different users often want data broken down spatially in very different ways, which may change over time. Where possible, the collection and provision of statistics should be sufficiently flexible to satisfy these varied needs. For example, official regional statistics have traditionally been broken down by the Nomenclature of Units for Territorial Statistics (NUTS), a standardised EU framework for geographical units. However, 2011 saw the creation of Local Enterprise Partnerships (LEPs) to shape local economic priorities and drive

72 For simplicity, this section regularly uses 'regional' to refer to a number of spatial areas below the UK-wide level – including at the country, regional, city and local levels.

73 Since the Allsopp Review, ONS responded by: developing regional output in real terms based on the output approach; making continuous improvements to regional output and household income measures; and refining apportionment methods by which informs how output is measured at sub-regional levels.

74 UKSA, (2013). Correspondence from Sir Andrew Dilnot to Department for Communities and Local Government Secretary of State on regional statistics, 23 April 2013. Available [here](#).

growth and job creation. These are voluntary partnerships between local authorities and businesses whose boundaries are subject to change and do not align naturally with the NUTS regions traditionally used to compile regional data.

Constructing regional GVA

- 2.78** There is a consequent need for fuller provision of granular data by location which can then be flexibly aggregated up to the particular geographical units that are of interest. However, there are serious obstacles to realising this objective. Because of the costs of collecting data at the regional level, regional estimates of National Accounts concepts, such as GVA, are currently estimated via a top-down approach that uses regional indicators to allocate the national totals geographically. This approach is unlikely to be reliable for small geographic areas. Data from surveys of low-level spatial areas can be aggregated up to yield statistics for larger geographic areas of interest, but the sample sizes are usually too small to provide reliable measures for small areas.
- 2.79** This could, in principle, be addressed by greatly increasing the quantity of information collected at a very fine spatial level. However, this would be costly, not only for ONS but also for survey respondents. For example, take a company with a large number of outlets. National data only requires the collection of company-wide information, but a regional breakdown requires information to be collected by individual outlet. This does not seem very practical.
- 2.80** ONS produces an income-based measure of regional GVA, but the absence of suitable prices to deflate its components means that it is only available at current prices. ONS has also experimented with a production-based approach, which does allow the construction of regional real GVA, as suitable national prices are available for deflation. Allsopp concluded that estimation of regional GVA by the expenditure measure was not worthwhile, most notably due to the high costs of measuring inter-regional trade. Regional estimates of some of the expenditure components (e.g. household final consumption expenditure or gross fixed capital formation) can, however, add colour to the understanding of differences in regional economic performance.

Improving timeliness

- 2.81** Many regional business and labour market statistics are relatively timely because the underlying data relies on samples at the regional level. For example, regional labour market statistics are drawn from the Labour Force Survey and are available about six weeks after the end of the period. However, the lack of timely data for regional GVA (and gross household disposable income) remains a common complaint of users: the reliance on the availability of Blue Book data means that the earliest estimate of annual GVA (the income measure) is only available almost a year after the end of the period. In his response to the Call for Evidence, Professor Henry Overman stressed that, “This makes getting a picture of the current performance of city and other economies very difficult.”

- 2.82** Allsopp suggested that short-term indicators might be used to produce a faster estimate of regional GVA. Currently, there are quarterly indicators of constant price activity for each of the devolved nations, but no counterparts for the English regions.⁷⁵ A 2009 ONS feasibility study of the use of regional short-term indicators set out how this might be achieved using information from the Monthly Business Survey, augmented by surveys of large companies operating across regional boundaries.⁷⁶

Regional prices

- 2.83** Price indices can vary by region both because individual prices differ by region, e.g. because of transport costs for goods, and because expenditure shares differ. Using the same information used to compile the RPI/CPI, for a short while ONS did produce annual estimates of regional prices, but these were discontinued after 2005. In the absence of an annual series for regional prices, constant-price regional statistics are obtained using a national price index. While there is no European requirement to produce regular estimates of regional prices, their availability would permit the construction of more reliable estimates of regional activity and real incomes.
- 2.84** Allsopp suggested that production of regional prices should be based on the cycle of surveys and updated according to a timetable that meets user demand. There is currently a six-yearly survey of relative regional consumer price levels that partially meets this end.⁷⁷ User feedback suggested only limited demand for doing more than this. Paul Johnson's recent review of UK Consumer Price Statistics also concluded that the provision of regular regional price statistics would be too costly to be justified.⁷⁸

The scope for greater use of administrative data

- 2.85** Many of the problems encountered in producing timely and detailed regional statistics arise because the source data is primarily sampled annually from company-wide units at the national level, such as the Annual Business Survey. Allsopp recommended that new and existing surveys should be designed to take account of the need for regional statistics. However, given the potentially high costs involved in sampling at a regional level, he recognised that exactly how this should be done depended on a relative assessment of the costs and benefits.

75 Gross Domestic Product for Scotland, available [here](#); Statistics for Wales Index of Production and Construction and Index of Market Services, available [here](#) and [here](#); Northern Ireland Statistics & Research agency, Northern Ireland Composite Economic Index, available [here](#).

76 ONS, (2009). 'Feasibility Study – Into the Development of Regional Short-Term Indicators'. Available [here](#).

77 ONS, (2011). 'UK Relative Regional Consumer Price levels for Goods and Services for 2010'. Available [here](#).

78 Johnson, P., (2015). 'UK Consumer Price Statistics: A Review'. Available [here](#).

- 2.86** The Annual Business Survey samples roughly 63,000 businesses. By contrast, HMRC VAT data would provide near-census information for over 1.8 million businesses whose location can be deduced from their postal address. Many of these businesses will operate from just a single site, providing data on activity at a very fine geographical level. Use of the data is complicated, however, by some businesses operating in multiple areas and additional information might be needed to cope with this. Use of VAT data thus has considerable potential to improve both the quality and timeliness of output-based measures of regional GVA.
- 2.87** Regional statistics on income are at present largely reliant on using regional indicators to apportion national measures. HMRC Pay As You Earn (PAYE) income tax data contains information on the addresses of both employee and employer, though not necessarily the actual place of work. However, there may be scope to use the Business Register and Employment Survey to match employees to their workplace. Use of PAYE data could thus provide an alternative source for income-based measures of regional GVA.
- 2.88** Embedding administrative data into the production of regional statistics would likely take some time, and would probably still need to be augmented with specific survey information. Nonetheless, greater use of administrative data seems to be the only viable way forward to provide a sufficiently rich picture of economic developments at the regional level.

Measuring the labour market

- 2.89** Alongside the National Accounts, the measurement of the labour market is another key set of the ONS's economic statistics. Since their inception in the late 1880s, labour market statistics have dramatically improved, though they have at times struggled to keep pace with structural change in the labour market.⁷⁹
- 2.90** There are three key official surveys used to produce labour market statistics. The Labour Force Survey (LFS) is the primary source of information on employment, unemployment and hours, and follows a cohort of individuals sampled five times at three monthly intervals. The Monthly Wages and Salaries Survey (MWSS) forms the basis of the Average Weekly Earnings (AWE) which is the main measure of earnings growth. The Annual Survey of Hours and Earnings (ASHE) provides a much more granular snapshot of 1% of individuals registered in HMRC's PAYE database, for example to enable exploration of income distributions.⁸⁰ Overall there is a reasonable spread of current indicators accompanied by less-regular but more detailed microdata which provides more granularity.

79 Denman, J., and P. McDonald, (1996). 'Unemployment statistics from 1881 to the present day.' *Labour Market Trends* 104, no. 1: 5-18. Available [here](#).

80 Despite its granularity ASHE is likely to under-report people with very low earnings. See e.g. IFS, (2015). 'Green Budget'. Available [here](#).

- 2.91** The use of administrative data could provide timelier and more granular insights into the labour market, enabling ONS to provide a better service in answering users' questions (see Box 2.D for an example).⁸¹ For instance, hailed by some users as the gold standard, the Swedish statistical system currently allows users to explore labour market trends from linked granular employer-employee data.
- 2.92** While UK labour market statistics are not as granular and timely as in the US, or indeed the Scandinavian systems that rely heavily on administrative data, their relative standing among the ONS's economic statistics is well regarded by most users. This section sets out some important limitations of labour market statistics, looks at recent developments in labour market flows data, and outlines new challenges driven by recent technological developments.

Limitations of current labour market statistics

- 2.93** Engagements with users suggested two broad limitations of current labour market statistics in the UK:
- **Alignment of closely-substitutable statistics.** There is an abundance of statistics relating to the labour market. For example, there are 15 official indicators of income and earnings alone.⁸² As the IFS has noted, this richness may not be a uniformly positive development, as it can lead to confusion.⁸³ Given the vast array of measures that define income or earnings differently, due to either different sources or different samples (some are UK-wide, others are just Great Britain), lack of alignment may not be surprising. There is likely to be some short term noise between different measures based on different ways of collecting the data – for example between AWE and ASHE.⁸⁴ ONS has worked to clarify the difference in unit labour cost trends between the AWE measure and the wages and salaries components of National Accounts. ONS should communicate methodological differences and limitations of statistics in order to enable non-experts to navigate the terrain and apply the statistics more appropriately.
 - **Compositional changes in the labour market.** Changes in the mix of the workforce, often referred to as compositional effects, can affect measures of earnings and productivity growth.⁸⁵ Compositional shifts often mean measures of average earnings growth are biased upwards in recessions

81 See e.g. Wallgren, A., and Wallgren, B., (2011). 'To understand the Possibilities of Administrative Data you must change your Statistical Paradigm!'. Section on Survey Research Methods, American Statistical Association. Available [here](#).

82 UKSA, (2015). 'The Coherence and Accessibility of Official Statistics on Income and Earning Statistics'. Available [here](#).

83 IFS, (2015). 'Green Budget'. Available [here](#).

84 See e.g. 'Earnings and Settlements' TUC Report 2014, available [here](#); Blanchflower, D., (2014). 'Yet more evidence that pay is going nowhere fast,' The Independent, available [here](#).

85 Broadbent, B., (2015). 'Compositional shifts in the labour market,' speech delivered at 'Understanding the Great Recession' Conference, Bank of England, 23 September 2015. Available [here](#).

(relative to the experience of people continuously in employment) and downwards in recoveries. This is the reason why the US Bureau of Labor Statistics publish an Employment Cost Index of wages, adjusting for these compositional effects, together with the (unadjusted) headline earnings series. In the UK, there is clear user demand for adjusted variants of many official labour market statistics. In order to partially deal with this issue, in 2015 ONS introduced information on continuously-employed workers in the Annual Survey of Household Earnings.⁸⁶

Labour market flows statistics

- 2.94** Labour flows statistics describe the dynamics of the labour market. They illustrate the number of jobs that appear or disappear and the corresponding number of individuals who move into, out of, and within the labour force every month. In fact, the relative stability of the aggregate stock of employment masks the large amount of underlying churn which takes place in the labour market. Gross flows into employment amounted to almost a million people per quarter even during the depths of the recession. Labour flows statistics provide a deeper understanding of movements in the labour market and enhance the understanding of how the labour market functions and how it changes with the business cycle.
- 2.95** The five-quarter longitudinal structure of the LFS data permits the calculation of gross flows across states of employment, unemployment and inactivity, which are published quarterly as experimental statistics.⁸⁷ In principle, the LFS microdata can be used to obtain more detailed disaggregation of the headline gross flows, such as flows from unemployment to employment broken down by unemployment duration, gender or other demographic characteristics. However, due to increasingly-restricted sample sizes as the data are disaggregated, the resulting flows series can in practice prove to be too noisy for drawing reliable conclusions.
- 2.96** In part due to the nature of the data, and partly due to problems collecting it, flows data is known to suffer from three important biases:
- **Time aggregation bias.** Survey data which is collected at discrete points in time fail to pick up labour market transitions which occur between sample dates. Specifically, the less frequent the survey dates, the more likely it is that intra-period moves occur which are not reflected in the survey. At quarterly frequency, time aggregation bias is likely to be present to a significant degree.

86 Available [here](#). See also ONS, (2014). 'Understanding average earnings for the continuously employed: Using the Annual Survey of Hours and Earnings 2014'. Available [here](#).

87 In August 2015 ONS started publishing data on job-to-job transitions.

- **Attrition bias.** This relates to certain types of household being more likely to drop out of the survey than others, e.g. people who rent their home privately. The estimation used for the LFS longitudinal data includes adjustments designed to counter such attrition bias.⁸⁸
- **Classification error bias.** For various reasons, respondents of the LFS may be classified into the wrong labour force state. Whereas, in stock data, classification errors tend to offset each other, they can have large effects on gross-flows calculation as the errors tend to be additive. Measurement error probabilities could be derived from re-interview data.⁸⁹ ONS is aware of this issue: stating that the error is only “slight” and likely to be relatively stable over time.⁹⁰ But it is difficult for data users to judge the severity of the bias from published information.

2.97 Whereas the LFS measures the supply side of the labour market, the demand side is captured by vacancies data. The ONS’s Vacancy Survey provides comprehensive estimates of the number of job vacancies across the UK economy, disaggregated further by industry and by size of enterprise. This provides information on the stock of vacancies, but not on the duration of vacancies, the flows as jobs are filled, which vacancies are new, the types of vacancy and skills required, nor regional breakdowns.

2.98 Even though the UK is one of the few European countries to currently publish flow estimates,⁹¹ the current state of development of the labour market flows data has yet to reach the breadth of similar statistics available in the US (see Box 2.C).

88 This adjustment was reviewed recently in relation to the 2013 National Statistics Quality Review of the LFS. Available [here](#).

89 See Abowd, J. M., and Zellner, A., (1985). ‘Estimating Gross Labor Force Flows,’ *Journal of Business and Economic Statistics*, and Poterba, J. M., and Summers, L., (1986). ‘Reporting Errors and Labor Market Dynamics.’ *Econometrica*.

90 Henshall, D., (2015). ‘Labour Market Flows, November 2015 (Experimental Statistics)’. Available [here](#).

91 The other European countries that produce labour flows statistics are Netherlands, Portugal, Spain and Sweden.

Box 2.C: A comparison with the US labour market flows statistics

In the US, the Bureau of Labor Statistics (BLS) is responsible for the production of labour statistics. The labour flows data is constructed from three separate sources. First, the Current Population Survey (CPS) provides monthly estimates of labour force status flows from the month-on-month changes in the employment status of individuals. The labour force status data has flow estimates that are compatible with the monthly employment, unemployment and labour force figures.⁹² Second, the Business Employment Dynamics data (BED) measures the gross number of jobs gained each quarter at expanding or opening establishments, as well as the gross number of jobs lost each quarter at contracting or closing establishments. The BED data is available quarterly and can be disaggregated at the industry level. Third, the Job Openings and Labor Turnover Survey (JOLTS) measures job openings and labour turnover data in order to assess the unmet demand for workers in the labour market. In particular, JOLTS collects figures on: job openings, hires and ‘separations’ (which are divided between quits, layoffs and discharges and other separations).⁹³ Those data are available monthly and can be disaggregated at the industry level.⁹⁴

The UK labour flows statistics, when compared to the US, fall short in terms of:

- **Breadth of information.** The UK labour market flows are mainly derived from the LFS and as such reflect only information on the supply side of the market. On the demand side, while data on employment levels in the UK is available at firm level, employment flows data is not. Moreover, the ONS’s Vacancy Survey provides an aggregate measure of job vacancies (i.e. the unmet labour demand) but provides no information in terms of rate

92 To make the CPS labour force status flows consistent with the reported stock estimates, the BLS developed a method that forces their reconciliation by adjusting for changes in the working-age population, net immigration, persons who just turned 16, and average death rates. For more information, see Frazis, H. J., Robison, E., Evans, T., and Duff, M., (2005). ‘Estimating gross flows consistent with stocks in the CPS’. Available [here](#).

93 Note also that even though the data are not publicly available the CPS allows to measure the job-to-job transitions of those continuously employed over the sample. See e.g., Fallick, B., and Fleischmann, C., ‘Employer-to-Employer Flows in the U.S. Labor Market: The Complete Picture of Gross Worker Flows,’ Federal Reserve FEDS Working Paper 2004–34. For more information on their measurement, see BLS, (2004). ‘Effects of Job Changing on Payroll Survey Employment Trends’. Available [here](#).

94 There are currently many countries that produce job openings (vacancies) data and fewer that produce hires (accessions) and separations data. Aside from the US, other countries that produce hires and separations data include Estonia, Japan, New Zealand, the Philippines and Singapore. See BLS, (2015). ‘Comparison of U.S. and international labor turnover statistics’. Available [here](#).

at which vacancies are filled, i.e. the JOLTS measure of hire. To clarify the limitations that this has for the understanding of the dynamics of the labour market, consider a data release showing an increase in total employment. There are several ways an economy adds jobs. Using the current UK data is hard to know whether this is due to decisions by established or new firms, and due to increased hiring or a decreased job exits.

- **Timeliness.** In the CPS, households are surveyed for four consecutive months, not surveyed for eight months, and then return for another four months before leaving the sample permanently. This design allows the BLS to produce monthly flow measures, ensuring a high degree of continuity from one month to the next (as well as over the year).⁹⁵ By contrast, in the LFS, households are surveyed for five consecutive quarters, allowing only computations of flows at the quarterly frequency.⁹⁶ Moreover, while the LFS allows for linkage spanning five quarters, in practice the number of continuous cases available for linkage drops significantly across the sampling period (from about 35,000 in the two-quarter longitudinal data set to about 5,000 in the five-quarter longitudinal data set).⁹⁷ Aside from providing less timely information, the longer the time frequency over which labour market flows are computed, the more susceptible the estimates are to time aggregation bias.
- **Relationship between the flows and the underlying stock data.** Flows data are useful because they provide greater clarity about movements in the underlying labour market stocks. However, in the UK, the longitudinal data used in the computation of the flows differs from the data used in the aggregate stock statistics derived from the LFS. As a consequence, it is not always possible to trace developments in the stocks to changes in flows with great precision.

Other stretching challenges

- 2.99** There are two measurement challenges which, if addressed, could bring the UK to the international cutting edge in terms of labour market statistics. One is the measurement of skills and the other the measurement of non-standard participation in the labour market.

95 Moreover, the 4-8-4 sampling scheme has the added benefit of allowing the constant replenishment of the sample without excessive burden to respondents.

96 The sample overlap from one quarter to the next on the LFS is 80%, and 20% one year to the next. This compares with a 75% (monthly) and 50% (yearly) overlap on the CPS. See Cheng, Y., (2012). 'Overview of Current Population Survey Methodology,' Proceedings of the Joint Statistical Meetings – American Statistical Association. Available [here](#).

97 See LFS Longitudinal User Guide, Vol 11. Available [here](#).

- 2.100** In a world of rapidly-changing markets, with accelerated adoption and diffusion of new technologies, firms often depend on workforce skills and knowledge to gain a competitive advantage and improve business performance.⁹⁸ Understanding the supply and demand of skills becomes increasingly important to understand the dynamics of the labour market. The absence of statistics that allow policy makers and market participants to analyse the evolution and shortages of skills is one of the areas that users have identified as needing further development (Chapter 3 explores issues around estimating investment in human capital). While the LFS captures qualifications and recent training courses in the available microdata, some users feel that it still did not provide sufficient granularity on skills. More importantly, the individual level data is not currently linked to firm-level information, and therefore cannot be used to answer questions around links between productivity, training and skills.
- 2.101** Mapping the level and flows of skills in the economy through traditional survey methods would be an almost impossible task at any reasonable cost. Yet this is an area where data science and creative uses of existing publicly-available information could potentially provide a solution. For instance, web-scraping online job advertisements could potentially give an idea of the demand for particular skills at a fine geographic level. Similarly, professional networks (such as LinkedIn, ResearchGate or academia.edu) aggregate information on workers' qualifications, skills, and job experience. In fact, a number of recent studies have illustrated the benefits associated with the use of web-based information on jobs and workers as a way of complementing and enriching the official statistics.⁹⁹ Moreover, studies of online job advertisements can also be informative about the evolution of standard occupation classification system. Box 2.D provides an illustration of two interesting applications in this area.
- 2.102** Finally, coverage of non-standard forms of participation in major labour market statistics is weak. Despite an increase in self-employment both the 1980s and again in the 2010s, the timeliness and accuracy of statistics on the number of self-employed workers and their earnings have struggled to keep up with the rest. Chapter 3 explores the issue of non-standard employment in relation to the sharing economy.

98 See e.g. Leitch Review, (2006). 'Leitch Review of Skills, Prosperity for all in the global economy – world class skills'. Available [here](#).

99 Einav, L., and Levin, J., (2013). 'The data revolution and economic analysis'. NBER working paper 19035.

Box 2.D: Uses of big data to complement labour market statistics

Mapping and monitoring jobs in fast-moving sectors of the economy.

Labour market surveys are typically not detailed enough to identify new types of jobs or activities. Moreover, occupation and industry definitions in the official statistics are usually amended with substantial lags with respect to the growth of innovative technologies. For instance, it would be impossible using the official statistics to identify the demand for jobs related to development and analysis of smartphone and tablet applications. In recent years, it has become common for employers to list job openings on the internet. The use of data from internet job boards has the potential to complement the tools available to any statistical agency by allowing more detailed statistics at relatively low cost.¹⁰⁰ For instance, this data can be used to produce statistics at low spatial levels and has applications for a broad range of industries.¹⁰¹

Employment shifts from LinkedIn data. Expansive and detailed privately-held data could be used for bespoke analysis of the labour market. For example, LinkedIn, the world's largest online professional network, has over 15 million members in the UK. Many users provide LinkedIn with up to date information on their current and past job titles, employers, and responsibilities. Moreover, LinkedIn can potentially track in real-time information about skills and geographical location of workers. LinkedIn classifies users' jobs by industry and occupation, often at a more detailed level than is available in government statistics. The resulting information can be used to track changes over time in the industries and occupations in which LinkedIn's members work and to identify emerging sectors and job titles. For instance, in 2012, LinkedIn's data science team collaborated with the White House Council of Economic Advisors to identify the industries that grew and shrank the most following the 2008-2009 recession. By monitoring profiles of people who were site members in 2007 longitudinally through 2011, the study identified a rapid growth in renewable energy and Internet companies, as well as sharp declines in a number of traditional sectors, such as newspaper publishers, restaurants and retail.¹⁰²

-
- 100 Mandel, M., and Scherer, J., (2012). 'The Geography of the App Economy,' South Mountain Economics Research Paper. Available [here](#).
Mandel, M., and Scherer, J., (2015). 'A Low-Cost and Flexible Approach for Tracking Jobs and Economic Activity Related to Innovative Technologies,' NESTA Working Paper No. 15/11. Available [here](#). It is important to stress that those statistics complement, rather than substitute, the official statistics. In fact, by their own nature, the population captured by online advertisement is not always representative. For instance, Mandel and Scherer show that their methodology is not able to give an accurate picture of the distribution of carpenters as one would be expecting.
- 101 Litan, R. E., Wyckoff, A., and Husbands Fealing, K., Editors (2014). 'Panel on Developing Science, Technology, and Innovation Indicators for the Future'. Committee on National Statistics, Division of Behavioral and Social Sciences and Education. Board on Science, Technology, and Economic Policy. Policy and Global Affairs; National Research Council. Available [here](#).
- 102 Council of Economic Advisors, (2012). 'Economic Report of the President'. Available [here](#).

Physical capital

- 2.103** The accumulation of capital assets is central to economic growth and productivity. Proper measurement of capital is necessary to understand its role as a store of wealth and as an input into the production process. Furthermore, recent technological advances are allowing for more resource-efficient use of capital and greater automation of production (e.g. 3D printing, bricks and mortar retailing moving online). This in turn means that measuring capital productivity may soon be as important for policy as traditional measures of labour productivity. This is a long standing issue. The Allsopp and Barker-Ridgeway Reviews both recommended improvements in this area.¹⁰³
- 2.104** This section focuses on the challenges associated with measuring physical capital (e.g. machinery and buildings). Chapter 3 considers issues around expanding the definition of capital to include knowledge-based capital (e.g. research & development).
- 2.105** When measuring capital it is important to differentiate between two related, but distinct, concepts. First, the productive measure of capital, which is estimated by capital services and is used to measure the capital input into production. Second, the wealth measure of capital, which is estimated by the net capital stock (its market value). As a simple illustration, imagine a light bulb which illuminates until its service life ends in an instant burn out. The net capital stock of the light bulb falls over its service life as the probability of a burn out increases, but its brightness (capital services) remains constant until the end of its service life.

Capital services

- 2.106** Capital services are the flow of productive services from capital into the production process. Capital services are derived from the productive capital stock, which is the gross capital stock corrected for its loss in productive efficiency. This is then weighted by the user cost of capital, or the price that the user would have to pay to hire the asset for the period. ONS produces the Volume Index of Capital Services (VICS), on an experimental basis, for use in growth accounting and analysing productivity. Breakdowns by asset and industry are available. Currently VICS is published on an annual basis, but the production of quarterly estimates is under consideration. This would be a welcome step, as it would enable production of quarterly estimates of multi-factor productivity shortly after the publication of the Quarterly National Accounts, as opposed to the current annual frequency.

103 Allsopp's recommendation 69 and Barker-Ridgeway's development recommendations 9-10. ONS has recently initiated a review of the current methodology for estimating the capital stock, which includes close engagement with subject experts.

Net capital stock

2.107 The net capital stock, a stock measure of wealth, captures the market value of gross capital stock, less economic depreciation. ONS, in line with international practice, uses the Perpetual Inventory Method (PIM) to obtain the measure of capital stock from the observed investment flows. Although a PIM is a commonly-applied method, the results may vary across countries depending on the assumptions about each asset class. Key challenges to the measurement of net capital stocks include estimating asset service lives, establishing the pattern by which capital depreciates over time, and the treatment of second-hand capital. These issues are examined in turn.

Asset service lives

2.108 The service life is the period during which the asset remains in use in a productive process. The service life assumptions for each asset class should be updated regularly to reflect the changes in asset mortality. Service lives may change over time if technological progress drives shorter product cycles or assets becoming more durable. For example, in response to a Eurostat reservation, ONS has recently changed the service life of roads in the UK from 75 to 55 years, bringing it in line with practice from other EU countries. Further work reassessing service lives across asset classes is currently ongoing.

2.109 In practice, some assets may be scrapped (retired or sold for parts) before their usual service life ends. Rates of scrapping can be endogenous to the economic cycle, for example if firms accelerate scrapping assets due to cyclical changes in the asset's price, usage, or technological change.¹⁰⁴ ONS adjusts their capital stock estimates by using bankruptcy data.¹⁰⁵ However, insolvency rates need not be a good approximation of premature scrapping, as they fail to capture the share of capital scrapped by firms which have not gone insolvent. Further measurement improvements in this area could broaden the understanding of cyclical drivers of the capital stock, but may currently be limited by availability of data on firms' decisions.

Depreciation of capital stock

2.110 The pattern of depreciation sets out the loss in the value of the asset over time. The primary purpose of a depreciation pattern is to move from a gross measure of capital stock to a net measure. The two most common depreciation patterns are 'straight-line' and 'geometric' (see Box 2.E for further detail). The OECD recommends geometric depreciation, as has been adopted by a number of

104 Harris, R., and Drinkwater, S., (2000). 'UK Plant and Machinery Capital Stocks and Plant Closures,' Oxford Bulletin of Economics and Statistics, 62: 243–265. Available [here](#).

105 No such adjustment is made for the Volume Index of Capital Services.

NSIs.¹⁰⁶ ESA 2010 does not prescribe any particular pattern by asset class. Instead it generically recommends the use of a straight-line method while recognising that in some cases a geometric rule may be more appropriate.¹⁰⁷

- 2.111** A geometric pattern implies a more rapid depreciation during the early stages of service lives. Like most other European NSIs, ONS assumes straight-line depreciation for physical capital when calculating the net capital stock, based on a fixed amount of depreciation over its service life.¹⁰⁸ While benefiting from simplicity, empirical evidence suggests that straight-line depreciation may not be the most realistic pattern for most asset classes.¹⁰⁹ ONS uses geometric depreciation for the calculation of capital services, but these estimates are highly experimental and differ from the method used to compute the net capital stock. ONS is currently developing methods to examine non-linear patterns of depreciation.¹¹⁰
- 2.112** Depreciation rates can be observed by comparing prices of new and used assets at different stages of their service lives, although relatively little data on these transactions currently exists. Canada and Japan use information from surveys on asset disposals to identify the unique characteristics of disposed assets, e.g. the age of the assets and the corresponding book value. The ONS's Annual Acquisitions and Disposals of Capital Assets Survey (ACAS) asks firms for the second-hand share of certain assets, but currently only focuses on transport equipment. A greater use of existing or new research on second-hand asset prices could not only improve ONS's understanding of depreciation patterns, but also be informative for explaining business cycle movements better.¹¹¹

106 OECD, (2009). 'Measuring Capital – OECD Manual'. Available [here](#). The OECD Manual recommends the use of geometric patterns for depreciation because they tend to be “empirically supported, conceptually correct and easy to implement.”

107 European System of Accounts 2010 (ESA 2010), paragraphs 3.143-3.144. Available [here](#).

108 Alternatively, the R&D capital stock assumes geometric depreciation.

109 E.g. Hulten, C., and Wykoff, F., (1981). 'The Measurement of Economic Depreciation,' in Hulten, C. (ed.), *Depreciation, Inflation and the Taxation of Income from Capital*, Washington DC, The Urban Institute Press. Available [here](#).

110 Stapenhurst, C., and McLaren, C., (2015). 'Presenting a Generalised Perpetual Inventory Method', United Kingdom Government Statistical Service Methodology Symposium. Available [here](#).

111 Lanteri, A., (2014). 'The Market for Used Capital: Endogenous Irreversibility and Reallocation over the Business Cycle'. Available [here](#).

Box 2.E: Depreciation pattern

Chart 2.H shows the two most common depreciation patterns. Under straight-line depreciation, an asset loses a fixed amount of its initial value (p_0) in every year (n) of its service life (T).

$$\frac{p_n}{p_0} = 1 - \frac{n}{T}$$

Under geometric depreciation, an asset's value declines by a proportional rate (δ) in every year, so that the amount of depreciation is largest at the beginning of asset's life:

$$\frac{p_n}{p_0} = (1 - \delta)^n$$

The geometric depreciation implies that an asset experiences a more rapid deterioration in the market value at the beginning of its service life. In the example below of assets with a common service life, half of the asset's value is gone by just under three years under a geometric pattern, whereas it takes ten years under straight-line depreciation. In practice, since the retirement is not fixed but assumed to be distributed around the average service life, the combined depreciation function for entire cohorts of asset classes typically resembles a geometric pattern; although individual assets die, there can be a long tail to the value of the cohort.

Chart 2.H: Examples of the functional form of depreciation

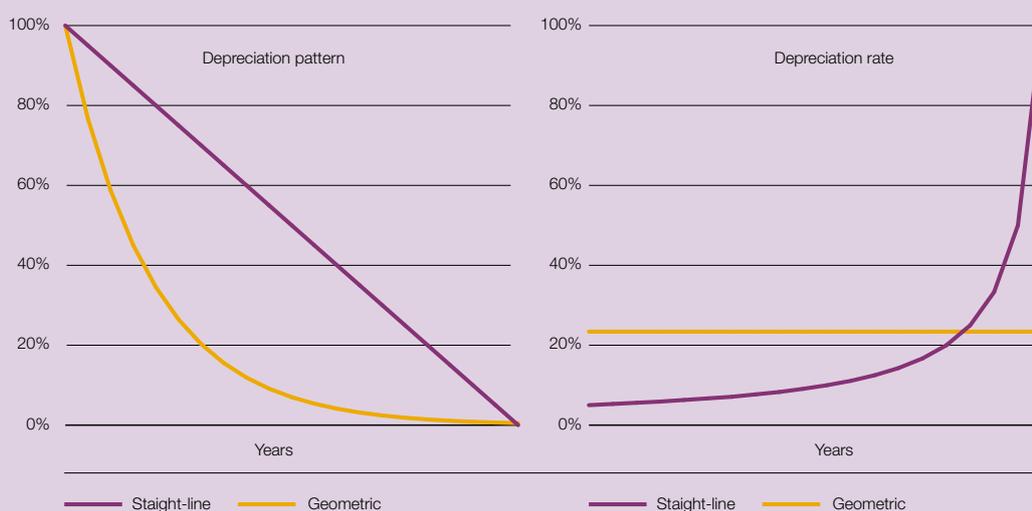


Table 2.B sets out the depreciation pattern for dwellings and other buildings and structures, which in the UK account for around three-quarters of total capital stock. The table illustrates how different countries assume different depreciation patterns for the same asset class.

Table 2.B: Examples of countries using different depreciation patterns for dwellings and other buildings and structures

Straight-line	Geometric	Other non-linear
Belgium, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Israel, Italy, Latvia, Lithuania, Malta, Mexico, Poland, Portugal, Slovakia, Slovenia, UK	Austria, Canada, Estonia (for dwellings), Iceland, Japan, Lithuania (for dwellings and roads), Norway, Sweden, US	Australia, Korea and the Netherlands use a hyperbolic decay function which implies a convex-shaped depreciation pattern

Source: Eurostat, OECD, (2013). 'Eurostat-OECD Survey of National Practices in Estimating Net Stocks of Structures'.

Second-hand capital

2.113 Another challenge in estimating net capital stocks relates to the treatment of second-hand capital goods, which by definition are included in gross fixed capital formation. Assets which are sold in the second-hand market are treated as entering the capital stock as if they were new. For example, a new asset with a 20 year service life which is sold after ten years will re-enter the PIM as having a service life of 20 years once more. This means that the depreciation of capital is underestimated when second-hand assets are purchased, and that the net capital stock is overestimated. It is important to note that this problem disappears where geometric depreciation is used, as the asset will simply continue to depreciate at the same rate after each re-sale.

Land market statistics

2.114 At the time of writing, average UK house prices are nearly 20% above their pre-crisis peak.¹¹² That has reignited concern about both the affordability of home-ownership and the possible risks to financial stability. One driver of higher prices has been a failure to boost the supply of new housing units to keep pace with demand. UK housing completions have been on a downward trend since 1970 and currently stand at just over 150,000 a year,¹¹³ well below the estimated 240,000-plus additional houses needed in England alone to keep pace with growing demand.¹¹⁴ Inadequate land market statistics potentially hinder a

112 ONS, (2016). 'House price index, December 2015'. Available [here](#).

113 Department for Communities and Local Government, (2016). 'Permanent dwellings completed, by tenure and country'. Available [here](#).

114 Town & Country Planning, (2013). 'New estimates of housing demand and need in England, 2011 to 2031,' Tomorrow Series Paper 16. Available [here](#).

suitable (public and private) supply response to the housing shortage. In particular, the 2004 review of housing supply by Dame Kate Barker highlighted the inadequate information on land quality and values.¹¹⁵

- 2.115** The lack of land market information may lead to inefficient allocations of land. Specifically, local authorities can utilise price signals as indicators of the demand/supply imbalances in their planning decisions, as advocated in the 2012 National Planning Policy Framework. But the effectiveness of the planning regime is hamstrung without access to adequate data on land values.¹¹⁶ Until 2011, the Valuation Office Agency, an executive agency of HM Revenue & Customs, produced a publicly-available Property Market Report which contained residential land value data at the local authority level reported by hectare, habitable room and internal area. The publication also included retail and office land value data, reported by square meter of internal space, and agricultural and industrial land by hectare. Although far from complete, the Property Market Report provided estimated values of ‘typical’ plots in each locality, information that was valuable for researchers and decision makers.
- 2.116** Since the Property Market Report was discontinued, the Department for Communities and Local Government has sought to fill the void by using information purchased from the Valuation Office Agency to produce land value estimates.¹¹⁷ This publication falls short of the statistics provided in the Property Market Report, however, by only including land value estimates for residential properties by hectare for each local authority, and providing only an England-wide average for agricultural and industrial land value estimates. Improvements to land value estimates, including through greater use of administrative data (e.g. applying regional house price trends to historical sales data), would not only improve efficiency in the land market but also allow better measurement of financial balance sheets when land assets are a significant component.
- 2.117** Data on land ownership and transactions are held by the Land Registry, a self-funded division of the Department for Business, Innovation, & Skills (BIS). The Land Registry provides information to the public on price paid per transaction of residential properties without charge. In order to cover its operating costs, however, the Land Registry charges for other data provision. Access to ownership information and commercial property transactions is only available at a cost that can be prohibitive when conducting spatial analysis beyond a small scale. Furthermore, ownership data is only available for purchase on an individual title basis. Bulk requests of ownership information of all the titles within a spatial area are denied for privacy considerations due to the interpretation of the Data Protection Act 1998, but can be requested individually if each address within the area is known.

115 Barker, K., (2004). ‘Barker Review of Housing Supply’. Available [here](#).

116 Cheshire, P., (2013). ‘Land Prices: the dog that’s lost its bark’. Available [here](#).

117 Department for Communities and Local Government, (2015). ‘Land value estimates for policy appraisal 2014’. Available [here](#).

- 2.118** The Ordnance Survey, a fully government-owned limited company, collects rich geographic information – essentially mapping Great Britain.¹¹⁸ This data offers potentially-useful insights into land use, and therefore availability for development. The data differentiates whether the land is developed or not, but, on its own, does not differentiate between the use of structures (e.g. residential, commercial, or recreational), which is an important distinction for efficient land use decisions. All of Ordnance Survey’s data is accessible at a cost, with a substantial share made available for free. The public sector has access to the majority of Ordnance Survey’s data through the Public Sector Mapping Agreement and One Scotland Mapping Agreement.
- 2.119** While the Land Registry, Ordnance Survey, and Valuation Office Agency are all public sector organisations, a requirement to self-fund activities inevitably creates a tension with the provision of statistics for the public good at a reasonable cost. The government announced in the 2015 Autumn Statement that it would be consulting on privatising the Land Registry by 2017 and developing options to bring private capital into the Ordnance Survey by 2020.¹¹⁹ These decisions ought to consider any associated risk to the continued access to adequate land market statistics at reasonable cost. Finally, the government could become a more intelligent customer of these agencies by centralising departments’ bilateral arrangements (e.g. the Ordnance Survey Public Sector Mapping Agreement).
- 2.120** In many cases, the use of an address or title deed number does not offer a suitable unique identifier to link data sets due to changes over time, spelling differences, or incomplete coverage. As discussed in Chapter 4, establishing a comprehensive register of clearly defined entities to facilitate the consistent application of a unique identifier represents an obvious public good. Application of a unique property reference number would provide a straightforward framework to cross-reference and link large microdata sets. Once combined, the statistical and analytical value of individual data sets is often multiplied many times over – unlocking the potential for this data to improve land market and other spatial statistics.
- 2.121** Lastly, information held across these three agencies (and a number of other sources) could also be more fully exploited through better data sharing across government (see Chapter 4). For example, sharing administrative data held by local authorities on planning permissions might act as a helpful short-run indicator for building or land use change.

118 Ordnance Survey of Northern Ireland is the mapping agency of Northern Ireland and part of Northern Ireland’s Department of Finance and Personnel.

119 HM Treasury, (2015). ‘Spending Review and Autumn Statement 2015’. Available [here](#).

Box 2.F: Some other existing statistical issues raised by users

This box sets out a handful of issues raised by several users that challenge statistics, including: the industrial classification of activity, globalisation, alternative economic indicators, and environmental sustainability.

Classifying activity

The existing scheme for classifying economic activity, the Standard Industrial Classification (SIC), is tied to a specific minimum level of granularity by international standards. However, as noted earlier, the changing structure of the economy means that SIC will constantly lag reality, under-representing newer industries and over-representing ones that are declining in importance (see discussion of measuring services in Chapter 3). These classifications are important beyond their role in facilitating analysis of the economic sectors. In response to the Call for Evidence, George Windsor from NESTA argued, “SIC codes can act as a tool for legitimisation of industries, which may open up routes for access to finance, say, or to talent.” Updates to the Classification have made some progress in addressing the lack of detail in the breakdown of services, yet more is needed if the structure of the UK economy today is to be adequately reflected in the statistics.

Users provided the Review team with several examples where the current Classification was insufficiently granular. For example, low-carbon economic activities are buried within several production and services industries and cannot easily be stripped out. Some have explored methods to use web-scraped data to provide more up to date and organic estimates of industries that can cut across standard Classification boundaries.¹²⁰ These methods might hold potential for a more fluid and responsive Classifications (see Boxes 2.D and 4.I). In the interim, a more granular Classification would help, but even the most granular industry classification will not always differentiate activities as demanded by users. However, if access to the underlying data is granted, then the application of new data science techniques to the microdata potentially offer users a way to stratify the information better to meet their needs.

120 See e.g. Nathan, M., Rosso, A., and Bouet, F., (2014). ‘Mapping information economy businesses with big data – findings for the UK’. Available [here](#). Also see Mandel, M., and Scherer, J., (2015). ‘A Low-Cost and Flexible Approach for Tracking Jobs and Economic Activity Related to Innovative Technologies,’ NESTA Working Paper No. 15/11. Available [here](#).

Cross-border flows of people, goods, and services

An increasingly globalised world, further enabled by significant improvements in communication technology, is posing problems for a statistical framework that has traditionally been stratified by geographic boundaries. Despite the advantages associated with most of the UK being an island without land borders, it continues to face significant challenges robustly measuring flows of people across its borders and the economic activities they are engaged in. Estimates of migration, tourism, and educational exports are all largely based on surveying individuals in air, sea and tunnel ports which can be subject to measurement and sampling error. ONS might consider supplementing these methods with greater use of administrative data in order to improve the size of the sample and quality of the data. For example, ONS could work with airlines, ferries, and others to share anonymised passenger lists. In the longer term, the successful delivery of the electronic border (e-border) project by the Home Office would have substantial positive statistical spillovers by providing near-census sample size information of migrants. In the near term, use of existing administrative information can provide useful insights into migratory inflows.

As a small open economy, a relatively large proportion of UK economic activity is associated with trade and foreign investment. Further work could be done in exploring the price indices for imports and exports, particularly given recent significant movements in the value of sterling. While HMRC's customs activities largely capture trade in goods, trade in services are estimated through a survey. Given improvements in information and communication technology, it is easier than ever to collaborate and outsource across geographic borders. Some consumers may not even be aware when they have purchased a service from a foreign country. Cloud computing and integrated business systems allow different arms of the same company to operate seamlessly across national borders. Compounding these cross-border issues with the generic issues facing the measurement of services (discussed earlier in this chapter) means that accurately capturing trade in services poses significant challenges. Improvements in this area could play a role in providing a more frequent and timely breakdown of trade, including country breakdowns of origins and destinations.

Reinstating the Purchases Inquiry and better measurement of services will help support the joint initiative by the OECD and World Trade Organisation to examine how value is added along global supply chains.¹²¹ While the trade balance has remained broadly unchanged in recent years, further efforts could be made to measure the individual factors driving the recent deterioration in the balance of payments better, including improved measurement of the income flows and the external balance sheet (see Chapter 3 for detailed discussion of the location of activity).

121 OECD and World Trade Organisation, Measuring Trade in Value Added. Available [here](#).

Alternative economic indicators

GDP, primarily a measure of market activity, has notable limitations as a measure of well-being. On the one hand, fixation on a single indicator, such as GDP, can lead to bad policy. On the other hand, simplicity can aid in communication and accessibility for users, while drowning users in the full panoply of available statistics would not necessarily lead to a better outcome. Recent research has examined this issue.¹²² The 2009 Commission on the Measurement of Economic Performance and Social Progress set out a number of recommendations to improve the measurement and profile of broader alternative statistics reflecting environmental sustainability, distribution and indicators of well-being.¹²³ ONS now produces a quarterly economic well-being publication that captures some elements of these recommendations.¹²⁴ Nevertheless, alternative economic measures, for example median household income,¹²⁵ fail to attract the same level of public interest as GDP.

Environmental sustainability

ONS produces an annual set of Environmental Accounts, some elements of which are required by European regulation. The Environmental Accounts are distinct from the National Accounts, and set out how the environment contributes to output (e.g. extraction), the impact of output on the environment (e.g. air pollution), and the taxes and spending reflecting environmental protection. However, separating the two in this way may inhibit public understanding of the interaction between them, and incorporating the depletion of natural resources and the degradation of the environment into an adjusted measure of GDP is a way to bring them together. ONS has set out a strategy to reflect fully the value of natural resource stocks in the Environmental Accounts by 2020.¹²⁶ This will provide a framework for aligning the treatment of natural resources stocks with stocks of physical capital, such as roads or machines, such that a depreciation in stocks is reflected in a reduction in measured economic activity.

122 See e.g. New Economics Foundation, (2015). 'Five headline indicators of national success: A clearer picture of how the UK is performing'. Available [here](#).

123 Stiglitz, J., Sen, A., and Fitoussi, J., (2015). 'Report by the Commission on the Measurement of Economic Performance and Social Progress'. Available [here](#).

124 ONS, (2015). 'Economic Well-being, Quarter 2 Apr to June 2015'. Available [here](#).

125 Aghion, P., Besley, T., Browne, J., Caselli, F., Lambert, R., Lomax, R., Pissarides, C., Stern, N., and Van Reenen, J., (2013). 'Investing for Prosperity: Skills, Infrastructure and Innovation – Report of the LSE Growth Commission'. Available [here](#).

126 ONS, (2015). 'Natural capital accounting 2020 roadmap – Interim review and forward look.' Available [here](#).

Addressing established statistical limitations

- 2.122** This chapter summarises some of the key challenges and gaps in the measurement of the UK economy. Many of these are longstanding and were highlighted in previous reviews. Particular issues highlighted in this Report include:
- Shortcomings in the production of National Accounts, including the absence of double-deflated volume measures of GDP;
 - The scope for improving early estimates of GDP through the use of administrative data, including by making greater use of information from the expenditure and income measures;
 - The need for more detailed and complete Flow of Funds statistics;
 - Inadequate measurement of the service sector, including the need for more detailed deflators and volume indices that better reflect the richness of service sector activity;
 - Inadequate regional statistics and the potential for administrative data to fill some of the gaps.
- 2.123** Addressing these established shortcomings is necessary to ensure statistical methods reflect international best practice and ONS meet users' needs. These efforts need to happen alongside remedial work to address the deficiencies of economic statistics that have had their status as National Statistics suspended ('de-designation'). The statistics for UK Trade, Construction activity and CPIH are all cases in point.
- 2.124** Shortcomings and gaps cannot all be satisfactorily addressed and resolved simultaneously. Some will be more important than others, and some will be easier to fix than others. Ultimately the UKSA board is responsible for endorsing a timetable for addressing statistical shortcomings and gaps on the basis of advice from ONS management. But that prioritisation should be transparent, responsive to the views of users and key stakeholders, and based on an assessment of costs and benefits.
- 2.125** In addition, ONS needs to satisfy both itself and users that all its statistics are not only trustworthy but also accurate, reliable and relevant to user needs. As discussed in Chapters 4 and 5, ONS should endeavour to proactively monitor and address any statistical shortcomings, rather than passively rely on external stakeholders to identify issues. To that end, the recently introduced programme of National Statistics Quality Reviews (NSQRs), which started by scrutinising the Labour Force Survey and the National Accounts and balance of payments, should be extended to the rest of the statistical estate.
- 2.126** This leads to the following specific recommended actions to address the issues associated established statistical shortcomings:

Recommended Action 1: ONS/UKSA should develop a programme to address established statistical limitations transparently and on the basis of an assessment of costs and benefits.

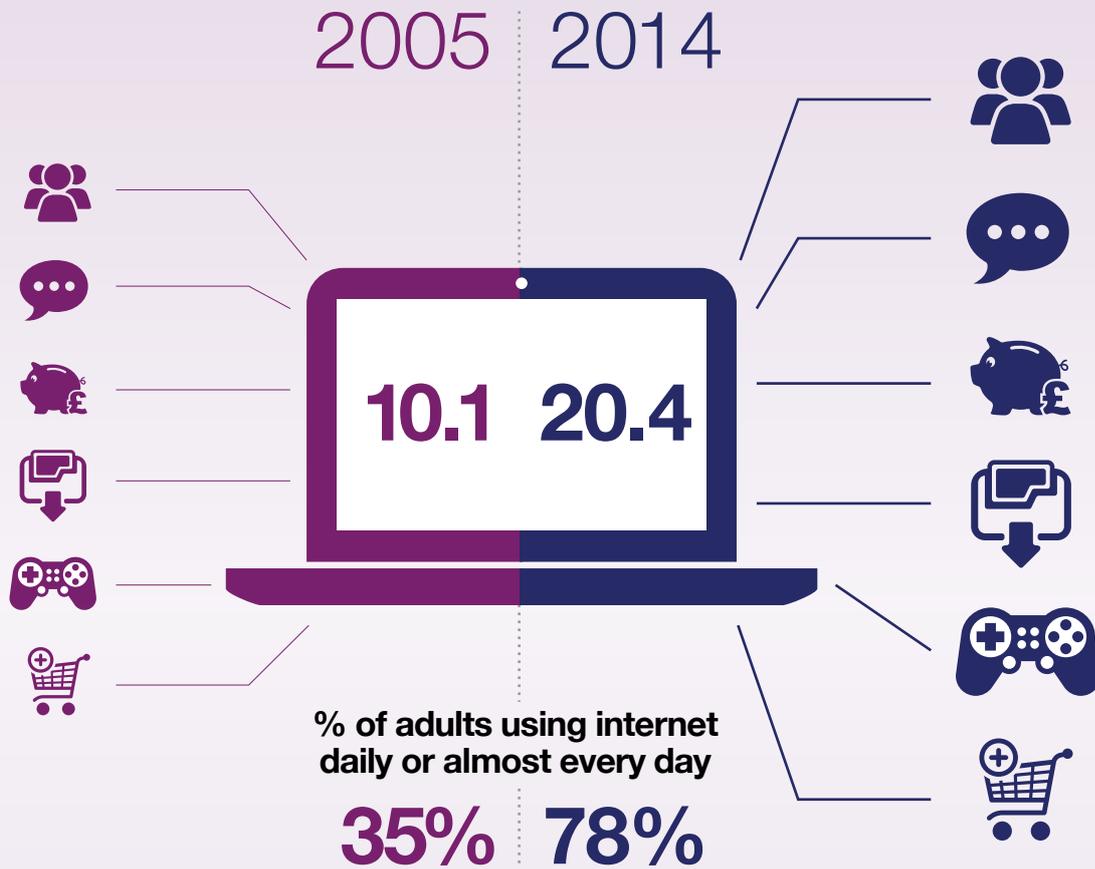
Recommended Action 2: UKSA should continuously seek to identify shortcomings in its economic statistics, both inside ONS and across departments, through a rolling programme of NSQRs, drawing on both internal and external expertise.

MEASURING THE MODERN ECONOMY

EMERGING STATISTICAL CHALLENGES

Innovation and technological change are the source of economic advancement and will continue to test the relevance and accuracy of economic statistics

Estimated hours spent online per week



Digital economy

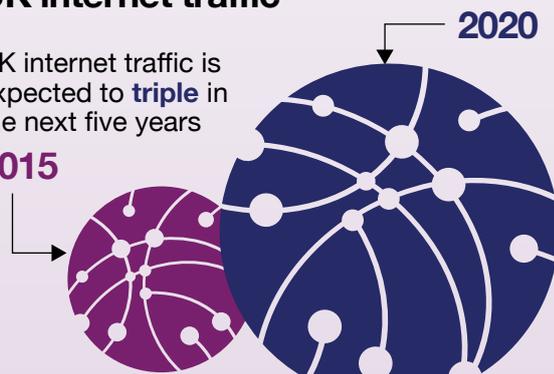
81% The UK has the highest share of consumers **purchasing online** out of all EU countries



UK internet traffic

UK internet traffic is expected to **triple** in the next five years

2015



London has produced the third largest number of **sharing economy** start-ups in the world

SEVENTY TWO

San Francisco 131
New York 89
Paris 24
Boston 20



Chapter 3: Measuring the modern economy – emerging challenges

- 3.1** Innovation and technological change are the wellspring of economic advancement. The rapid and sustained rise in computing power, the digitisation of information and increased connectivity have together radically altered the way people conduct their lives today, both at work and play.¹ These advances have also made possible new ways of exchanging goods and services, prompted the creation of new and disruptive business models, and made the location of economic activity more nebulous. This has generated a whole new range of challenges in measuring the economy.
- 3.2** Traditional methodologies used for measuring economic variables, such as GDP, are almost bound to struggle to keep pace with such developments. In his response to the Call for Evidence, Will Page of Spotify observed that, “GDP faces a ‘square peg, round hole’ dilemma in that it was originally designed to measure tangible manufactured goods which are losing relevance in the modern economy.”
- 3.3** This chapter explores some of the measurement issues associated with the digital revolution. These include: quantifying value-added in the digital modern economy; capturing the ‘sharing economy’; measuring intangible investment; allowing for quality change; and understanding the international location of economic activity. The future will no doubt throw up more. But finding ways to meet the challenge is essential if economic statistics are to remain relevant to user needs.

Value added in the digital modern economy

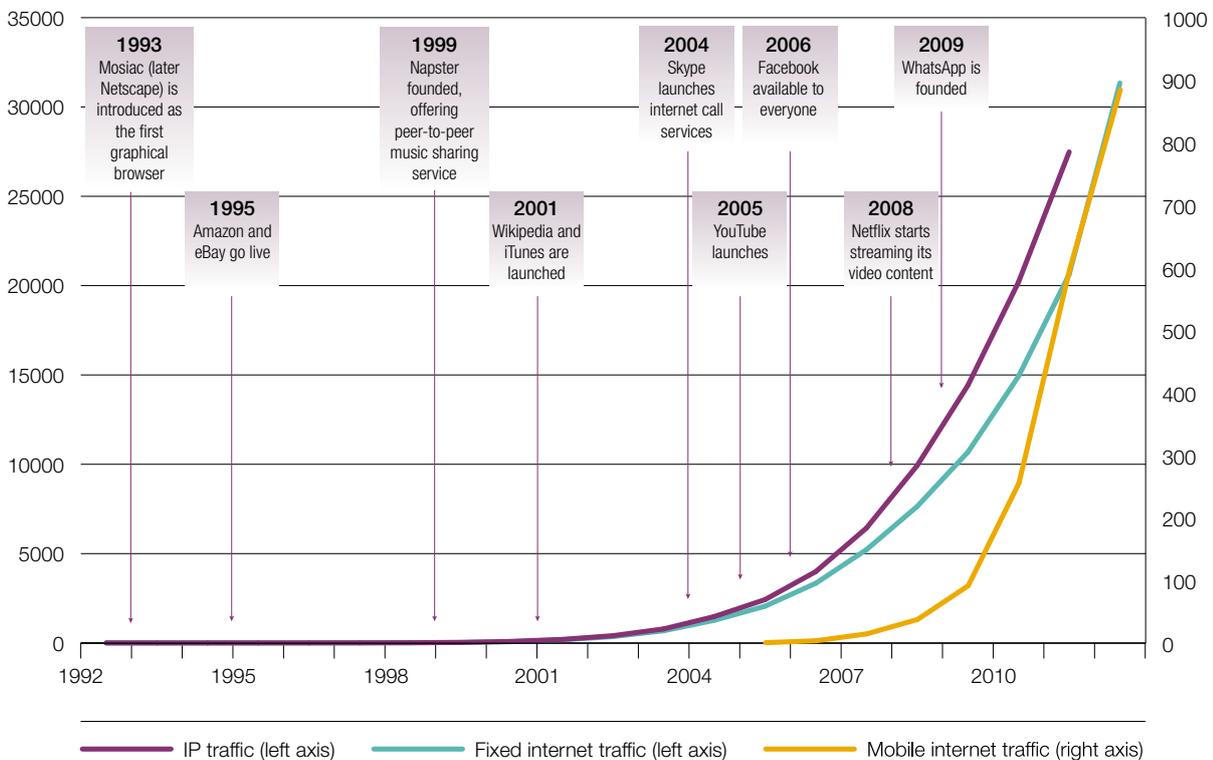
- 3.4** Recent years have seen a radical change in the way information is stored and accessed. In 2005, just over half of UK adults had access to the internet, about a third still used dial-up, and less than one fifth used a wireless connection. Even though mobile phones were widespread, less than one in ten of the population used them to access the internet or read email. Just ten years later, roughly 90% of adults access the internet, while four out of five households have a fixed broadband connection. Ownership of smartphone and tablet devices has also increased dramatically. According to Ofcom, two thirds of adults own a smartphone, up from less than third in 2011, while more than a half own a tablet. As a result, the number of adults accessing the web on a mobile has tripled in

1 Brynjolfsson, E., and McAfee, A., (2014). ‘The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies,’ W. W. Norton & Company

just five years. Moreover, advances in mobile network technology have further increased the speed and facility of exchanging data. Since its launch in 2013, 4G mobile connections have already reached almost a third of the entire market.^{2,3}

3.5 These developments in hardware, software and network technologies have greatly facilitated the production, processing and sharing of digital information, making possible a huge and exponentially increasing amount of data available in various forms. According to some estimates, 90% of the total data available in the world at the end of 2013 had been generated over the previous two years,⁴ while according to the International Telecommunication Union, the volume of data stored in electronic format doubles roughly every 18 months.⁵

Chart 3.A: Global internet traffic trends



Notes: Petabytes per month. Aggregating from multiple sources and applying usage and bitrate assumptions, Cisco Systems, a major network systems company, has published the following historical Internet Protocol (IP) and internet traffic figures.

Source: Wikipedia.

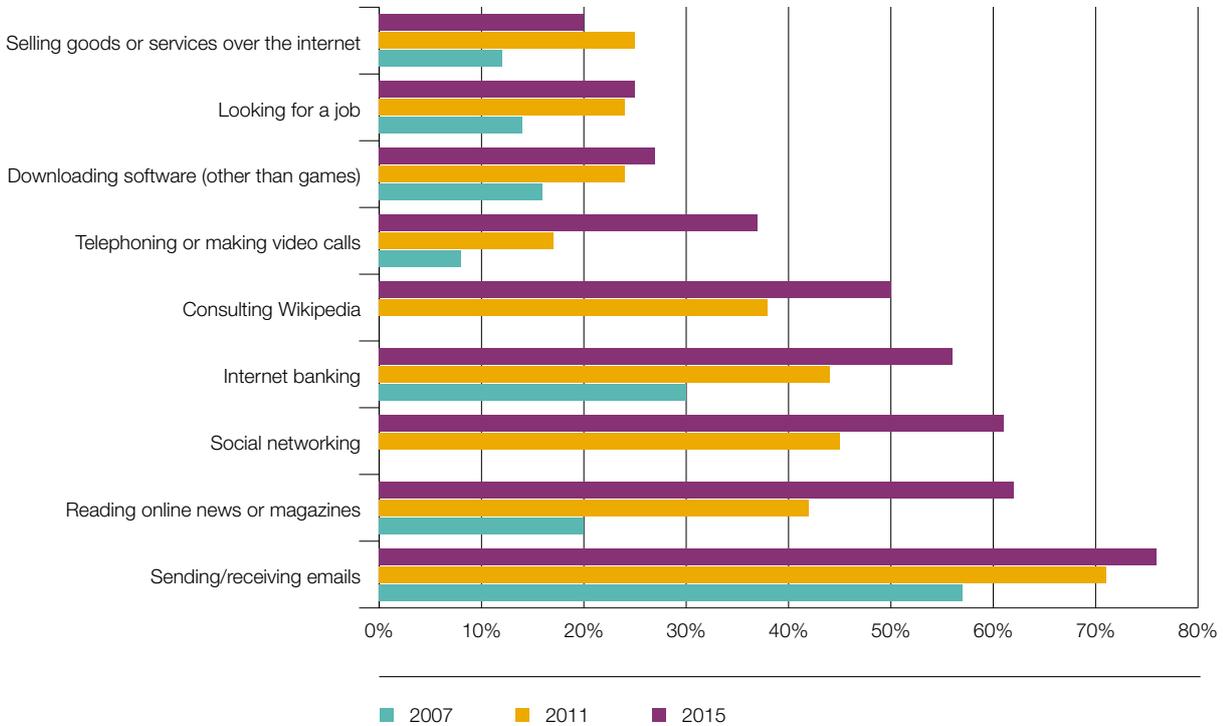
2 Ofcom, (2015). 'Communications Market Report'. Available [here](#).
 3 Ofcom, (2015). 'Adults' media use and attitudes'. Available [here](#).
 4 Science Daily, (2013). 'Big Data, for better or worse: 90% of world's data generated over last two years'. Available [here](#).
 5 International Telecommunication Union, (2015). 'Measuring the Information Society Report'. Available [here](#).

- 3.6** Chart 3.A reports estimates of the amount of data exchanged through the web worldwide. Total internet traffic has also experienced dramatic growth. In 1992, global internet networks carried approximately 100 gigabytes (GB) of traffic per day. By 2002, global internet traffic had risen to 100 GB per *second* (GBps). And by 2014, it had reached 16,144 GBps.⁶ Cisco Systems expect UK internet traffic to triple in the next five years.
- 3.7** To some extent, the increase in online data traffic reflects digital services replacing traditional counterparts. Examples include: reading news content online as opposed to reading newspapers; and using streaming media providers, such as Spotify and YouTube, instead of buying CDs and DVDs. But to some degree it is instead the counterpart to new forms of consumption, such as the millions of Google queries, or hundreds of thousands of social network messages exchanged, every minute (see Chart 3.B).⁷
- 3.8** Widespread access to the internet through high-speed broadband, coupled with easy access through portable devices such as smartphones, has also greatly reduced the costs of undertaking many information-intensive activities. As a result, activities that might previously have needed the services of a dedicated intermediary (provided at a charge) can now be undertaken directly by the consumer at negligible monetary cost. In addition, the digital economy and the internet have increased the scope for a variety of digital cottage industries, so blurring the boundaries between work, domestic activity ('home production') and leisure.

6 Cisco Systems, (2015). 'The Zettabyte Era – Trends and Analysis'. Available [here](#).

7 Yossi, A., (2015). 'What Happens in an Internet Minute? How to Capitalize on the Big Data Explosion'. Available [here](#).

Chart 3.B: Share of the population undertaking internet-enabled activities



Notes: Share of adult population in Great Britain who have undertaken a particular internet activity within the last three months.

Source: Office for National Statistics.

3.9 Several studies have sought to quantify the size of the internet economy by looking at economic activities directly ascribable to internet-based companies or at the economic impact of the web.⁸ The real question, though, is whether the current framework of the National Accounts is flexible enough to capture the full extent of the transformation brought about by the digital revolution. The nature of digital products has led to business models where it is harder for the statistician to observe both transactions and a corresponding price. The great challenge for economic measurement stems from the fact that the consumption of digital products often does not involve a monetary transaction that corresponds to its value to consumers. Digital products delivered at a zero price, for instance, are entirely excluded from GDP, in accordance with the internationally-agreed statistical standards. The issue is analogous to that posed by public goods provided free of charge at the point of delivery. But, unlike that example, there is not even a protocol that dictates their value is related to the value of inputs used in their creation.

3.10 Brynjolfsson and McAfee sagely note, “The great irony of the information age is that, in many ways, we actually know less about the sources of value in the economy than we did fifty years ago.”⁹ The gap between what is measured and what is valued grows every time access is gained to a completely new good or

8 See e.g. OECD, (2013). ‘Measuring the Internet Economy’. Available [here](#).

9 Brynjolfsson, E., and McAfee, A., (2014). ‘The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies,’ W. W. Norton & Company

service or when existing goods or services are offered free as is often the case after digitalisation. The question is how these new forms of consumption should be accounted for in economic statistics such as GDP.

Measuring the consumption of digital products

3.11 Digital product is a general term used to describe products that are stored, delivered and/or used in electronic format. Three particular characteristics of digital products make capturing their economic value difficult:

- Digital products are typically ‘non-rival’ – their consumption by one agent does not prevent their consumption by other agents. Indeed, the value of many digital products actually increases with the number of other users (a ‘network effect’).¹⁰
- Digital products can be replicated at negligible cost and are frequently indistinguishable from the original.¹¹
- Digital products are weightless and aspatial. They can be easily and freely stored on a computer and sent large distances over a network.

3.12 A digital product may be costly to create in the first instance. But these features mean that if it can be easily imitated, without a barrier to entry, its price will be apt to be driven down to zero. Moreover, even when the original supplier can inhibit entry, he may still have an incentive to set the price very low in order to attract a large number of users, especially in the presence of network effects. As a result, there is no observable price for use for some of the most important digital products, excepting the fixed cost for general access to the internet. Hence it becomes hard to identify the value to users and to capture it in measures of GDP and of productivity.

3.13 Firms can essentially generate revenues from online digital products in three ways: levy a conventional charge for access; sell information about their customers to third parties; or sell online advertising space.¹² In the first case, the consumer pays for the product with money; in the second case, the customer offers (or provides unwittingly) their personal information; in the third case, the customer pays with their time, in the form of attention to the advertisements. Firms can obviously combine approaches, for example by charging customers for a subset of services, as well as generating additional revenues from selling advertising or personal information.

10 For instance, search engines improve their reliability with the increase in the number of users, similarly instant messaging services and social networks will deliver greater value the greater the number of people connected to these services.

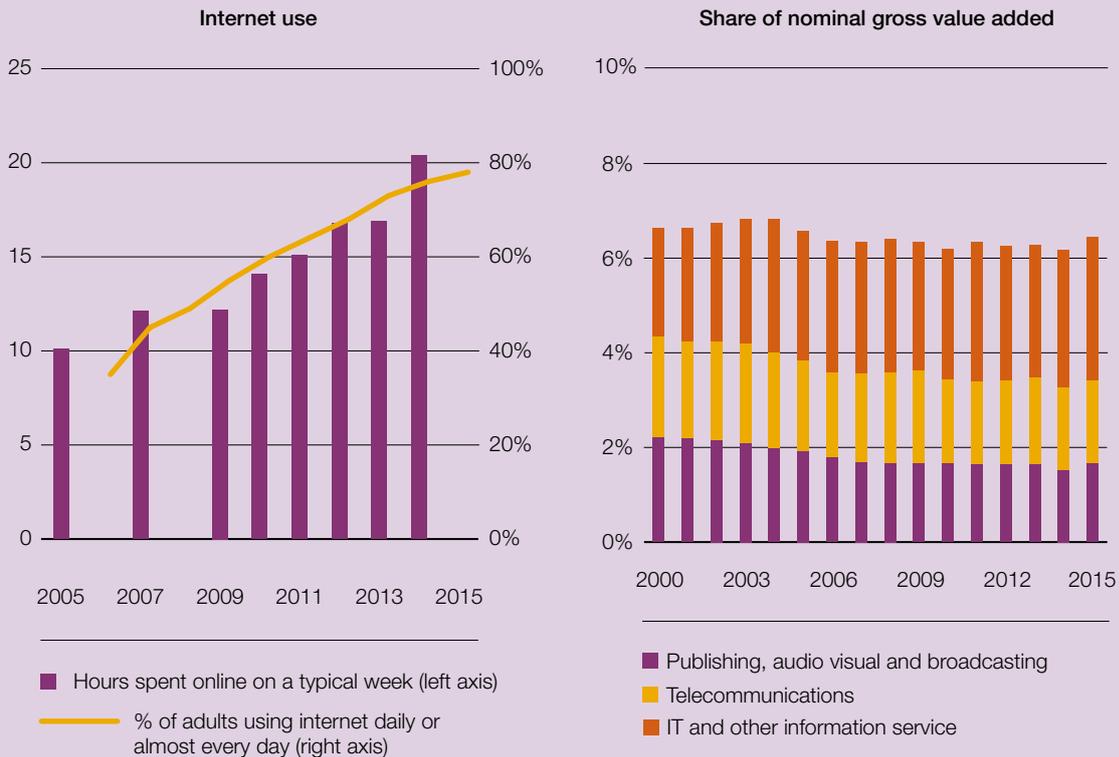
11 Shapiro and Varian state that, “Information is costly to produce and cheap to reproduce.” Shapiro, C., and Varian, H., (1998). ‘Information Rules: A Strategic Guide to the Network Economy,’ Harvard Business School Press.

12 Lambrecht, A., Goldfarb, A., Bonatti, A., Ghose, A., Goldstein, D., Lewis, R., Rao, A., Sahni, N., and Yao, S., (2014). ‘How do firms make money selling digital goods online?’ Marketing Letters, Springer, vol. 25(3), p331-341, September. Available [here](#).

Box 3.A: UK internet use and the challenges of measuring the information sector

Over the past ten years, the time spent using the internet, at home, work and on the move, has increased substantially (see Chart 3.C). Today some 80% of the adult population access the internet daily. Moreover, the average adult now spends about 20 hours surfing the web per week, double the time spent ten years ago. Over the same period, the speed of internet connections, both on fixed and mobile services, has improved substantially.¹³ The increased internet accessibility has led to a dramatic growth in the digital product consumed online. One would expect to see similarly buoyant growth in the statistics meant to capture the digital sector. But this is far from the case, suggesting that official statistics may be missing an important aspect of the contemporary economy.

Chart 3.C and 3.D: Internet use and the share of information and communication in gross value added



Source: Ofcom, (2015). 'Communications Market Report,' Ofcom, (2015). 'Adults' media use and attitudes,' Office for National Statistics, Review calculations.

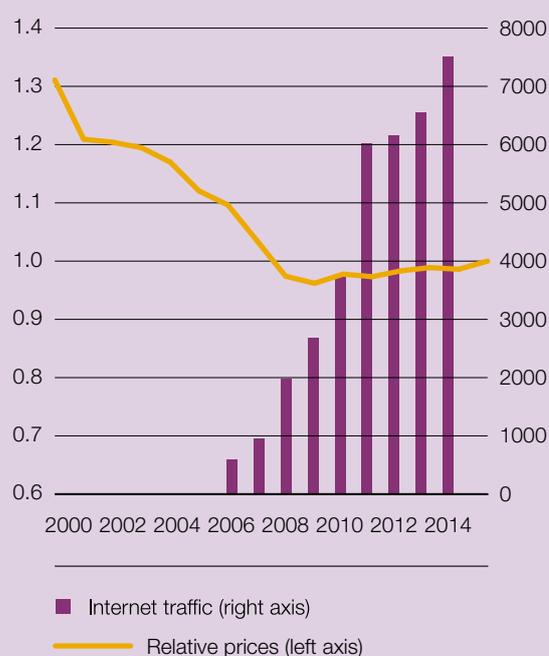
13 See Ofcom, (2015). 'Communications Market Report'. Available [here](#).

Chart 3.D plots the evolution of the ‘information and communication’ sector as a share of total GVA.¹⁴ Given the explosion of online data access from the mid-2000s, the relative stability of the size of the sector, at about 6.5% of overall GVA, is both striking and somewhat unexpected. The almost constant share also masks a modest decline in the telecommunication and publishing, audio-visual and broadcasting sub-sectors. Constant nominal shares in aggregate value added can conceal substantial growth in one sector when relative prices are falling quickly. However, looking, for instance, at the movement in prices in the communication services sector over the last decade one finds them to be broadly in line with the overall CPI (see Chart 3.E). These relatively flat prices fail to reflect the improving quality of communication services, based on vastly increasing volumes of data exchanged.

The web has led to cheaper alternatives for many products and some of the new forms of consumption may not be well captured in the official statistics. For instance, according to some estimates, UK sales of paper maps fell by a quarter with the advent of online map services.¹⁵

To see that some digital products are likely to be unaccounted for in – and might even have reduced – the official GDP statistics, it is insightful to compare expenditure and value-added activity measures with corresponding internet usage statistics, for some of the industries that have undergone substantial digitisation.

Chart 3.E: Relative price of communication and internet consumption traffic



Notes: Prices: CPI Index Communication divided by CPI All Items (2015=1). Internet traffic: Cisco Systems' estimates of Western Europe consumer internet traffic (Petabytes per month).

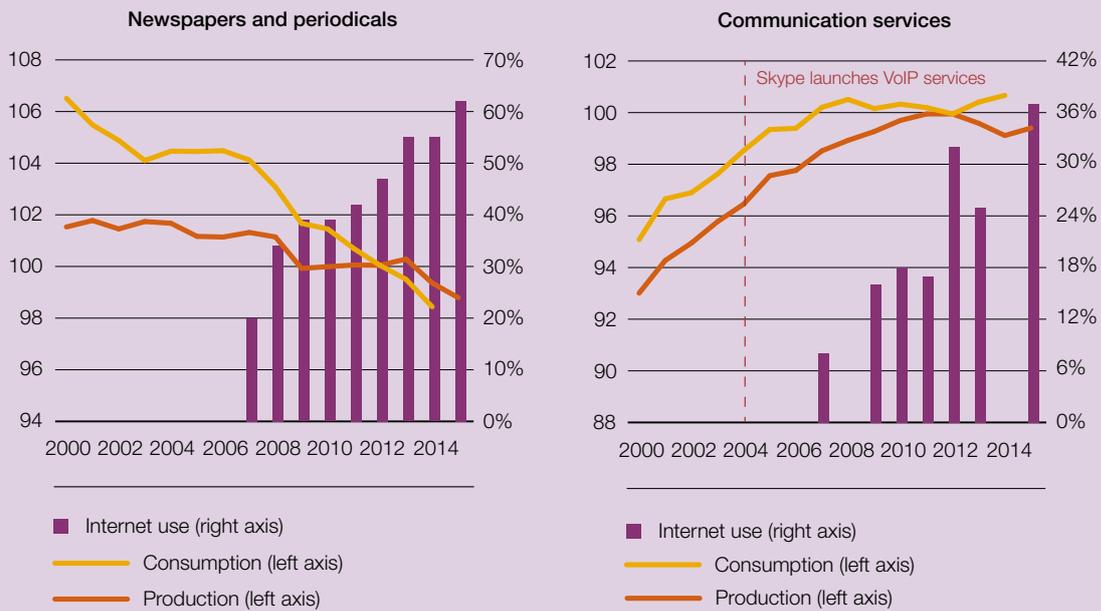
Source: Office for National Statistics, Cisco Systems, Review calculations.

14 A separate ‘information and communication’ sector was first introduced in the UK with the 2007 reform of the standard industrial classifications. Examples of key activities falling within this sector are: publishing (software, motion picture and music), radio and TV broadcasting, telecommunications, information technology and other information service activities. It seems appropriate therefore that digital economy activities should be covered in this sector.

15 BBC News Magazine, (2014). ‘The lost era of the A-Z map?’. Available [here](#).

For instance, since 2007, the number of people reading the news online has risen from one in five to three in five. Over the same period, the output of the publishing sector as a share of GDP, and household expenditure on newspapers and periodicals, declined sharply (see Chart 3.F).¹⁶ Clearly, if the same content can be accessed online for free or at a much lower price, purchasing a paper copy becomes less likely, or less frequent.

Chart 3.F and 3.G: Internet activity and economic activity in selected sectors



Notes: Left panel: Internet use corresponds to the share of adults that stated to have read news, newspapers or magazines online. Consumption refers to the (log, normalised to 100 in 2012) household expenditure on newspapers and periodicals. Production refers to the (log, normalised to 100 in 2012) value added volumes for the publishing activities sector.

Right panel: internet use corresponds to the share of adults who used the internet to make voice or video calls. Consumption refers to (the log, normalised to 100 in 2012) household expenditure on communication, telephone and telefax services. Production refers to the (log, normalised to 100 in 2012) value added volumes for the telecommunications sector.

Source: Office for National Statistics.

Similarly, it has been possible to make cheap calls over the internet rather than over more expensive fixed line and cellular networks ever since Skype introduced its Voice over internet protocol (VoIP) service in 2004.¹⁷ As a result, the number of adults making voice or video calls online has increased from around one in ten in 2007 to nearly four in ten today.¹⁸ And about 80% of these users end up paying nothing for their calls.¹⁹

16 The overall nominal share of consumption in newspapers, books and stationery is today about half of what it was at the beginning of the 1990s.

17 See Bebusiness.com, 'The History of VoIP'. Available [here](#).

18 According to the McKinsey Global Institute, between 2005 and 2013 the Skype share of international phone calls increased from less than 5% to almost 40%. See McKinsey Global Institute, (2014). 'Global flows in a digital age: How trade, finance, people, and data connect the world economy'. Available [here](#).

19 Ofcom, (2015). 'Communication Market Report' (page 271). Available [here](#).

The increase in the number of online communication channels (e.g. email, social media, and instant messaging apps) also reduces the need for conventional voice calls (and SMS messaging) altogether. But this new form of digital communication appears to be largely absent in official statistics: the last ten years has seen a sharp tailing off in the growth rates of both consumption and production of the telecommunication sector (see Chart 3.G).²⁰

These examples suggest that a significant volume of activity taking place over the web is indeed not well captured within the existing statistical framework.

- 3.14** Most of the web’s popular destinations, such as Google, Facebook, and YouTube, rely on advertising to generate income. Their revenues mostly come from search ads (links shown alongside results from queries typed into search engines), or display ads (images or animations shown next to web content) with advertisers being willing to pay more for their ad to be seen by more users. In this case, digital products and services are effectively paid for by the advertisers. As such, the 2008 UN System of National Accounts (SNA) treats them as an intermediate input in the advertising industry. Therefore, the advertisement expenditure adds to the value added of the industries supplying advertisement space, and at the same time detracts from the value added of the advertising industries. Consequently the value of digital products financed through selling advertising space will be accounted for in aggregate GDP only to the extent that it also translates into higher consumption of the goods and services being advertised.
- 3.15** The pricing model for many internet and mobile services is one where a basic version is available for free with an enhanced version available to paying subscribers (the so-called ‘freemium’ model). Moreover, where a service is financed through a subscription, the subsequent use of the service is unlimited (i.e. there is a fixed cost for access but a zero marginal cost of use). This implies that the monetary transaction, even when recorded, fails to reflect the volume of digital product consumed; in effect, the price per unit is not observed.

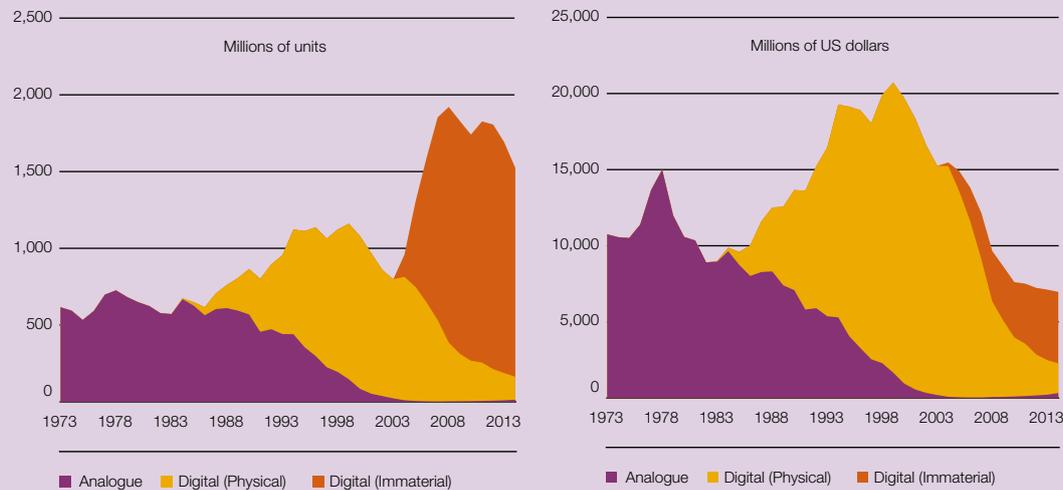
²⁰ This is even more surprising if one notes that these figures include the cost of accessing the internet.

Box 3.B: Digital disruption of the music industry and national accounts

The music industry has been particularly affected by the digital revolution. CDs, the dominant medium in the 1990s, have now largely been superseded by online downloads and streaming services. Chart 3.H shows data for volumes and values in the US music industry, according to the different media of delivery. The comparison between units consumed, i.e. the number of albums or singles bought in different technological formats, and the (real) revenue from those sales is stark. Whereas the broad movements in volumes and revenues are similar for analogue (vinyl/tape) and CD formats, the switch to the downloaded format is not reflected in a similar surge in revenues, with a sharp fall in both revenues and margins.

Several factors explain these diverging trends. First, it is feasible to buy a single song rather than being forced to buy a bundle of them in the form of an album.²¹ Second, the use of smart phones to listen to music means that there is even less need to download music. Preferred songs can now be easily streamed directly on-demand through subscription services and free applications. So the unit statistics might themselves miss a large fraction of consumed music.

Chart 3.H: Comparison of units and value of music sales



Notes: Analogues includes cassette, cassette Single, LP/EP, Vinyl Single, 8 – Track, and Other Tapes. Digital (Physical) includes CD, CD Single, Music Video, DVD Audio, and SACD. Digital (Immaterial) includes downloaded single, album, music video, ringtones and ringbacks, Kiosk, soundexchange distributions, paid subscriptions, on-demand streaming (ad-supported), and synchronization. Right panel is in real terms.

Source: Recording Industry Association of America.

21 DeGusta, M. (2011). 'The real death of the music industry,' Business Insider. Available [here](#).

The trends in Chart 3.H are global. For instance, estimates from 2011 suggest that the value of physical albums sold in the UK had nearly halved over the previous five years and was continuing to fall rapidly.²² Moreover, while the number of streamed tracks has roughly doubled each year since 2012, the revenues from subscriptions have been rising by only two-thirds each year. Furthermore, the ease in streaming music appears to have made consumers less inclined to own copies of their music.²³ In the face of these changes, a large fraction of music industry revenues are generated instead through business-to-business transactions. In particular, record labels have become more skilled at licensing live music and associated merchandise. For example, by 2011 less than half of the revenues of the UK records industry came from physical product sales.²⁴

How does all this affect the national accounts? The consumption of music is not any lower – indeed, it almost certainly higher in terms of tracks listened to – but the way the music business monetises its products has changed profoundly, with an increased reliance on business-to-business transactions, such as advertising and licensing. Estimates of GDP are not invariant to a different choice of business model. Business-to-business transactions count as intermediate inputs, rather than value added. Consequently a large fraction of the production and consumption of the music industry ends up not being reflected in aggregate GDP.

Alternative methods for measuring the consumption of digital products

3.16 The current treatment of digital products within the SNA inevitably tends to result in the underestimation of the value generated by the digital economy. But figuring out the unobservable value created by the internet-based activities is by no means easy. Several approaches have been suggested, differing in their choice of proxy for the value of digital products. These are: the associated advertising expenditure; the value of the time spent on the internet; and physical measures of internet data traffic. None of these metrics is perfect. Yet together they can provide a sense of the extent to which conventional activity measures such as GDP provide a misleading picture.

22 Page, W., and Carey, C., (2011). 'Adding up the UK music industry 2010,' PRS for Music, Economic Insight Issue 23. Available [here](#).

23 Ofcom, (2015). 'Communications Market Report'. Available [here](#).

24 Page, W., and Carey, C., (2011). Op. cit.

- 3.17** The use of advertising revenues to impute digital product value²⁵ is consistent with the tradition of valuing products at cost²⁶ when consumption is not purchased (e.g. public goods and services) or unpriced (e.g. owner-occupied housing and financial intermediation services). Effectively, this methodology builds on the principles for incorporating barter transactions into GDP, as permitted under Section 6.102 of SNA 2008. Specifically, the supplier of the digital product and the consumer are viewed as engaging in a barter transaction in which the consumer agrees to view the accompanying advertisement in exchange for the content (e.g. via computer, radio, newspaper). As in any barter transaction, the income paid to the consumer is exactly equal to the consumption of the advertising and so is fully balanced. Expenditures on media content are assumed to be equal to total advertising expenditures minus any ad-related costs. The corresponding prices are calculated by measuring input costs, such as actor salaries and software and server costs. But because advertising expenditures constitute only a small fraction of GDP, this approach tends to find that allowing for ‘free’ media in this way has only rather a small impact on GDP.²⁷
- 3.18** There are, however, several shortcomings with this approach to valuing the digital economy. First, valuing products at cost is potentially misleading when marginal costs are zero as there is no guarantee that the full value of the digital product is captured in the advertising expenditure.²⁸ Second, when applied to measuring web content, this approach ignores the value of digital services that are produced without requiring any compensation, such as the millions of blogs or Wikipedia entries freely accessible online. Third, it neglects the value generated by those businesses that do not rely on advertisement revenues, but instead earn revenues by selling (often repackaged) information. Hence it provides very much a lower bound on the value of digital product.

25 This methodology builds on the work of Cremeans (1980) who proposed a barter mechanism for measuring free media. Cremeans, J., (1980). ‘Consumer Services Provided by Business through Advertising-Supported Media in the United States,’ *Review of Income and Wealth* 26, pages 151-174.

26 Valuing content at costs implies that this methodology excludes amateur media like fan fiction because production cost is zero. This choice inevitably pose a downward bias in their estimate. For instance a number of previously amateur video have transformed anonymous performers into YouTube celebrities. See e.g. *The New York Times Magazine*, (2012). ‘On YouTube, Amateur Is the New Pro’. Available [here](#).

27 Nakamura, L., and Soloveichik, R., (2015). ‘Valuing “free” media across countries in GDP,’ Working Papers 15-25, Federal Reserve Bank of Philadelphia.

28 Most web sites and apps are built with free, open-source applications. This makes producing and running a site or app cheap. Moreover, the rapid fall on the cost of production for digital goods has meant that there is now an oversupply of advertising space, so that the cost of advertising itself has also been reduced by the advent of the digital economy.

- 3.19** The second approach to valuing digital product delivered over the internet relies on valuing the amount of time a person gives up in order to access it, i.e. estimating the opportunity cost.²⁹ The underlying assumption is that every hour spent on the internet necessarily comes at the expense of time that could be working or else on leisure activities.³⁰ There is a long tradition in economics of treating the wage rate as the shadow price of leisure, at least for those who can participate in the labour market.³¹ The US Bureau of Economic Analysis employs a similar approach to compute satellite accounts for non-market home production activities, such as cooking, ironing and cleaning.³²
- 3.20** Applying this approach in the US, Brynjolfsson and Oh concluded that the welfare gains associated with access to free products on the internet would be roughly equivalent to an additional 0.75 percentage point increase in the growth rate of GDP for every year between 2007 and 2011.³³ That additional growth estimate is around 20 times larger than estimates based solely on internet subscription fees. While these are rough estimates, they give a sense of the potential value of the digital economy.
- 3.21** Since internet penetration and average time spent online are similar in the UK, one might expect to find something similar in the UK. Excluding usage at work, average weekly time spent on the internet by UK adults has increased from seven hours in 2005 to slightly more than 15 in 2014.³⁴ However, some of this reflects activities that are already picked up in conventional activity measures, so we need to avoid double-counting. Assuming that the opportunity cost of time is given by average hourly earnings, and making the (conservative) assumption that the opportunity cost for the non-employed is zero, then one finds that the average annual growth rate over the period 2005-2014 would have been

29 Goolsbee, A., and Klenow, P.J., (2006). 'Valuing Consumer Products by the Time Spent Using Them: An Application to the Internet,' *American Economic Review* (96:2), pp.108-113. Brynjolfsson, E., and Oh, J., (2012). 'The Attention Economy: Measuring the Value of Free Digital Services on the Internet,' AIS Electronic Library.

30 This assumption would be consistent with the observation that, although high-income people were more likely to have adopted the Internet, conditional on adoption, low-income people spend more time online. See Goldfarb, A., and Prince, J., (2008). 'Internet Adoption and Usage Patterns are Different: Implications for the Digital Divide,' *Information Economics and Policy* (20), pp.2-15.

31 Becker, G., (1965). 'A Theory of the Allocation of Time'. *The Economic Journal*, Vol. 75, No 299. See also Aguiar, M., Hurst, E., and Karabarbounis, L., (2012). 'Recent developments in the economics of time use,' *Annual Review of Economics* 4, pp.373-397.

32 Time-use survey collecting data on how the population spends its time, is already the single most important source of data for nonmarket production and income accounts in the US. See Landefeld, S. J., Fraumeni, B. M., and Vojtech, C., (2005). 'Accounting for Nonmarket Production: A Prototype Satellite Account Using the American Time Use Survey'. Available [here](#).

33 Those estimates are in line with Varian who attempted to quantify the value of Google's search engine based on the value of time savings to average users. Varian, H., (2006). 'The Economics of Internet Search,' Technical Report, Google, Inc. Available [here](#).

34 ONS, (2015). 'Labour Force Survey'. Available [here](#). And Ofcom, (2015). 'Communications Market Report'. Available [here](#).

0.66 percentage points higher if a third of digital products are already accounted for within the official statistics,³⁵ falling to 0.35 percentage points if two thirds are already accounted for. While only a rough illustration of the possible economic contribution of this sector, it does serve to highlight its potential importance.

- 3.22** In a world where people are continuously connected to the web, survey-based measures of active internet usage of the sort underpinning this calculation may even underestimate the importance of the digital economy. Moreover, accounting only for the time spent on the internet overlooks the improvement in the quality of that access, with faster connections making possible the downloading of better-quality digital product such as ultra-high resolution video. So it is entirely possible that these illustrative calculations may understate the economic significance of internet activity.
- 3.23** The third approach to measuring the footprint of the digital economy rests on the insight that the production and use of data is a fundamental element of economic activity, in parallel to the production and consumption of goods and services.³⁶ This idea leads naturally to focusing directly on measuring data generation, flows, use and storage as routes into understanding digitally-based economic activity. More specifically, growth in internet traffic can be used as a proxy for the growth in the consumption of digital product. Cisco Systems estimates of the average growth of Western European consumer internet traffic between 2006 and 2014 is roughly 35%.³⁷ If the telecommunication services subsector – which currently accounts for about 2% of the UK economy – had fully reflected this pace of growth, then the average annual GDP growth rate over the same period would have been 0.7 percentage points higher than the rate recorded in the official statistics.
- 3.24** The aspatial nature of digital products creates a further problem for the national accounts. Even if a measure of the consumption of digital product can be derived, it may be far from obvious where the counterpart production – at home or abroad – should be located. The location of the consumer of a product downloaded from the internet may be clear enough, but to which country should the corresponding production be associated for a web page located in cyberspace? If there is a user charge, it may be easy enough in principle – it is the registered location of the business receiving the funds. But it may be less clear when there are no such associated transactions. This issue becomes important for the compilation of the national accounts. If the product is imported that will detract, as opposed to add, to aggregate value added.

35 Assuming that two-thirds of time spent online is at so-called free sites is in line with Brynjolfsson and Oh (2012).

36 Mandel, M., (2012). 'Beyond Goods and Services: The (Unmeasured) Rise of the Data-Driven Economy,' Policy Memo, Progressive Policy Institute. Available [here](#).

37 Cisco Systems measures internet traffic from a variety of sources, this in an estimate of the flow of data across the internet measured in petabytes per month. The consumer subset of the entire internet traffic includes fixed traffic generated by households, university populations, and Internet cafés. Cisco Visual Networking Index. Latest update available [here](#).

- 3.25** Fully accounting for zero price digital products would result in downward revisions to official price statistics.³⁸ Common internet subscription fees that are invariant to the amount of data used mean the increased number of internet-based products used are not visible in the price statistics. Suppose that from one year to another the price of internet access does not change but data traffic doubles. Effectively, the user is paying half of what they were, for a fixed amount of data consumption. This implies that, in presence of flat fees for internet subscriptions, increased data traffic can effectively be seen as a measure of ‘quality’ improvement associated with the internet service. For instance, telephone and telefax equipment and services accounts for about 3% of aggregate CPI, if one applies an average improvement in quality of 35% for every year between 2006 and 2014 to reflect the average increase in data traffic within this period,³⁹ then accounting for the greater benefit associated with the internet connection would lower overall CPI inflation by slightly more than one percentage point per year over the period considered.
- 3.26** The calculations reported in this section, while purely illustrative, highlight the importance of further investigation of the relevance of digital products for understanding the evolution of economic activity over the past decade.

Disintermediation and the digital economy

- 3.27** Advances in digital technology have dramatically reduced the transactions costs incurred when individuals or organisations share the provision or use of an asset or service. Any business, by integrating its existing databases and applications with an internet interface, can now easily reach its customers, employees, suppliers and partners at any time of the day or night, no matter where they are. As a result, companies can engage in their core transactional activities much more efficiently. In particular, customer self-service electronic platforms/apps offer end users 24/7 access to information and support without having to engage with a customer representative.⁴⁰ Effectively, these electronic platforms/apps greatly reduce the (marginal) costs of undertaking many information-intensive activities and have eliminated (or reduced) the need for a dedicated intermediary.
- 3.28** Take, for instance, the travel industry. Previously, a consumer wishing to book travel or a holiday would visit (or phone) a travel agent to do this. Instead, consumers can now search online to find what they want and then book with hotels and airlines directly, or through online portals such as Expedia, with a significant reduction in the service commission. It is therefore hardly a surprise

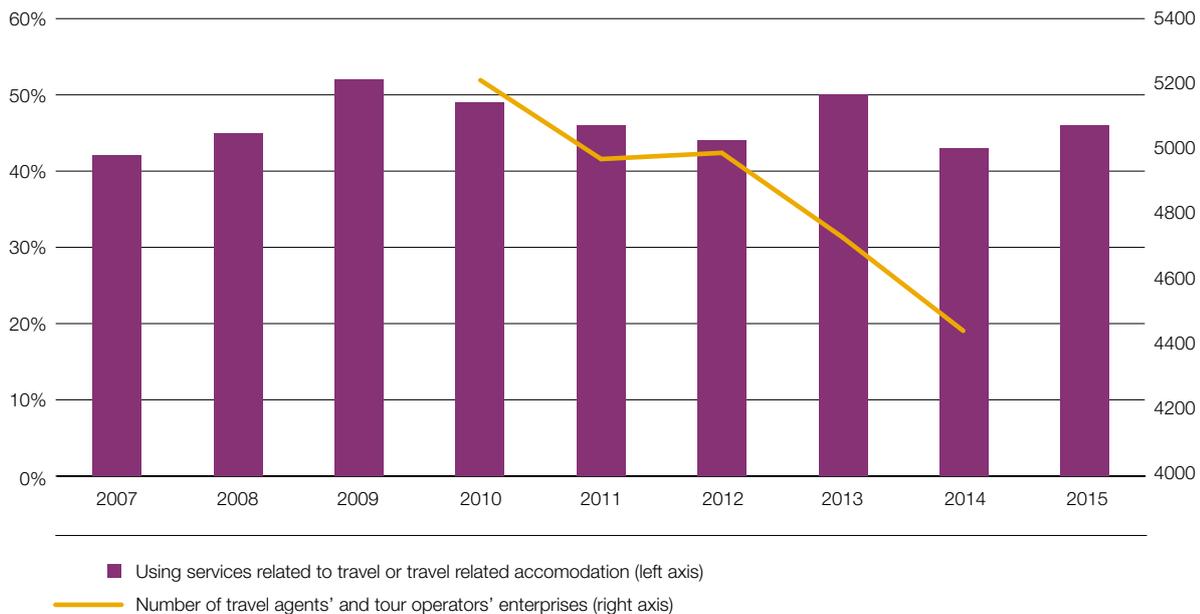
38 Similarly a measure of inflation that accounts for a positive share of zero price goods and services would be systematically below the official inflation statistics. See Feldstein, M., (2015). ‘The U.S. Underestimates Growth,’ Wall Street Journal. Available [here](#).

39 This reflects Cisco Systems estimates of the average growth on Western European consumer internet traffic in this period.

40 Moreover, customer self-service software allows the organisation to gather personal information about the costumers. This information is in itself valuable as it can be used for research and targeted marketing purposes.

that the number of independent travel agents has fallen sharply over the past few years (see Chart 3.I). In essence, an activity that was previously undertaken through the market – the acquisition of information about travel options – has now been outsourced to the consumer.

Chart 3.I: Digital disruption in the travel booking industry



Notes: The bars represent the share of the adult population using services related to travel or travel related accommodation in the last three months. The line represents the number of travel agents' and tour operators' enterprises in the UK.

Source: Office for National Statistics, (2015). 'Internet Access – Households and Individuals', The European travel agents' and tour operators' associations (ECTAA).

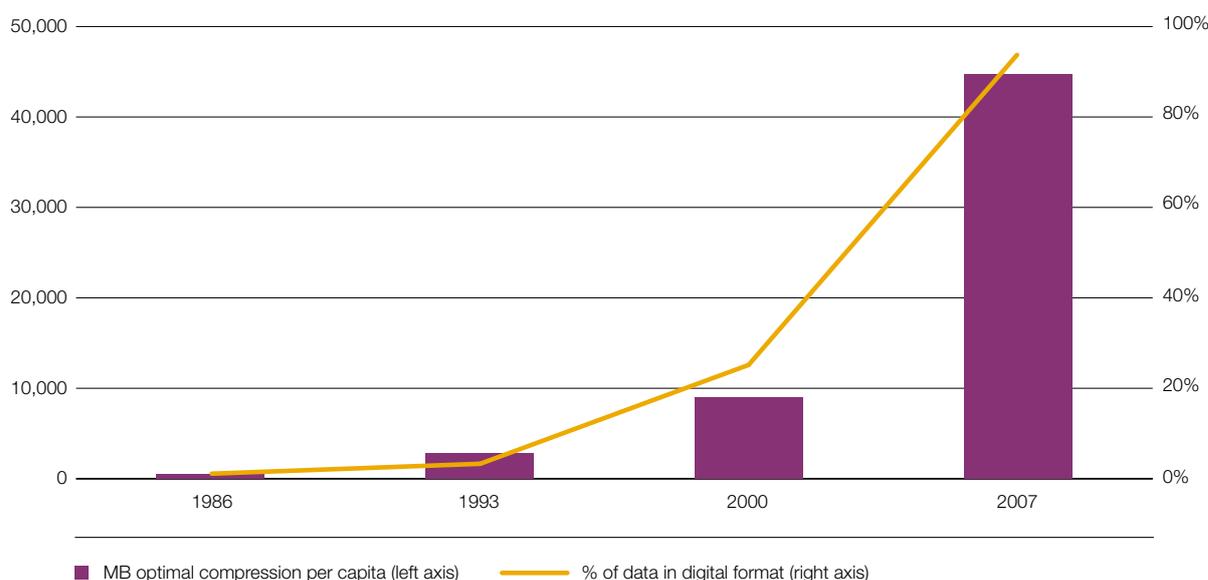
3.29 Today, contact with customers increasingly happens via the web. This has significant implications for consumer-facing business like banking, travel agency and insurance. Activities that were previously undertaken in the market economy have instead become part of 'home production' instead. But, by convention, home production activities are not counted as part of GDP (see the discussion of Household Satellite Accounts below). This tendency for the disintermediation of information-intensive service activities still has a considerable way to run, with potentially significant implications for the interpretation of conventional measures of productive activity. In particular, by shifting activity from inside the GDP boundary to outside, it has the potential to lower GDP.

The value of investing in data in the modern economy

3.30 Data have always held a central role in economic planning and decision-making. Much effort is spent daily collecting and processing information on customers or processes which are then used to enhance productivity and profitability. But the advances in digital technology have led to a veritable explosion in the creation and accumulation of data. Chart 3.J shows that data storage capacity exploded over the period 2000-2007 and has surely continued to rise exponentially since. Moreover, the development of sensors facilitating interaction between

appliances, vehicles, and other interconnected electronic devices (the ‘Internet of Things’) that collect and share data on, for example, location and preferences, will further boost the already vast amount of data that is generated daily. Deloitte estimate that, in 2015, one billion wireless devices that were not PCs or mobiles were shipped, 60% more than in 2014, leading to an installed base of nearly 3 billion devices.⁴¹ According to some forecasts, this is expected to increase to 26 billion by 2020.⁴²

Chart 3.J: Data storage capacity



Notes: Normalisation on compression rates is essential for comparing the informational performance of analogue and digital technologies. It is also indispensable for obtaining meaningful time series of digital technologies because more efficient compression algorithms enable handling more information with the same amount of hardware. For example, we estimated that a hard disk with a hardware performance of 1MB for video storage was holding the equivalent of one optimally compressed MB in 2007 and merely 0.017 optimally compressed MB in 1986. The compression rate used here is the one available as of 2007. Information is measured as if all redundancy were removed with the most efficient compression algorithms available in 2007 (i.e. ‘optimally compressed’).

Source: Hilbert, M., and López, P., (2011). ‘The world’s technological capacity to store, communicate, and compute information,’ Science, Vol. 332, Issue 6025, pp. 60-65.

3.31 Information in digital format can be easily accessed and used. And developments in computational power and, more importantly, in data science, such as machine-learning algorithms, facilitate unlocking the potential of this ‘big data’.⁴³ Companies churn out a burgeoning volume of transactional data, capturing trillions of bytes of information about their customers, suppliers, and operations.⁴⁴ For instance, retailers can track customers’ purchases via loyalty

41 Deloitte, (2015). ‘The internet of Things really is things, not people’. Available [here](#).

42 Gartner, (2015). ‘Gartner Says 6.4 Billion Connected “Things” Will Be in Use in 2016, Up from 30 Percent in 2015’. Available [here](#).

43 Shaw, J., (2014). ‘Why “Big Data” Is a Big Deal,’ Harvard Magazine, March-April. Available [here](#)

44 McAfee, A., and Brynjolfsson, E., (2012). ‘Big Data: The Management Revolution,’ Harvard Business Review. Available [here](#).

cards, allowing them to make customised offers or discounts.⁴⁵ Moreover, by applying analytics to the massive amount of personal data collected, data analytics companies, such as Amazon’s AWS and Google AdSense, can more accurately profile consumer preferences and provide personalised advertisements. Utility companies increasingly use connected devices to monitor pipe leakage and brownouts, as well as to monitor customers’ consumption habits. And agribusiness giants such as Monsanto deploy predictive analytics tools to gauge weather and crop conditions.

- 3.32** As a consequence, data is effectively becoming another factor of production, analogous to physical and intangible capital. Recent research suggests that such data capital creates significant value for the world economy, enhancing the productivity and competitiveness of market and non-market producers and creating substantial consumer surplus.⁴⁶
- 3.33** The need to store all this data has prompted massive investment in data centres across the globe. Despite advances in data storage technology over the past few years, aggregate US ‘floor space’ of data centres was expected to rise to 727 million square feet by the end of this year, from 666 million square feet in 2014. Cloud-computing traffic, the fastest growing area of data centre activity, is expected to more than quadruple between 2012 and 2017, at which point it will represent nearly two-thirds of total computing workload.⁴⁷ But there are major conceptual challenges involved in working out how to capitalise the knowledge embodied in a database. It is somewhat ironic that while official statistics capture the investment in the facilities used for storing all this information, they do not capture the value of the asset that is being stored – the data.
- 3.34** In recognition of the economic value of databases, the SNA 2008 classifies databases as a separate sub-category within the intellectual property asset category ‘software and databases’ (see the discussion of intangible capital below).⁴⁸ In particular, databases are defined as, “Consist[ing] of files of data organized in such a way as to permit resource effective access and use of the data.”⁴⁹ This definition implies that accumulation of all data holdings with a useful life of more than one year should be recorded as investment in a fixed asset, including both databases created on own-account and those purchased.

45 For instance large retail store collects approximately 10 gigabytes (GB) of data per hour, and 1 GB of that is transmitted and stored in a data centre. See Cisco Systems, (2014). ‘Cisco Global Cloud Index: Forecast and Methodology, 2013–2018’. Available [here](#).

46 McKinsey Global Institute, (2011). ‘Big data: The next frontier for innovation, competition, and productivity’. Available [here](#).

47 Lev-Ram, M., (2014). ‘What’s the next big thing in big data? Bigger data,’ Fortune 500. Available [here](#).

48 SNA 1993 first described the treatment and measurement of databases as a special case of software. However, no precise definition for databases was provided. Moreover it was recommended that only large databases should be capitalised. These uncertainties were clarified in the SNA 2008.

49 SNA 2008 paragraph 10.112.

- 3.35** Although, in theory, national accounts measures ought to include databases, in practice NSIs tend to measure just software and do not report databases separately.⁵⁰ This practice understates the importance of one of the most important assets in the modern economy. The ONS's Quarterly Survey of Capital Expenditure Survey collects information on investment in software and asks businesses to include 'large' databases within that category.⁵¹ One approach to valuing databases is to record expenditures on database creation, known as the 'sum of costs' method in the national accounts. This aligns with the current treatment of Intellectual Property Products, such as software and R&D. OECD recommends the use of specialised surveys that distinguish between external costs (expenditures) related to databases for own final use and internal costs of in-house database creation.⁵² In addition, the survey should ask for the company's own estimate of its capitalised databases, if any. ONS has conformed to this recommendation and has added two specific questions in the Quarterly Capital Assets Survey. Separate estimates of the value of database investment within the national accounts are planned for Blue Book 2017.
- 3.36** In order to differentiate between data that is consumed and data that represents a lasting investment, a central question is determining which data provide capital services for more than a year, since it is the average length of time data is stored for that determines the classification of the database. In principle, data in digital form can last forever and its productive capacity is not affected by its use. But clearly its economic value can decline, possibly quite rapidly.
- 3.37** In practice, most databases are produced on own-account, either for internal use or for distribution via licence. Establishing the value of these databases is therefore challenging when a market on which they are traded does not exist or when licences fail to reflect the true value of the data for the users. Consider, for example, a firm holding data on consumer transactions and preferences. There are significant opportunities for monetising this information and, if the company were sold, the value of the data would contribute to the sale value of the company. However, such databases are not commonly bought and sold in isolation.
- 3.38** The costs of obtaining information are not included when summing costs to value database gross fixed capital formation. This recommendation in SNA 2008 is meant to avoid capitalizing the value of the data as a form of 'knowledge' in the national accounts. Indeed, the capitalisation of knowledge could create an inconsistency in the SNA, because its capitalisation would depend on how it was stored. If the knowledge were stored and embodied in a database, it would be capitalised. However, if it was stored elsewhere, e.g. on paper files, it would not be capitalised. In addition, the data/information may already be recorded in

50 See McLaren, C.H., (2012). 'Synthesis of the results of the survey on Intellectual Property Products,' Working Party on National Accounts, OECD, Paris. Available [here](#).

51 This is in agreement with the recommendations in SNA 1993 and ESA 1995.

52 OECD, (2010). 'Handbook on Deriving Capital Measures of Intellectual Property Products'. Available [here](#).

the accounts as fixed assets, in the category ‘entertainment, artistic or literary originals’, or they may not be, e.g. paper records.⁵³ Yet, in principle, one might quite plausibly argue that the digitised knowledge becomes more ‘usable’ in day to day activity and therefore should be included in the accounts. Think for instance of the digitisation of non-fiction books by Google. Whereas the knowledge embodied in these books was already available, when in digital form they can be more easily accessed, analysed and exploited.

- 3.39** Developing an appropriate output price index for databases is also difficult, if not impossible. There are three alternatives. The first is to base it on input prices, but this implies zero productivity growth. The second is to adjust the input price index by assuming that multi-factor productivity growth in database investment is similar to that in some other comparable industry. The third is to use a proxy price index of some related activity for which there is a price index of reasonable quality.⁵⁴
- 3.40** An alternative route to gauge the accumulation in the volume of data is to look at companies’ storage capacity and utilisation. In principle, this provides a physical measure of the amount of data businesses are using in production. For instance, Cisco Systems estimates that the total worldwide volume of data stored on client devices and in data centres will more than double in the next five years.⁵⁵ If these estimates provide a good approximation of the growth rate of data accumulation in the UK as well, not accounting for them would have a potentially large impact on measured Intellectual Property Products and, to a more limited extent, aggregate GDP.
- 3.41** Even these approaches have their limitations. Once in digital form, data can be copied many times, often at essentially zero cost, while ownership rights might often not apply. Therefore, imputing the value of databases from their costs is likely to understate the true value of the data to all its users. Moreover, new and more valuable databases can often be created by merging or recombining existing data sources.⁵⁶ So the accumulation of data may still end up understated within the Intellectual Property Products category.
- 3.42** The capitalisation of databases is one of the major challenges that national accountants will have to tackle in the future. Given the UK’s leading role in the digital economy, ONS is in a good position to lead in developing suitable methodologies and in influencing international statistical standards in this area.

53 OECD, (2010). ‘Handbook on Deriving Capital Measures of Intellectual Property Products’. Available [here](#).

54 OECD, (2010). ‘Handbook on Deriving Capital Measures of Intellectual Property Products’. Available [here](#).

55 Cisco Systems, (2015). ‘Cisco Global Cloud Index: Forecast and Methodology, 2014–2019 White Paper’. Available [here](#).

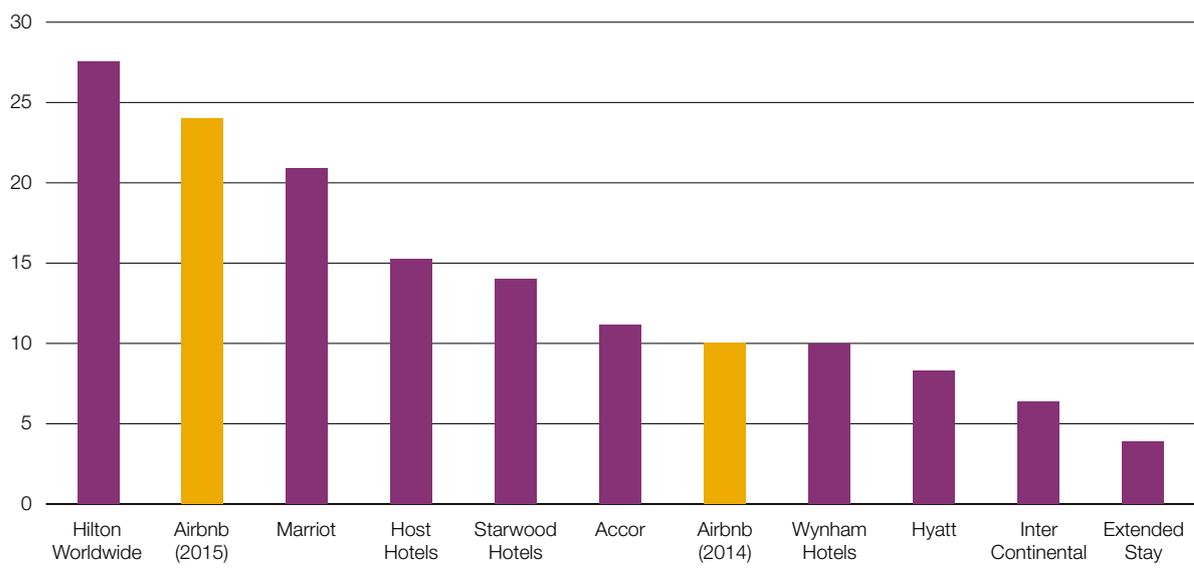
56 This is in effect in line with the idea of recombinant growth. Weitzman, M. L., (1998). ‘Recombinant Growth,’ *The Quarterly Journal of Economics* 113 (2): 331-360.

The sharing economy

3.43 The ‘sharing economy’ is the use of digital technologies to unlock online marketplaces and social networks to facilitate the purchase, hire, and sharing of assets and skills. It consequently covers a rather broad church, from accommodation (e.g. Airbnb) and transport (e.g. ZipCar) to more specialised activities.⁵⁷ Airbnb allows individuals to rent out spare rooms or properties for short-term lets. City bicycle-share schemes and ZipCar allow individuals to rent transport on-demand without facing the burdens of ownership. Fiverr offers a global marketplace for tasks and services, named after jobs starting at \$5, endeavouring to match the supply of skills and time with demand for specialised services.

3.44 A characteristic feature of the sharing economy is the shift from ownership to rental on demand. The sharing of idle assets and skills is not original. Comparable activities in the past include, for example, purchasing a holiday timeshare or renting a lawnmower through a newspaper’s classified section. However, the sharing economy in its current digital incarnation is unprecedented in scale and scope. This growth is down to the impact of digital innovation on the search and transaction costs involved in matching the supply and demand for specialised products. Increasing internet speed and mobile access has expanded the number of potential participants, creating markets that would otherwise be unviable.⁵⁸ Finally, the establishment of social networks between sharing economy participants provides a channel for feedback on past experiences in order to help develop trust.

Chart 3.K: Market capitalisation of Airbnb compared to major hotels, 2015 (£ billion)



Source: Davidson, L., (2015). ‘Airbnb boss calls the UK the “centre of the sharing economy”,’ *The Telegraph*.

57 Botsman, R., (2010). *What’s mine is yours: The rise of collaborative consumption*. HarperCollins Publishers.

58 Anderson, C., (2006). *The Long Tail: Why the Future of Business Is Selling Less of More*. Hyperion.

- 3.45** Chart 3.K illustrates the rapid growth of Airbnb’s market capitalisation in recent years – in part reflecting expectations of future earnings potential – and its value compared to major established hotel chains. Moreover, there are reasons to believe that UK residents are particularly active in the sharing economy. UK consumers are relatively computer-literate and are the most likely in the EU to make online purchases.⁵⁹ Professor Diane Coyle recently estimated that some 3% of the UK workforce provide a service through the sharing economy,⁶⁰ while NESTA estimates that one in four UK adults has made use of such digitally enabled services.⁶¹ In 2015, a survey indicated that the UK produced one in ten of the world’s sharing economy start-ups, and London was the home for the third largest number of these new firms in the world, trailing only San Francisco and New York.⁶² PricewaterhouseCoopers estimate that the UK’s five largest sharing economy activities generated revenues of £500 million in 2013 and projected this to rise to £9 billion by 2025.⁶³ Yet the activity associated with this fast-growing sector is largely neglected in the official statistics.
- 3.46** There are two particular challenges in measuring the sharing economy. The first relates to whether or not the established statistical framework correctly identifies, measures and classifies these new types of transactions. But the second, arguably more fundamental, challenge relates to what we want GDP to capture; for instance, as the line between work and leisure becomes blurred and some activity strays outside the GDP boundary.

Challenges of capturing the sharing economy in existing statistics

- 3.47** By and large, ONS measures economic activity predominantly through surveys of businesses. This is based on the traditional view that businesses are the producers and creators of value added, while households are the consumers. As unincorporated individuals increasingly take up the role of value-creators, economic activity that should be included within official statistics may not be adequately captured. This has consequences for the measurement of output, prices and labour market activity.

GDP

- 3.48** Traditionally the method for estimating GDP – or value added – is based on a sample of the business population. The Inter-Departmental Business Register (IDBR) is the main statistical sampling frame for surveys of businesses carried

59 Eurostat, (2015). ‘E-commerce statistics for individuals’. Available [here](#).

60 Coyle, D., (2016). ‘The Sharing Economy in the UK’. Available [here](#).

61 Stokes, K., Clarence, E., Anderson, L., and Rinne, A., (2014). ‘Making sense of the UK collaborative economy,’ NESTA. Available [here](#).

62 Davidson, L., (2015). ‘Mapped: how the sharing economy is sweeping the world,’ The Telegraph. Available [here](#).

63 PricewaterhouseCoopers, (2014). ‘Five key sharing economy sectors could generate £9 billion of UK revenues by 2025’. Available [here](#). By construction, this estimate is likely to be an underestimate of total sharing economy as the scope does not cover the wide breadth of the sharing economy activities.

out by ONS and other government departments. The IDBR has recently been improved by making better use of businesses registered for VAT, PAYE income tax, and with Companies House.⁶⁴ However, businesses are not captured if they fall below the VAT threshold of £82,000 annual turnover and have no employees on PAYE payroll. Firms involved in the sharing economy which are captured in this sample frame will therefore be included in the official statistics. However, the commission that these firms earn on intermediating transactions may be a relatively small share of all the activity in the sharing economy.

- 3.49** As search and transaction costs have fallen, it has become easier to match the supply and demand for goods and services, which in turn has led to more person-to-person transactions. In other words, individuals no longer need a business to act as intermediary to match their supplies to demands. IDBR-based business surveys thus not only fall short in capturing the output of some small businesses, but also the growing activity of unincorporated individuals. While this group may constitute a small proportion of total economic activity now, this activity appears likely to grow.⁶⁵

Prices

- 3.50** The way prices are measured is also better suited to more traditional business models. Price information is currently sourced entirely from businesses. Price estimates therefore reflect the downward pressure exerted by the increased competition from these non-traditional forms of exchange. However, they do not reflect the prices associated with the person-to-person transactions. For example, if an individual chooses to rent a room from Airbnb, rather than from a traditional hotel, they could well end up paying less for a comparable service due to the lower overhead costs. But if this lower price is not captured by official inflation measures then the lower nominal expenditure would pass through into lower real GDP (see Box 3.C).
- 3.51** The potential scale of this issue could be large, as the international practice is to exclude prices of all second-hand products, except cars, from consumer price statistics. Therefore, the prices associated with the growing number of second-hand transactions on eBay and Amazon Marketplace are not reflected in price estimates.

64 ONS, (2016). 'Improving the coverage of the standard business survey population'. Available [here](#).

65 O'Connor, S., (2015). 'Workers moving from large to smaller companies,' Financial Times. Available [here](#).

Box 3.C: Impact of Airbnb prices on real gross value added in accommodation services

Airbnb provides home owners with a platform for reaching a vast market to rent out underutilised dwelling space. Gross value added from the accommodation services are currently deflated by the Services Producer Price Index (SPPI) and the Consumer Price Index (CPI). Both indices contain hotel prices but not Airbnb prices. Some analysis from 2013 suggests that renting an entire flat through Airbnb was 20% cheaper than renting a hotel room, whereas renting a single room within an Airbnb host's home was almost 50% cheaper.⁶⁶ Moreover, an Airbnb rental is arguably superior to a hotel room due to the variety of choice, access to a kitchen, etc. Consequently, the failure to reflect the price of Airbnb rentals in the price deflator for accommodation services suggests that the value added generated by that sector may be underestimated, even assuming that Airbnb nominal expenditures are fully captured through surveys (which is a strong assumption).

In order to get a sense of the magnitude of the possible understatement of real gross value added, consider the following rough calculation. Research sponsored by Airbnb found £243 million in direct spending on UK Airbnb rentals in 2013, equivalent to roughly 2% of gross value added in total accommodation services.⁶⁷ Assuming that the relative price of UK Airbnb rentals compared to hotel prices is the same as in the US (i.e. a third cheaper), then real gross value added for accommodation services would be underestimated by 0.7%. If Airbnb expenditures are not properly picked up through surveys, then the scale of the underestimation could be larger. These numbers are of course small (and even smaller relative to GDP), but will have been rising in view of the rapid expansion in Airbnb's activities since 2013.

New forms of employment and income

3.52 A key element of the sharing economy is the opportunity it provides to earn extra income. Contrary to the traditional model of work, with a single occupation and income stream, it is now possible to monetise spare time or spare assets by participating in various types of 'cottage industry' activity. Freelance.com and TaskRabbit are examples of platforms on which such micro-jobs are advertised and bid for. The reduced search and matching costs offered by these online marketplaces provides great flexibility to those demanding and supplying labour, in terms of the type of task and time commitment.⁶⁸ Indeed some people may even choose to switch from a full-time occupation to operating a rolling set of individual tasks or contracts. This phenomenon is often referred to as the 'gig economy', drawing an analogy to the way many musicians make a living by stringing together live performances (gigs).

66 Priceonomics, (2013). 'Airbnb vs Hotels: A Price Comparison'. Available [here](#).

67 Davidson, L., (2015). 'Airbnb boss calls the UK the "centre of the sharing economy"', The Telegraph. Available [here](#).

68 In February 2016, 'Talent Exchange' was launched to match the skills and experience of freelancers with opportunities at PricewaterhouseCoopers.

- 3.53** There is some debate whether these changes in the nature of labour market participation represent a major change.⁶⁹ Such scepticism is more prevalent in the US, which has not witnessed a rise in self-employment of anything like the same magnitude as the UK. While there are several factors behind the rise in self-employment and the number of people with several jobs, a lack of data makes it difficult to separate effects related to the sharing economy from wider cyclical or structural drivers. But more relevantly for this Report, the new activities are unlikely to be fully captured in current labour market statistics and measures of household income.
- 3.54** For example, the Labour Force Survey (LFS) asks respondents whether or not they have more than one job, and how many hours a week they contribute to those additional jobs. But it provides little detail on the number and nature of any additional jobs. Furthermore, the interpretation of what constitutes a ‘second job’ may lead to an under-representation of sharing economy activity in the labour market statistics: even if respondents receive extra income as a result of such activities, they may well not consider treating it as an additional job and so it is left unreported.⁷⁰ For instance, would an LFS respondent think that letting out his spare room over Airbnb constitutes an additional job? Strictly speaking he should, as he is operating as a part-time hotelier.
- 3.55** In sum, more needs to be done to understand the growing diversity of labour market activities, such as independent workers, temporary workers, moonlighters, and workers with multiple income sources.⁷¹ Moreover, hours worked is an important element in measuring labour productivity. This is hard enough in traditional jobs, but doubly difficult for activities in the sharing economy. Use of big data holds the potential to help answer some of these questions.⁷²

Investment versus consumption

- 3.56** Goods and services purchased by the consumer are classified as final consumption in the national accounts framework.⁷³ In contrast, goods and services purchased by a producer may be used as inputs (intermediate consumption) or investment. Maintaining a clear distinction as to whether an entity is acting as a consumer or a producer is important for the accurate

69 Gardiner, L., (2015). ‘The ‘gig economy’ – revolutionising the world of work, or the latest storm in a teacup’. Available [here](#).

70 Wile, R., (2015). ‘There are probably way more people in the ‘gig economy’ than we realize’. Available [here](#).

71 The US Bureau of Labour Statistics is rerunning the Contingent Worker and Alternative Employment Supplement in 2017, last run in 2005, in order to improve their understanding of these issues.

72 JPMorgan Chase Institute, (2016). ‘Paychecks, Paydays, and the Online Platform Economy’. Available [here](#). Analysis uses data from six million US checking accounts to explore trends in income derived from online platforms.

73 With the exception of new homes (dwellings), which contribute to gross fixed capital formation.

classification of economic activity. Traditionally, this differentiation is made at the time of purchase and is reinforced by government tax rules on what purchases can be treated as a business expense. However, the expansion in participation in the sharing economy is likely to result in more misclassification within the national accounts.

- 3.57** The distinction between firms producing and households consuming leaves little room to account for households investing in their own productive capacity. The standard example is the purchase of durable consumption goods such as a car. But the sharing economy has made it possible for households to either rent out the assets or else sell services exploiting the assets, for instance as an Uber driver. To the extent that the durables are used to enable production in the sharing economy, official statistics of investment will be underestimated and consumption overestimated (see Box 3.D). Innovations such as 3D printers will likely further expand the scope for household production.⁷⁴ While the aggregate impact on GDP may be zero, the classification of activity by expenditure category remains an important input for policy.

Box 3.D: Potential misclassification of expenditure on Uber vehicles

Uber first launched in the UK in 2012 and has since rolled out to 12 UK cities. Vehicles are not owned by Uber, in most cases being owned by the driver. Where vehicle owners are not incorporated, the purchase of vehicles is accounted in the national accounts as household final consumption expenditure. However, to the extent that those cars are used in a productive capacity to provide transportation services for over a year, that spending should strictly contribute to business investment.

Every two years the Department for Transport surveys the licensing authorities to record new private hire vehicles (PHVs) in England and Wales.⁷⁵ PHVs include those operating for Uber and other driver services using app-based technologies. The number of PHVs rose sharply between 2013 and 2015, with an additional 8,000 vehicles each year for hire. Given the coincidence with the entry of Uber, it is reasonable to assume that these additional vehicles were mainly associated with Uber drivers. 8,000 new Toyota Priuses (the ubiquitous Uber car) corresponds to around £185 million of extra expenditure.⁷⁶ Moreover, this figure is likely to be an underestimate because it fails to capture vehicle expenditure in Scotland, where Uber has also recently launched.

74 Edens, B., van den Bergen, D., van Rossum, M., Hoekstra, R., and Rensman, M., (2015). 'The SNA: Facing a Choice Between Measurability and Relevance'. Available [here](#).

75 Department for Transport, (2015). 'Taxis, private hire vehicles and their drivers'. Available [here](#).

76 Toyota, (2015). 'February Price List 2016'. Available [here](#).

Cars are arguably one of the world's most underutilised physical assets, used just seven hours a week by the average US household.⁷⁷ A survey of Uber drivers in the US found that the median driver recorded roughly 15 hours a week.⁷⁸ That implies that 70% of the time the cars are on the road they are being used for Uber transportation services, while the other 30% is for personal use. If one assumes that similar patterns obtain for the UK, some £129 million out of the £185 million expenditure associated the Uber car purchases is misclassified as household consumption rather than a form of business investment.

This ball-park estimate of the amount of misclassification corresponds to just over 1.5% of business investment in transportation and storage services, which is obviously negligible in a macroeconomic sense. The figure could also be tempered if drivers are purchasing second-hand cars or using their existing vehicles. But there is a potential for this mismeasurement to grow. The CEO of Uber has said he expects the number of Uber drivers in London to almost treble to 42,000 in 2016.⁷⁹ Such growth would not be out of line with its experience in the US, where the number of Uber drivers has been doubling every six months since 2013.⁸⁰

Conceptual challenges

- 3.58** The sharing economy also poses conceptual challenges for the interpretation of measures of economic activity. The sharing economy offers several potential benefits to participants, including: more opportunities to earn income; lower prices through greater competition; more consumer choice; greater flexibility in labour supply and demand; more efficient transactions; and improved environmental sustainability from greater asset utilisation. In general, sharing economy activities should be welfare-enhancing if people are freely opting to switch from traditional activities. However, some of these benefits will not be reflected under the agreed conventions governing the construction of GDP. So, even if the sampling challenges are addressed, the overall impact of the sharing economy on measured GDP is still uncertain.
- 3.59** Recent trends have seen the sharing economy supplant some traditional market activities (e.g. Airbnb versus hotels), the monetisation of traditionally non-market activities (e.g. using Taskrabbit to hire someone to hold one's place in a queue), and the replacement of traditional market activity with non-market activity (e.g. using Olio or Freecycle to make use of goods that would otherwise be thrown away instead or buying new goods). The replacement of market

77 Jonas, A., Shanker, R., Liu, J., Jain, P., and Mehta, N., (2015). 'Shared Autonomy: Put This Chart on Your Wall, It's My Sad Life,' Morgan Stanley Research. Available [here](#).

78 Hall, J., and Krueger, A., (2015). 'An Analysis of the Labor Market for Uber's Driver-Partners in the United States'. Available [here](#).

79 Davidson, L., (2015). 'Since Uber launched, there are 26pc more cabs in London,' The Telegraph. Available [here](#).

80 Hall, J., and Krueger, A., (2015). 'An Analysis of the Labor Market for Uber's Driver-Partners in the United States'. Available [here](#).

transactions by non-market activity poses a conceptual challenge to the national accounts that is not new. Consider, for example, a person who marries their housekeeper. Previously the housekeeper's services were paid for in a market transaction. Now (presumably) no such financial transaction occurs. More generally there is a raft of useful activities – for example, cleaning, cooking, laundry, adult and childcare, ferrying children around and volunteering – for which there is no associated financial transaction. ONS are presently developing a Household Satellite Account which attempts to impute a market value to such activities.⁸¹ Within this work, effort should be made to assess the quantitative impact of the sorts of phenomena discussed here.

Avenues for exploration

- 3.60** Looking forward, NSIs, including ONS, will need to understand better how the sharing economy has affected their conventional economic statistics and what may be missing. Key to this will be access to better information about productive activities of individuals and households, in effect part-operating as unincorporated businesses. This requires garnering more detail about household behaviour. That could come through an extension of household surveys such as the LFS and Living Costs and Food Survey (LCF). A time-use survey of the sort last run by ONS in 2005 might also provide useful information. But since many of these activities leave a digital footprint, there should also be scope to use big data creatively to discover more.
- 3.61** The government's response to the recent Woskowsky review into unlocking the UK sharing economy requested that ONS be involved in publishing a feasibility study into the development of statistics on the sharing economy by summer 2015.⁸² ONS has pushed back the date for delivering this study on account of the complexity of the issues involved. But it should provide a helpful first step in setting out some of the technical challenges and which methodologies look most promising.
- 3.62** Sceptics may feel that the sharing economy is too small relative to the total economy to make it worth expending much energy on. But the truth is that we do not know enough about the size and impact of the set of phenomena associated with the sharing economy to be sure. Moreover, even if it is small now, it is certain to continue growing in importance. So further investigation does seem to be warranted.

Intangible investment

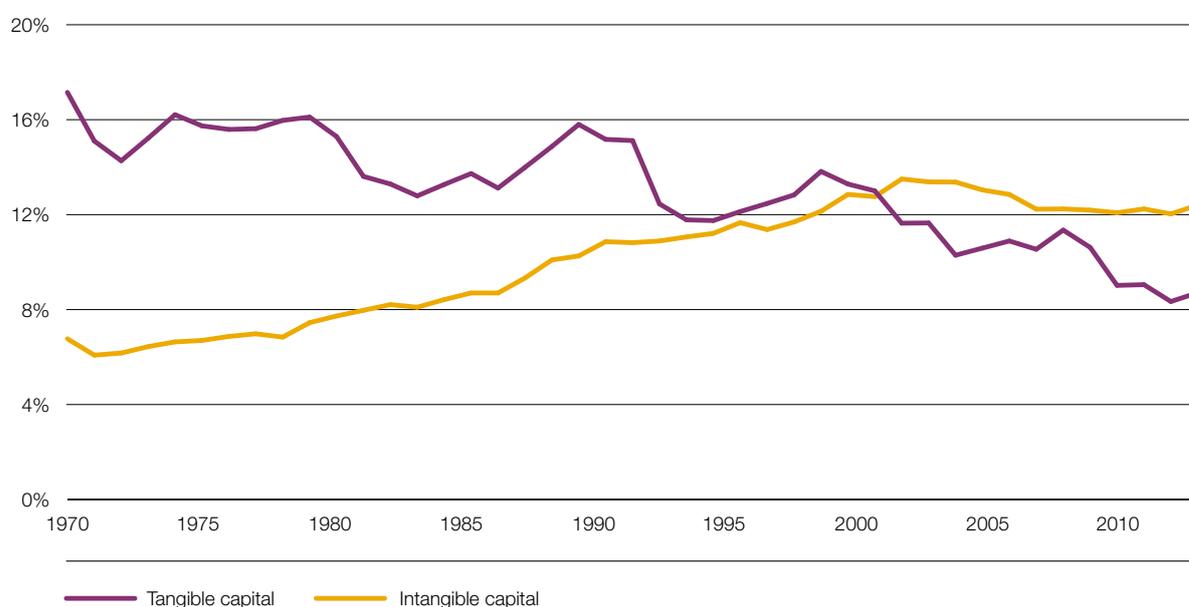
- 3.63** This section looks at the increasingly difficult challenge of measuring intangible investment, a key issue given the shift from capital-intensive to knowledge-intensive production. Intangible capital encompasses assets contributing to the

81 ONS, (2014). 'Household Satellite Accounts'. Available [here](#).

82 Woskowsky, D., (2014). 'Unlocking the sharing economy – An independent review'. Available [here](#). Department for Business, Innovation and Skills, (2015). 'Independent review of the sharing economy – Government response'. Available [here](#).

long-term accumulation of knowledge, such as human capital, research and development (R&D), or information stored in software. Intangible investment complements physical capital in driving economic growth. Based on some estimates, investment in intangible assets in the UK surpassed investment in physical capital in 2001 and remained more resilient to the financial crisis (see Chart 3.L). But given its intangible nature, as well as commonly not being traded in the market, this form of capital is especially hard to measure. In its response to the Call for Evidence, HM Treasury said, “Intangible investment is not yet well represented in UK National Statistics, partly due to conceptual and measurement challenges.”

Chart 3.L: UK business investment in tangible and intangible capital, 1970 to 2012 (% of adjusted GVA)*



Source: Goodridge, P., Haskel, J., and Wallis, G., (2014). ‘UK Innovation Index 2014,’ NESTA Working Paper No. 14/07.

*Market sector gross value added including all intangible assets, excluding real estate.

3.64 Following a research initiative in the mid-2000s, the academic literature has widely adopted an approach which classifies intangible investment into three broad categories (see Table 3.A).⁸³ While recent European System of Accounts (ESA) 2010 methodological changes have reclassified a select handful of intangible assets as capital, the conceptual range of assets that constitute intangible capital is considerably broader than those currently captured in the national accounts.⁸⁴ Measurement of intangibles within the national accounts

83 Corrado, C., Hulten, C., and Sichel, D., (2005). ‘Measuring Capital and Technology: An Expanded Framework,’ in Corrado, C., Haltiwanger, J., and Sichel, D. (eds.), *Measuring Capital in the New Economy*, National Bureau of Economic Research and University of Chicago Press. Available [here](#).
OECD, (2013). ‘Supporting Investment in Knowledge Capital, Growth and Innovation,’ OECD Publishing. Available [here](#).

84 Assets currently capitalised as ‘intellectual property products’ (IPP) include: software and databases, R&D, mineral exploration and evaluation, and entertainment, literary or artistic originals.

can often be further limited by official definitions following only a narrow interpretation of what is being captured as investment. For instance, an earlier section of this chapter explored issues around a more comprehensive measurement of databases, in particular focussing on the value of the information stored itself.

Table 3.A: Classification of intangible capital

Computerised information (knowledge stored in programmes)	Innovative property (research and development assets)	Economic competencies (human and organisational capital)
		
Software*, databases*	Scientific R&D*, mineral exploration*, artistic originals*, financial product innovation, design, R&D in social sciences and humanities	Branding (advertising, marketing), training, organisational structure

Source: Corrado, C., Hulten, C., and Sichel, D., (2005). 'Measuring Capital and Technology: An Expanded Framework,' in Corrado, C., Haltiwanger, J., and Sichel, D. (eds.), Measuring Capital in the New Economy, National Bureau of Economic Research and University of Chicago Press.

*Contains assets currently capitalised in the official measure of investment.

3.65 Whether intangibles are classified as capital is central to the way they are recorded in the National Accounts. Traditionally, the acquisition of intangible assets has been considered intermediate consumption and not investment, and therefore subtracted from total output when calculating gross value added. Capitalising intangible investment instead means that the level of gross value added increases. Many respondents to the Call for Evidence raised the need for improvement in the measurement of intangible assets, and suggested that there was scope to capitalise a wider range intangible assets in the official measure of investment. In his response to the Call for Evidence, Graham Turner of GFC Economics said, “A thorough breakdown of intangible investment by type of asset (R&D, software, etc.) would provide a more complete picture of the UK economy.” These improvements could also play a part in informing the recent debate on the ‘productivity puzzle’, including potential mismeasurement of investment.⁸⁵

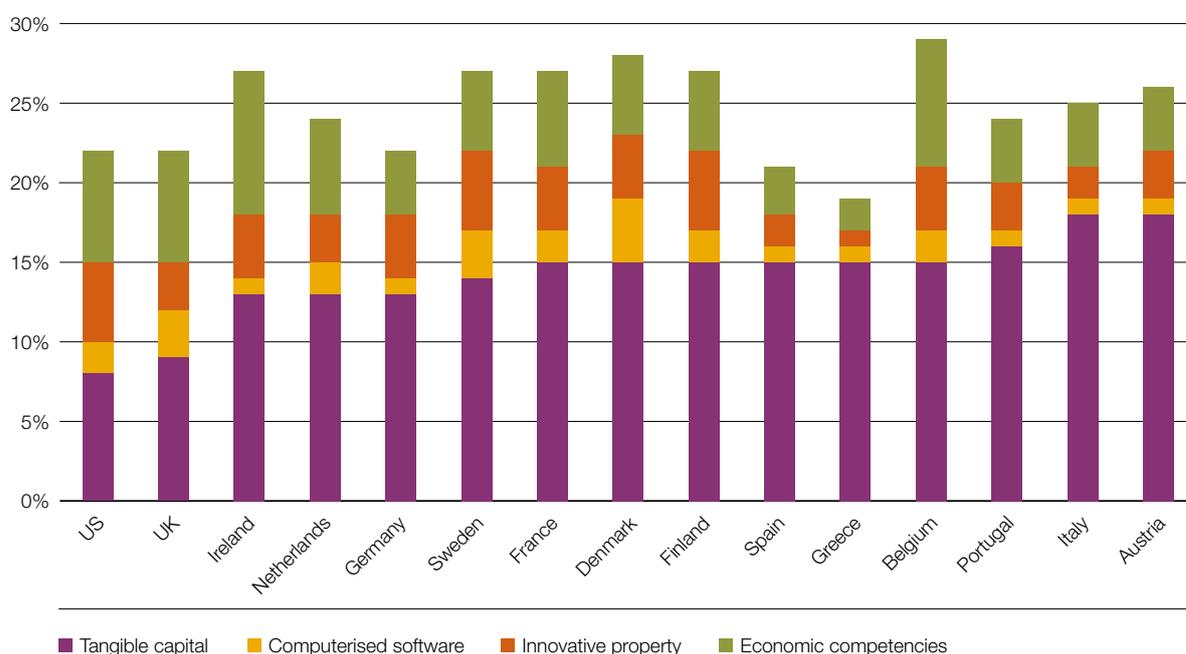
85 E.g. Haskel, J., Goodridge, P., and Wallis, G., (2015). ‘Accounting for the UK productivity puzzle: a decomposition and predictions,’ Discussion Paper 2015/02, Imperial College Business School. Available [here](#).

Measuring intangible capital: progress to date

3.66 ESA 2010 specifies which intangible assets are classified as investment and which are treated as intermediate consumption. According to recent research, when the full range of possible intangible assets are treated symmetrically to physical capital, many of the cross-country differences in investment intensity decrease or disappear altogether (see Chart 3.M). This is particularly relevant for the UK, which appears to spend a greater share of value added on branding and human capital compared to its peers.

3.67 In this context, ONS should continue to develop the measurement of intangible assets, including through close collaboration with academics and other experts, in order to play an active role in influencing international standards on how assets are measured and whether they are recorded as investment. Research on intangible capital is at a relatively early stage, partly because it is often limited by the lack of reliable and internationally comparable data.⁸⁶ If knowledge assets were classified as investment in the national accounts that would not only have implications for policy-making, but also help better understand the drivers of growth and productivity (see Box 3.E for further detail).

Chart 3.M: Business investment, 2010 (% of adjusted GVA)*



Source: Corrado, C., Haskel, J., Jona-Lasinio, C., and Iommi, M., (2014). 'Internationally comparable macro-estimates of investment in intangible assets at the industry level: INTAN – Invest'.

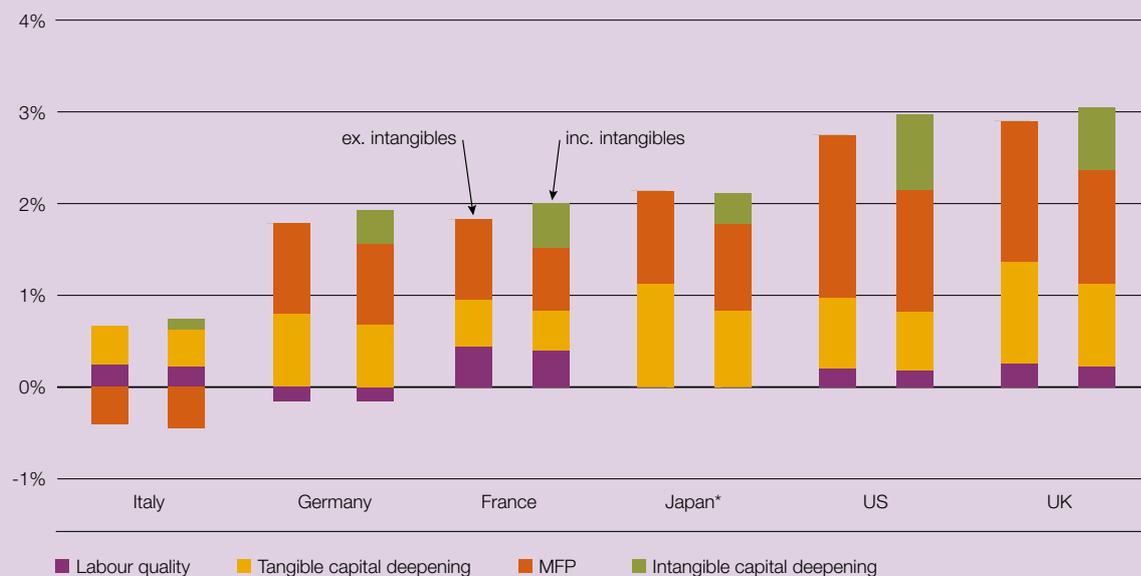
*Market sector gross value added including all intangible assets, excluding real estate.

86 Examples of recent work include projects funded by the European Commission (COINVEST and INNODRIVE), the INTAN-Invest database, and an ongoing effort of the Conference Board and NESTA.

Box 3.E: Intangible capital and growth accounting

In the traditional growth accounting framework, labour productivity growth can be decomposed into the contribution of labour quality, capital deepening, and multi-factor productivity (MFP). The latter component is calculated as a residual and can be interpreted as capturing technological progress. Capital deepening, the change in the volume of capital services per unit of labour input, makes no distinction between physical and intangible capital. Recent research argues that expenditure on all intangible assets should be explicitly treated as investment, as it aims to enhance the future value of a firm at the expense of current consumption.⁸⁷ Conceptually, this results in a different structural representation of the economy, with a distinct production factor contributing to productivity growth.

Chart 3.N: Labour productivity growth before and after the contribution of intangible assets, 1995 to 2006



Source: OECD, (2010). ‘Measuring Innovation: A New Perspective,’ based on research papers.
 *2000-2005. Japanese estimates do not account for the contribution of labour quality.

87 E.g. van Ark, B., Hao, J., Corrado, C., and Hulten, C., (2009). ‘Measuring Intangible Capital and Its Contribution to Economic Growth in Europe,’ European Investment Bank Papers. Available [here](#).

Chart 3.N shows a decomposition of labour productivity growth in six advanced economies under the two alternative frameworks. The choice of framework can alter total labour productivity growth due to the impact on both output and inputs from reclassifying intermediate consumption as investment. Overall, including intangible capital has two implications for the allocation of growth. First, empirical estimates show that intangible investment is often a sizeable driver of growth, in some cases equalling or even exceeding the contribution of tangible capital. The inclusion of intangible capital leads to the decline in the contribution from tangible capital, as some of the capital traditionally treated as tangible (e.g. software) is now considered a distinct production factor. Second, the introduction of intangible capital helps explain some of the contribution previously counted as TFP. This should not come as a surprise; as more production factors are now accounted for, the greater their absolute contribution and the lower the remaining share ‘unexplained’ by the labour and capital components.

Research and development

- 3.68** In recent years, revised European statistical standards (ESA 2010) sensibly reclassified research and development (R&D) expenditures as investment, which now account for the most visible part of investment in intellectual property.⁸⁸ ONS has already implemented the changes to R&D and other intellectual property products as required by ESA 2010. ONS was heavily involved in working closely with Eurostat colleagues in both formulating the approach for R&D and organising international workshops for R&D implementation. However, it is likely that Eurostat will review all countries implementation of R&D capitalisation as part of its next review process which may lead to further recommendations on the treatment.
- 3.69** Official guidelines used by ONS for collecting R&D data come from the OECD.⁸⁹ ONS conducts three surveys on R&D (covering business enterprises, government, and private non-profit organisations), while data on higher education is provided to ONS by the Higher Education Statistics Agency (HESA). Given the annual frequency of these series, the value of R&D which inputs to the quarterly estimates of gross fixed capital formation is produced by splining the annual values. For the quarters which have not yet been covered by the annual dataset, values have to be forecast based on the existing time series. This contributes to revisions to the early vintages of R&D data.

88 This change is perhaps one of the most visible changes in the ESA 2010, which increased the level of UK nominal GDP in 2013 by 1.7%.

89 OECD, (2015). ‘Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development,’ The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris. Available [here](#). Some guidance also comes from the OECD’s Manual on measuring capital and Handbook on deriving capital measures of intellectual property products.

3.70 Currently, it is predominantly the ‘scientific’ part of R&D that is captured within the national accounts, which reflects research and development in the manufacturing, engineering and IT industries. Expenditure on non-scientific and creative activities conducted in the social sciences, humanities and arts, or development of new products in the service-oriented industries such as finance or retailing, is more difficult to define, but arguably no less important in creating economic value. This kind of activity may not be as formally organised as in more technical industries, which often have a dedicated R&D department. The OECD recommends greater attention to the boundaries that define R&D and further work on better capturing non-scientific R&D in surveys could help provide a fuller picture of the overall investment.

Human capital

3.71 Human capital denotes the knowledge and skills embodied in individuals that enables them to create economic value. Perhaps more so than in the past, human capital is a key driver of a successful economy, as routine tasks are automated and the premium paid to creativity rises (see Chapter 2 on measuring skills). Development of satellite accounts for human capital formation was a recommendation of the Atkinson Review in 2005.⁹⁰

3.72 The Census provides information about formal qualifications but lacks detail on job-specific skills. ONS produces experimental estimates of the value of UK human capital as part of the Economic Wellbeing measures. The estimates come from the Annual Population Survey (APS). Human capital is measured in monetary terms as the discounted total potential future earnings of the working age population, reflecting the fact that earnings often provide a reasonable approximation of the level of qualification and other social attributes and can be interpreted as the marginal product, or rental price, of different types of labour. With breakdowns available by qualification and age group, human capital provides a valuable addition to the traditional measures of output per capita and productivity. However, there are three limitations to this methodology:

- First, the approach assumes that the educational qualifications are the main driver of higher earnings. Other factors (e.g. personal characteristics or family background) are not taken into account. Thus, the estimated value of potential future earnings is likely to be distorted;
- Second, no proper adjustment is made to the human capital of those who are not in employment. ONS provides estimates for both ‘employed’ and ‘full’ human capital. The former measure only looks at the working-age population in employment, giving the remaining part of the population a value of zero. The latter measure includes the human capital of the unemployed,

90 Recommendation 7.5. See: Atkinson, T., (2005). ‘Atkinson Review: Final Report – Measurement of Government Output and Productivity for the National Accounts,’ Palgrave MacMillan. Available [here](#).

but values them at the same rate as an individual with the same characteristics who is employed. One could argue, however, that being unemployed erodes skills, a process sometimes referred to as ‘hysteresis’;

- Third, the value of human capital only accounts for activity that falls within the production boundary. Home production, on-the-job training or other non-market labour activity are all excluded. Therefore, the ‘true’ value of human capital is likely to be underestimated.

3.73 Another measure, which can be interpreted as the contribution of human capital to economic growth, is captured by the quality-adjusted labour input (QALI). The main data source for QALI is the Labour Force Survey, and other sources are used to provide consistency with national accounts aggregates. QALI accounts for both the number of hours worked and the composition of the labour force and serves as an input into measuring multi-factor productivity (MFP). An important feature of this measure is that the number of hours worked can be subtracted from the aggregate value of labour input to obtain a ‘pure’ estimate of changes in labour quality. This can be then used as a distinct production factor in growth accounting (see Box 3.E again).

Organisational capital

3.74 Organisational capital denotes the costs of organisational change and development embedded in both managerial and non-managerial occupations. It covers all the practices that contribute to the long-term functioning of a business, such as matching workers with tasks, developing strategies, or building and maintaining a client base. However, it is arguably one of the most difficult intangibles to measure. For instance, a recent report from the Royal Society argues that service providers tend to focus on business model innovation, which is not currently capitalised in the national accounts, limiting measured innovation to scientific R&D.⁹¹

3.75 Furthermore, recent research has found organisational capital to be central to understanding productivity growth and differences in productivity levels across countries.⁹² This form of investment is likely to be particularly relevant during recessions, where the turn of the business cycle can trigger reorganisations and ‘change or die’ strategies. Recognising the gap, the US Census Bureau has recently conducted the first large-scale survey of management practices in the US, and ONS is planning to follow suit in the UK.⁹³ The pilot survey will use a sub-sample of the Annual Business Survey within the manufacturing sector and

91 The Royal Society, (2009). ‘Hidden Wealth: the contribution of science to service sector innovation’. Available [here](#).

92 Bresnahan, T., Brynjolfsson, E., and Hitt, L., (2002). ‘Information Technology, Workplace Organization, And The Demand For Skilled Labor: Firm-Level Evidence,’ *The Quarterly Journal of Economics*, vol. 117(1), p.339-376, February. Available [here](#).
Bloom, N., Genakos, C., Sadun, R., and Van Reenen, J., (2012). ‘Management Practices Across Firms and Countries,’ NBER Working Papers, no. 17850. Available [here](#).

93 US Census Bureau, (2013). ‘Management and Organizational Practices Survey’. Available [here](#).

the results are expected later this year. Given the evident importance of organisational capital to innovation and productivity, taking a less narrow view to measuring this form of capital will be a welcome step towards better accounting for value added and growth.

Accounting for quality change

- 3.76** Continual innovation has led to great improvements in the quality of many goods and services. Measuring economic activity and failing to adequately control for quality change results in a biased measure of growth, as some of the change in nominal output is incorrectly attributed to a ‘pure’ price change, such as inflation. For example, it might be that the price of a standard desktop computer, relative to that of other goods and services, has remained broadly constant, yet processing capability has increased dramatically, and with it the value of the services it can support. Simply recording the price of a computer is not enough – one really wants to allow for the improvement in what is being offered, for example by measuring the price of a unit of processing power.
- 3.77** The issue of quality change is well recognised. In 1996, the Boskin Commission noted that inadequacies in measuring quality improvements and prices of new goods could have resulted in an overestimation of US CPI inflation at the time by 0.6 percentage points per year.⁹⁴ This suggested that there had been an underestimation of real GDP through higher price deflators. Reflecting the centrality of the issue, Shapiro and Wilcox referred to the problem of quality change as the “house-to-house combat of price measurement”.⁹⁵ In 2015, Paul Johnson’s Review of consumer prices recommended that ONS should introduce regular monitoring of the impact of quality adjustment on its price statistics.⁹⁶ Emerging and future innovations, particularly those associated with the digital revolution, mean that quality change in goods and services is likely to grow in statistical importance.
- 3.78** Recent research has focused on whether the mismeasurement of quality change may have played a role in explaining the recent weakness in productivity growth, for example by not fully capturing productivity gains from new technologies. For instance, research from Goldman Sachs suggests that the mismeasurement of quality change in IT output leads to a 0.7 percentage points underestimation of annual GDP growth in the US and up to 0.5 percentage points in European

94 Boskin, M., Dulberger, E., Gordon, R., Griliches, Z., and Jorgenson, D., (1996). ‘Toward a More Accurate Measure of the Cost of Living,’ Final Report to the Senate Finance Committee. Available [here](#).

95 Shapiro, M., and Wilcox, D., (1996). ‘Mismeasurement in the Consumer Price Index: An Evaluation,’ NBER Working Paper No. 5590. Available [here](#).

96 Johnson, P., (2015). ‘UK Consumer Price Statistics: A Review’. Available [here](#).

countries.⁹⁷ Possible reasons for such understatement include the difficulty in capturing quality change in the software and digital industries (see the earlier section this chapter on measuring data), and pricing behaviour in the semiconductor industry not being properly picked up in the deflators.⁹⁸ It nevertheless seems most unlikely that quality mismeasurement can fully explain the recent productivity slowdown in many advanced economies.⁹⁹

- 3.79** In the UK, between 3% and 9% of items in the Producer Prices Index are in some way quality-adjusted every year. However, ONS applies only limited quality adjustment to price deflators beyond the IT goods sector. For example, in line with OECD guidance, ONS has switched to using the US quality-adjusted PPI deflator for pre-packaged software in Blue Book 2015, while continuing to explore the feasibility of producing a consistent UK index. That has led to the average growth rate of the volume measure of software being revised up by around 2.1 percentage points per year since 1997, and the cumulative growth of business investment revised up by 4.8 percentage points over the same period. This suggests that the choice of method used to deflate products with rapidly changing quality can have significant implications for price movements and distort the international comparisons of economic growth and productivity. The remainder of this section looks at the challenges associated with measuring quality and the methods used by NSIs in dealing with quality change.

Challenges in measuring quality change

- 3.80** Quality change can be prone to mismeasurement for a number of reasons. First, an inability to capture the changing characteristics of goods and services through sample updates, either for individual products or the mix of elementary aggregates for which the prices are compiled into an index (this is known as ‘quality bias’). For example, individual models of cars may become more durable or equipped with more electronics, or the composition of cars within a single price basket may shift towards those of higher quality. Second, a failure to introduce entirely new goods to price indices in a timely manner, such that falls in the product’s price from an initially high level are not picked up (known as ‘new goods bias’). As an example, music streaming subscriptions were introduced to the UK CPI in 2015, only after many years of being available to consumers.

97 Hatzius, J., and Dawsey, K., (2015). ‘Doing the Sums on Productivity Paradox v2.0,’ Goldman Sachs US Economics Analyst, No. 15/30.

Munday, T., and Daly, K., (2015). ‘Tech mis-measurement – Likely a bigger problem when estimating US GDP than European GDP,’ Goldman Sachs Economics Research, November.

98 Byrne, D., Oliner, S., and Sichel, D., (2015). ‘How fast are semiconductor prices falling?’ AEI Economic Policy Working Paper 2014-06. Available [here](#).

99 E.g. Syverson, C., (2016). ‘Challenges to mismeasurement explanations for the U.S. productivity slowdown,’ National Bureau of Economic Research Working Paper 21974. Available [here](#). And Byrne, D., Fernald, J., and Reinsdorf, M., (2016). ‘Does the United States have a Productivity Slowdown or a Measurement Problem?’, Federal Reserve Bank of San Francisco, Working Paper 2016-03. Available [here](#).

3.81 The quality of a good or service is a function of its physical and intangible characteristics. But quality can mean different things to different people. It therefore depends on the perspective of the individual, which raises special challenges for statisticians. Further obstacles to measuring quality change are determined by the specific characteristics of goods and services that it embodies. The pace of change of the modern economy makes these issues particularly relevant at the current conjuncture:

- Often products exhibiting the largest quality change also have relatively short life-cycles; examples are the rise and fall of Mini-Disc Players and Palm Pilots. Or consider the rapid innovation across the six generations of iPad introduced since 2010 – four of which have already been discontinued. The replacement of products in price indices, due to the birth of new products and the extinction of others, increases the difficulty of estimating movements in prices for comparable products. This is exacerbated by digital services replacing traditional forms of activity (see earlier sections in this chapter for further detail);
- Quality can take both tangible and intangible form. Improvements in quality that are not captured by physical characteristics, for example the accessibility of a mobile phone’s user interface, are difficult to measure or even identify. This is particularly challenging when measuring non-physical characteristics of services, such as reliability, safety, or ease of use. In particular, ESA 2010 specifies that even deliveries of a product in different locations or at different times of the day should be treated as differences in the product’s quality.¹⁰⁰

Available methods of quality adjustment

3.82 ONS and other NSIs already use a variety of methods to control for quality change in the most-affected products. Such methods are discussed more fully in various technical manuals.¹⁰¹ Examples of dealing with quality change include, but are not limited to, the following methods:

- **Direct volume measurement.** When the difference in volume of two products is directly observable, it is possible to pro-rate the price of the old product to make it comparable with the new product. For example, if the size of a chocolate bar has changed, one can adjust its price proportionately so that the volumes compared are identical. This method is suitable for homogenous goods whose characteristics do not change over time, such as food products or commodities.
- **Option costing.** If the difference between two products consist of an extra option which can be directly valued at market prices, it is possible to subtract the price of the option from the overall price difference. For

100 European System of Accounts 2010 (ESA 2010), paragraph 10.18. Available [here](#).

101 E.g. Eurostat, (2016). ‘Handbook on prices and volume measures in national accounts’. Available [here](#).

example, a TV set which includes a built-in DVD player that was not available before can be thought of as buying a TV and a DVD player separately. The difference between the old and new product can be then broken down into quality change (price of an option) and a ‘pure’ price change.

- **Hedonic adjustment.** When characteristics cannot be directly quantified or valued at market prices, it is possible to employ econometric methods to estimate the impact of observed changes in the characteristics of a product on its price. Since products can be generally thought of as being bundles of characteristics which are not individually priced, hedonic adjustment can be used to ‘unbundle’ the contribution of each characteristic. Box 3.F looks in more detail at the examples of hedonic adjustment in the UK and internationally.
- **Implicit methods.** If no information is available to make a reasonable estimate of the impact of quality on price, the price movement can be imputed by the average price movements of similar products (this is known as imputation). Alternatively, if the new and old products are both available on the market, the price difference within the same period can be used as a measure of quality difference (this is known as overlap). Implicit methods are the predominant form of quality adjustment used by ONS.

Box 3.F: Hedonic quality adjustment in the UK and internationally

Hedonic quality adjustment can provide a powerful tool in estimating the impact of changes in quality on price of certain products. The prices of products are regressed on what are considered to be the key characteristics of the different models. The regression coefficients measure the estimated marginal effects of the various characteristics on the prices of products. Hedonic adjustment has been particularly successful and is widely used in estimating the prices of computers. For example, processor, memory, and hard drive could be considered key characteristics of a computer. The regression coefficients would provide an estimate of the change in the price of a computer associated with a one unit increase in each of these components. As a result, the estimated coefficients allow a calculation of a quality adjusted price of a computer given the change in its key characteristics.

In 2013, ONS conducted a review of the use of hedonic quality adjustment in the UK and internationally, in relation to consumer price statistics. Table 3.B shows that the use of hedonics is still relatively limited, even across IT products, although ONS is not lagging behind other NSIs. For example, at the time of the review, ONS was the only NSI of those contacted which hedonically adjusted the prices of smartphones. Overall, hedonically adjusted products constitute around 0.6% of UK CPI. This compares with 1.4% of the CPI in Canada and 10% in the US, although 7 percentage points of this is related to the measurement of rental prices for primary residences. Denmark, Finland and the Netherlands did not use hedonic adjustment for any items in the CPI.

Table 3.B: Use of hedonic quality adjustment in the CPI and date introduced

Australia	PCs (2005)
Canada	PCs, Laptops, Printers, Monitors (1996), Internet Services (2008)
Germany	Used Cars, PCs (2003), Laptops (2004), Tablet PCs (2013)
New Zealand	Used Cars (2001)
Sweden	20 Clothing and 12 Footwear items
Switzerland	PCs, Laptops (2012)
UK	PCs (2003), Laptops (2005), Smartphones (2011), Tablet PCs (2013)
US	Clothing, Footwear, Refrigerators, Washing Machines, Clothes Dryers, Ranges & Cooktops, Microwave Ovens, TVs, DVD Players

Source: Wells, J., and Restieaux, A., (2014). 'Review of Hedonic Quality Adjustment in UK Consumer Price Statistics and Internationally'.

The main obstacle in using hedonic quality adjustment is its resource-intensive nature and therefore high cost. To produce stable estimates, each hedonic model requires a large amount of data to be collected for every individual characteristic that needs to be estimated. For example, omitting an important characteristic can lead to biased estimates, which can be difficult to adjust for if the characteristic is actually unobserved.¹⁰² Some NSIs outsource the collection of this rich data to external providers, but most, including ONS, collect the data internally. Furthermore, for a model to capture the new innovations in the marketplace, or to reflect changes to the estimates of existing characteristics, it needs to be re-estimated on a regular basis. In practice, ONS estimates its hedonic models every three to four months. Given this burden, many of the NSIs contacted by ONS cited the demand on resources versus relatively low CPI weights as justification for not using hedonic adjustment for a wider range of products.

Quality adjustment of services

3.83 Quality change is not unique to physical goods. Non-tangible characteristics, such as service reliability, effectiveness, or customer satisfaction can vary over time, which means that the quality will not be constant. However, quantifying movements in quality without clearly defined characteristics can nevertheless prove conceptually much more difficult when compared to physical goods. In his response to the Call for Evidence, Deputy Governor of the Bank of England Ben Broadbent said, "Mass customisation to meet unique consumer preferences also makes goods and services more heterogeneous, which complicates quality adjustment." While this section focuses primarily on market services, see Chapter 2 for a discussion of the challenges of adjusting public service output for quality change.

102 Benkard, L., and Bajari, P., (2005). 'Hedonic Price Indexes With Unobserved Product Characteristics, and Application to Personal Computers,' *Journal of Business & Economic Statistics*, Volume 23, Issue 1. Available [here](#).

- 3.84** A key challenge in measuring quality change in services is that it is not always clear how to define how users value each element of the service. One attempt has been made in using the value of time to measure quality change in rail fares.¹⁰³ The study looked at journey duration, delays, cancellations, and changes in frequency as proxies for service quality. It highlighted a number of challenges in interpreting quality indicators. For instance, delays caused by weather-related speed restrictions increase the time spent travelling, but arguably also increase the safety. The results are therefore sensitive to time-specific circumstances, meaning that sampling on one day a month is less representative for quality than, for instance, prices.
- 3.85** In practice, ONS applies no explicit quality adjustment to the components of the Services Producer Price Index beyond the overlap method discussed above. ONS justifies this approach by the relative stability of its sample of services compared to manufactured goods, and by asking survey respondents whether the service they provide has changed over time. However, this procedure puts a lot of weight on the subjective interpretation of respondents, which could be less robust than other methods. Failure to reflect quality change in services can lead to measurement issues that can worsen over time, particularly in a country like the UK where the service sector dominates the economy and continues to grow in relative importance.

Ways forward

- 3.86** In a modern economy, with an increasing variety of goods and services available on the market, many undergoing perpetual innovation, a proper measurement of volume changes requires capturing changes in quality as well as quantity. The Johnson review emphasised the need for robust procedures for dealing with quality change within the Consumer Price Index. ONS should go further to assess the appropriate approach for adjusting the Producer Price Index and Services Producer Price Index, particularly for products facing rapid innovation, short life-cycles, and greater variety.
- 3.87** ONS should have a process for regularly assessing which quality adjustment method is most appropriate for each product. While hedonic methods offer clear potential to capture quality better, in practice they are highly data- and resource-intensive, which limits their wide applicability. However, new data sources have the potential to improve ways of identifying quality change. As new methods of data collection, such as web scraping, develop these costs may fall making this method more viable and estimates more stable.
- 3.88** Over time, some goods and services may deteriorate, rather than improve, in quality. While this is likely to be less common due to ongoing technological progress, examples might include the deterioration of rented accommodation or the reduced size of airline seats. While ONS recognises this in some areas, it

103 Richardson, C., (2005). 'Using the value of time for quality adjustment – testing the concept for rail fares,' *Economic Trends* 621. Available [here](#).

needs to take a comprehensive approach to ensure adjusting for quality does not become a process only reflecting quality adjustments that lead to an increase in output.

- 3.89** Understanding the market structure of each product is essential to understand how much of the quality improvements can actually be inferred from the prices. Market imperfections (for example price discrimination) or different business models (for example product pricing strategies) mean that differences between prices of similar goods may not be the best approximation of the difference in quality. This means that even sophisticated quality adjustment methods will need to be interpreted carefully within the context of each product's market structure.
- 3.90** These challenges are not unique to ONS, but approaches of different NSIs can be markedly different. The OECD Software Task Force 2002 found that the deflators for software investment varied significantly across countries, reflecting the fact that many countries did not have suitable methods for quality adjusting their price indices.¹⁰⁴ One possible solution to these shared challenges is greater international cooperation. Even if pricing strategy might differ across countries, much expertise could be shared about the characteristics and cycles of specific products, which are often common across countries. ONS should therefore continue to collaborate with other NSIs, to share expertise and develop an informed international approach. Finally, given that ONS is a world leader in the quality adjustment of public services, statisticians working on the measurement of market services should take a collaborative approach with their ONS colleagues to harness their experience on overcoming common obstacles.

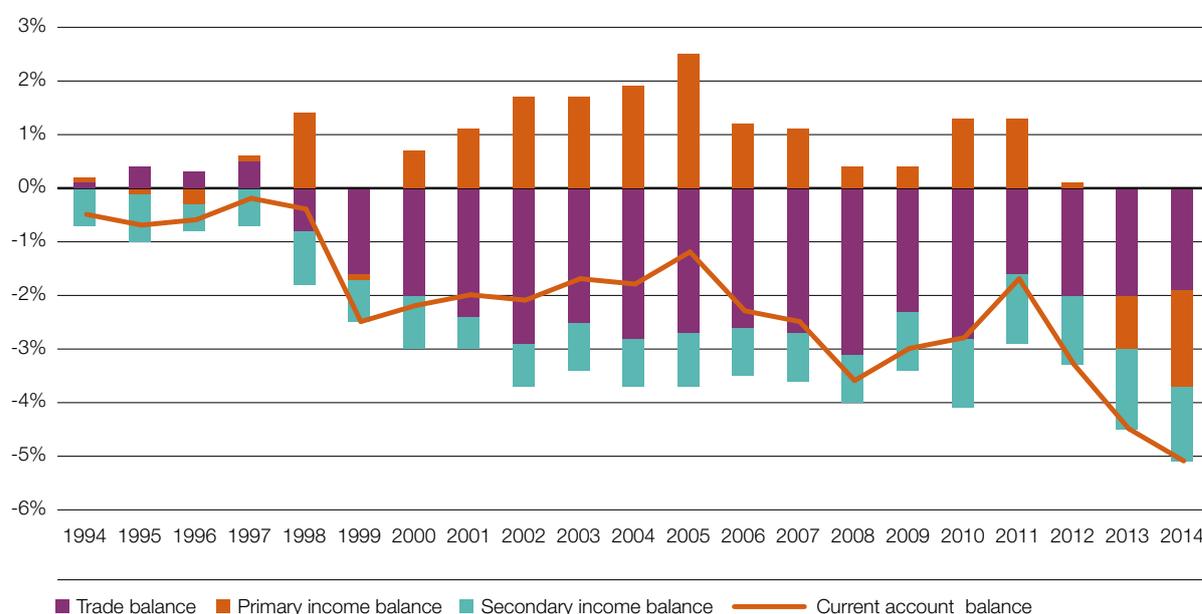
Understanding the international location of economic activity

- 3.91** In her response to the Call for Evidence, Professor Diane Coyle warned, "The role of multinationals and extensive cross-border supply chains reallocating activities and tasks both inside and outside the boundary of the firm is not well captured." The Barker-Ridgeway Review explored the measurement of the balance of payments and the International Investment Position, including a number of valuable recommendations about collecting better data to understand evolving international transactions. In the vein of making use of new data sources, their review recommended that, "Particular attention be given to international financial transactions." This section focuses on how inter-subsidiary transactions by multinational enterprises (MNEs), possibly in an effort to minimise their tax liability, can distort income flows and obfuscate statisticians' attempt to identify the location of economic activity.
- 3.92** Since 2011, the current account has seen a sizeable deterioration of over 3% of GDP. Whereas the trade balance has remained broadly unchanged, the deterioration has been driven by a deterioration in net primary income flows (see

104 Lequiller, F., Ahmad, N., Varjonen, S., Cave, W., and Ahn, K., (2003). 'Report of the OECD Task Force on Software Measurement in the National Accounts,' OECD Statistics Working Papers No. 2003/01. Available [here](#).

Chart 3.O)¹⁰⁵ The latest Foreign Direct Investment (FDI) estimates suggest that nearly 80% of this weakness has been driven by a deterioration in net FDI earnings.¹⁰⁶ While the relative macroeconomic strength of the UK compared to a number of key European investment partners is an important driver of this deterioration, measurement issues related to financial engineering by MNE's could also be worsening the measured current account position. Given the importance of the current account as an indicator of external sustainability, it is important to understand whether changes in international payments are driven by changes in economic fundamentals or intra-MNE transfers which do not reflect the true location of economic activity.

Chart 3.O: UK current account balance (% of nominal GDP)



Source: Office for National Statistics.

Potential impact of financial engineering by MNEs

3.93 MNEs can often reduce their tax liability by relocating the company's headquarters or the foreign registration of intellectual property patents. Such decisions will result in subsequent international transfers between affiliated subsidiaries, affecting the primary income balance of the current account. But the rationale for these financial transactions are not always easy to detect in complex international flows data.

105 Net primary income flows are the difference between the flow of income (interest payments, dividends, etc) of foreign assets held by domestic residents and domestic assets held by foreign residents.

106 ONS, (2016). 'An analysis of Foreign Direct Investment, the main driver of the recent deterioration in the UK's Current Account: January 2016'. Available [here](#). Net FDI earnings equal the difference between earnings on UK assets abroad and earnings made by non-resident enterprises on assets held in the UK.

- 3.94** Relocating the tax residence of a company is also known as redomiciling or corporate inversion. An MNE with substantial investments in country A can register its legal headquarters in a low tax country B while conducting little or no service or manufacturing activity there. Simply put, by establishing a legal presence in country B, the MNE's global current earnings are payable in country B. These income inflows are retained in country B, with a corresponding outflow only when a dividend is paid to foreign shareholders. The retained earnings, that is those not distributed as dividends, remain in country B – thereby enhancing the value of the MNE. In practice, firms rarely pay dividends which exceed their total current earnings. Therefore a relatively high tax country facing MNEs redomiciling to foreign countries might expect net outflows of income relative to the situation where the MNE's country of tax residence remains unchanged.
- 3.95** Research has attempted to estimate the impact of MNEs redomiciling in Ireland, a relatively low corporate tax environment, which results in inflating Irish gross national income and the Irish current account surplus.¹⁰⁷ If these findings in part reflected UK firms redomiciling to Ireland, then the corresponding implication would be an overstatement of the UK current account deficit and an underestimate of gross national income. More recent research has suggested that the movements in the stocks of, and rates of return on, FDI assets and liabilities, which underpinned the deterioration in primary income flows, are consistent with some highly profitable firms redomiciling their headquarters to a foreign country.¹⁰⁸ More granular international financial information than is currently available would, however, be necessary for a comprehensive assessment.
- 3.96** Another driver of international financial flows is the choice of location where the ownership of intellectual property patents are registered. Patents are the legal documents that grant their owners exclusive rights to use or licence a new concept or technology for a certain time period. Income derived from intellectual property is often paid where the patent is registered and therefore this income can be highly mobile. A firm can register legal ownership of a patent in a subsidiary located in a low-tax country other than where the firm's headquarters are located, other than where the innovation was developed, and other than where the innovation will be applied. Royalties on the use of the patent then allow the firm to shift the booking of revenues across national boundaries into the low-tax country. But the flows associated with the attempts to reduce tax liability in this fashion have little connection to where value is actually created.
- 3.97** Research has shown patent location choices to be responsive to tax rates.¹⁰⁹ Chart 3.P illustrates that share of patent application made by subsidiaries of UK parent firms that are located outside of the UK and separate from the location of

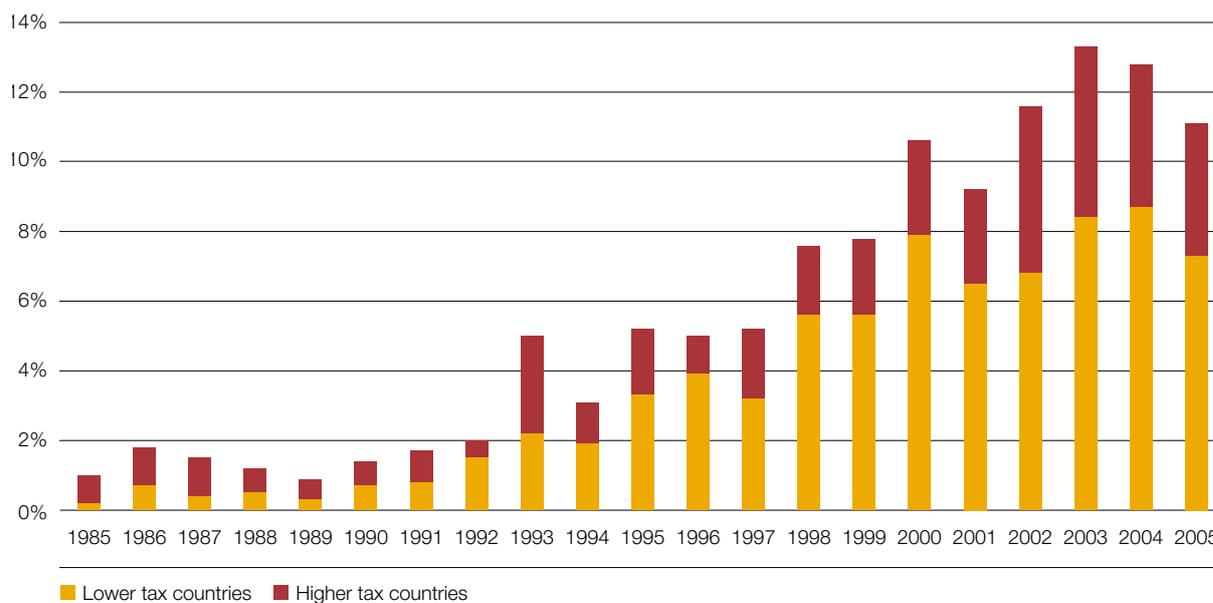
107 Fitzgerald, J., (2013). 'The effect of re-domiciled Plcs on Irish output measures and the balance of payments,' ESRI QEC Research. Available [here](#).

108 Lane, P., (2015). 'A financial perspective on the UK current account deficit,' National Institute Economic Review, No.234, November. Available [here](#).

109 Griffith, R., Miller, H., and O'Connell, M., (2014). 'Ownership of intellectual property and corporate taxation'. Available [here](#).

the innovative activity. Over this period, the growth of patent applications in countries with a lower statutory tax rate than the UK is notably stronger than in countries with a higher tax rate.

Chart 3.P: Share of parent applications located outside the UK and separate from inventors (%)



Source: Griffith, R., Miller, H., and O'Connell, M., (2014). 'Ownership of intellectual property and corporate taxation'.

3.98 Furthermore, as noted, transfers between subsidiaries to pay royalties for the right to exploit this intellectual property create financial flows that distort economic statistics. Consider, for example, a firm in a high-tax country that makes financial transfers to a subsidiary in a low-tax country for the right to exploit the intellectual property registered there. These payments are represented as imports and exports of intellectual property services and reduce the profit of the firm in the high-tax country and increase it in the low-tax country. OECD has carried out an examination of international corporate tax avoidance at the behest of the G20 (the Base Erosion and Profit Shifting Project) and found that the ratio of the value of royalties received for spending on research and development of intellectual property in a group of low-tax countries was six times higher than the average ratio for all other countries and has increased three-fold between 2009 and 2012.¹¹⁰

3.99 Benefiting from this international income shifting typically requires that the royalties paid for the use of the intellectual property are made at preferential prices. Put another way, the transfer is intentionally inflated above its market value. The pricing of intra-firm transactions is commonly referred to as 'transfer pricing' and poses challenges for both the tax authorities and statisticians. To mitigate these distortions, there are transfer pricing rules that enforce a principle that the prices are set as if they took place between unrelated parties

110 OECD, (2015). 'OECD/G20 Base Erosion and Profit Shifting Project: Measuring and Monitoring BEPS'. Available [here](#).

– an ‘arm’s length principle’. However, determining an appropriate transfer price creates conceptual and practical difficulties. It is difficult to establish a price without an accurate volume measure – which is absent in the case of intellectual property due to its intangible nature. The value and use of the intellectual property is often unique to the firm and so without a comparable market counterpart. Once more, firms have more information than the tax authorities and an incentive to minimise their tax liability. Detecting inappropriate transfer pricing and making appropriate adjustments in the statistics is thus very difficult.

Ways forward

- 3.100** This section explored two potential rationales for inter-subsidiary transfers, redomiciling and intellectual property transactions. But these issues are not exhaustive and the challenges from intra-MNE transfers are more diverse. Transfer pricing can also be used to distort non-intellectual property transfers and debt can be shifted around the arms of a company creating distortions through interest rate payments.
- 3.101** Continued integration of global markets is expected to perpetuate the trend to greater foreign asset ownership – of both foreign ownership of UK assets and UK ownership of foreign assets. Therefore intra-MNE transactions of the sort discussed above may increase, worsening potential statistical measurement problems.
- 3.102** In response to user interest, ONS are planning to publish analysis to estimate the impact of redomiciling companies on UK FDI statistics. This is an encouraging initiative, but more could be done to collect and understand the data on international financial transactions between affiliated parties, particularly between the arms of large MNEs.
- 3.103** The UK is not alone in facing these challenges. There is a limit to understanding the size of these potentially distorting financial flows without better access and sharing across countries of granular external balance sheets and corporate tax data. Given their unique positioning to access to this sort of data, ONS needs to continue to work closely with the Bank of England and could develop a closer collaboration with HMRC on this issue. In parallel, ONS should exploit data collected under the OECD/G20 Base Erosion and Profit Sharing Project.

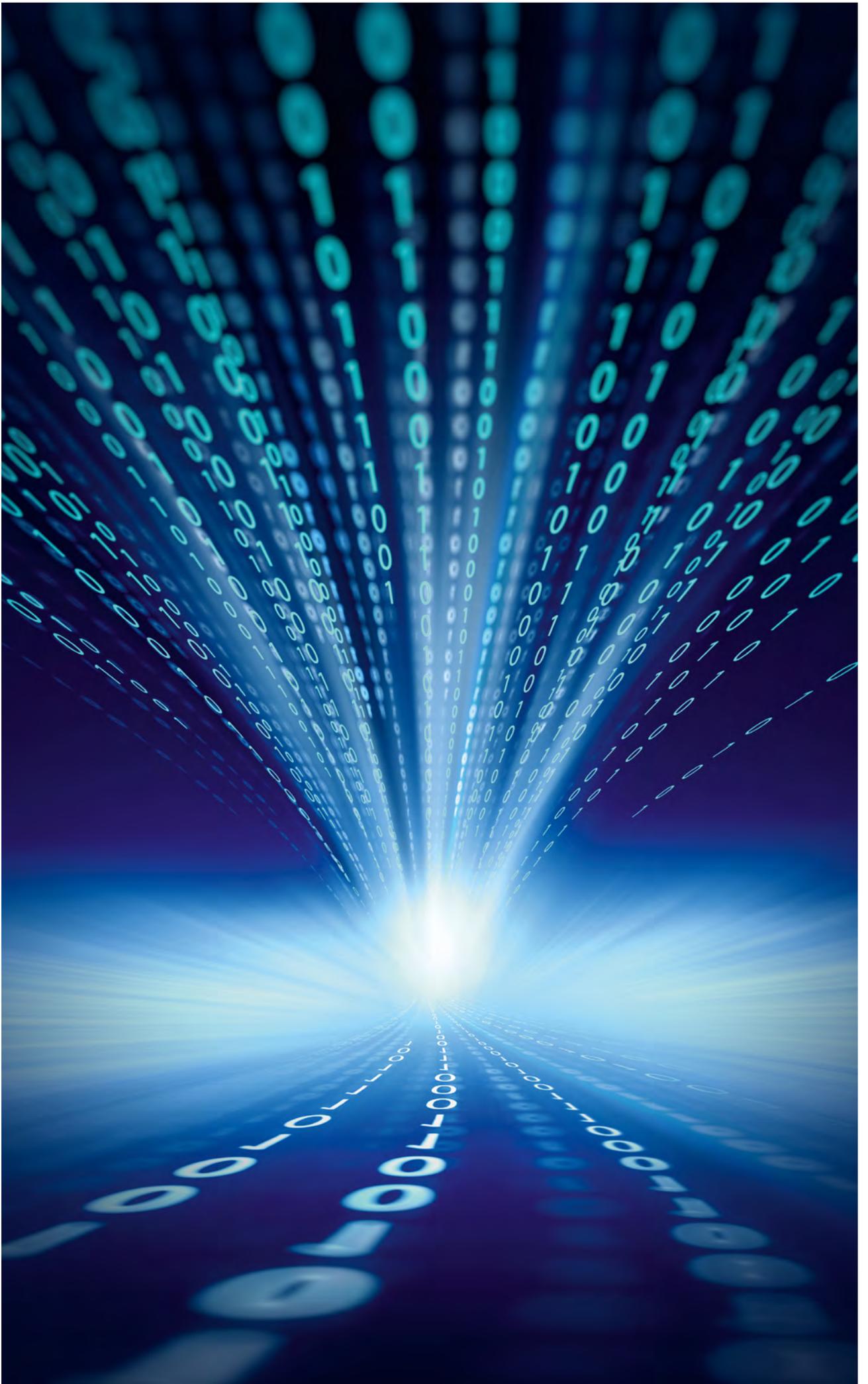
Keeping abreast of an evolving economy

- 3.104** Ensuring statistics accurately reflect a changing economy is one of the hardest challenges NSIs face. This chapter has explored how its complexity and structure are becoming increasingly difficult to capture within the basic conceptual framework that underpins the national accounts. When the statistical framework was first devised, the economy was one in which most businesses were engaged in the production of reasonably homogenous goods in a single country. The reality today is rather different, with many businesses operating across national borders and producing a range of heterogeneous goods and services that may be tailored to the tastes of individual consumers.

- 3.105** The digital revolution has not only led to rapid quality change and product innovation as a result of advances in computing power, but also to new ways of exchanging and providing services as a result of increased connectivity. Measuring the digital modern economy poses particular challenges to established measurement approaches. Although hard to capture, the analysis in this chapter suggests that emerging economic phenomena can potentially lead official data on economic activity to be understated. Further investigation is therefore warranted.
- 3.106** Moreover, this is not a one-off challenge. As the economy evolves, so does the appropriate frame of reference for statistics: it is a constantly moving target. As a result, the internationally-agreed statistical methodologies will almost always be somewhat out-of-date or incomplete as they are bound to lag behind the changes in the economy.
- 3.107** A progressive response to this challenge requires ONS not only to be abreast in understanding (and explaining) the limitations of its statistics but also to lead the way in developing more appropriate measures. ONS should therefore establish a continuing programme of research into the measurement implications of emerging economic trends, conducting one-off studies at first to gauge their potential quantitative importance. If warranted, this could then guide the development of experimental statistics capturing the new phenomena, possibly complemented by additional data collection. The analysis would help ONS to be a leader in developing the international standards that govern the definitions of most official economic statistics.
- 3.108** To leverage knowledge on the latest economic trends and statistical methods, this exploratory programme should be conducted in collaboration with relevant outside experts and institutions. In order to facilitate this, ONS should establish a centre of excellence in the measurement of the economy. This centre would support ONS capability to make greater use of one-off exploratory and horizon-scanning projects to identify and analyse emerging measurement issues, and develop new statistical approaches to capture them. This centre, discussed further in Chapter 4, would comprise of one or more partners and act as a focal point to draw in the best thinking on measurement issues, domestically and internationally. The measurement issues associated with the digital economy would be a key focus of this centre's agenda. The centre would provide the facility for ONS to make greater use of one-off exploratory and horizon-scanning projects, carried out in collaboration with experts in academia and other entities.
- 3.109** This leads to the following specific recommendations to address issues associated with the digital economy and with keeping abreast of emerging measurement challenges more generally:

Recommended Action 3: Institute an ambitious work programme to evaluate the quantitative implications for the measurement of economic activity associated with the digital economy.

Recommended Action 4: In conjunction with suitable partners in academia and the user community, ONS should establish a new centre of excellence for the analysis of emerging and future issues in measuring the modern economy.

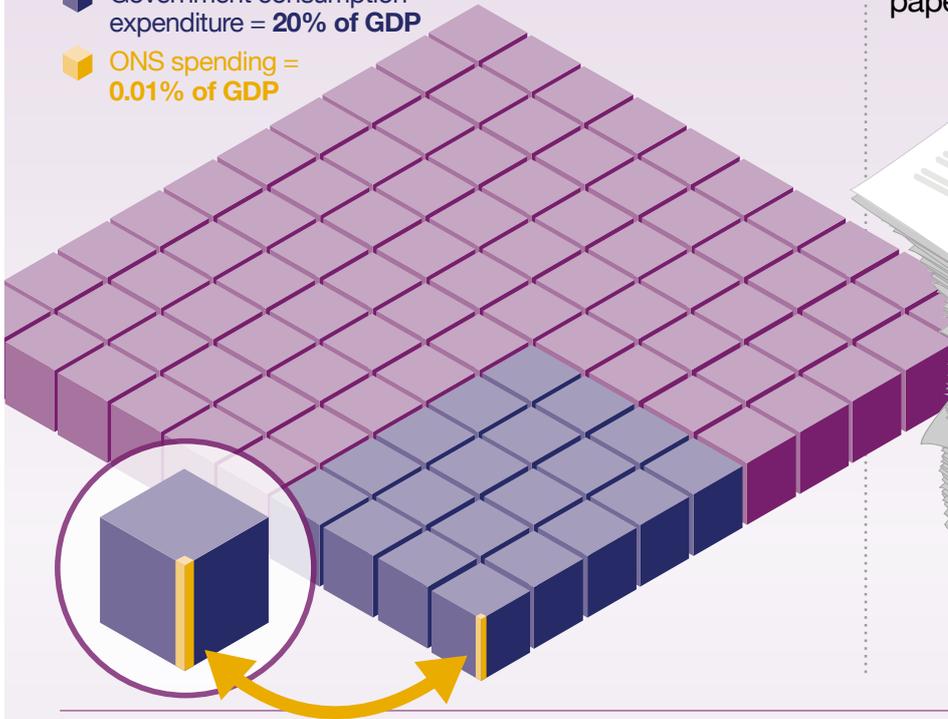


EFFECTIVENESS OF ONS

ONS is the primary source of economic statistics in the UK. It needs to be able to exploit the growing volume of data that could in principle be used to measure the economy.

ONS spending as a proportion of GDP, 2014-15

-  **GDP = £1.8 trillion**
-  Government consumption expenditure = **20% of GDP**
-  ONS spending = **0.01% of GDP**



ONS sends out more than

1.5million

paper survey forms a year



Businesses sampled by the Annual Business Survey

63,000

The HMRC VAT database has information for



1.8million businesses

Consumer Prices Statistics

Traditional price collection

Monthly manual collection of prices across 140 locations



Web scraping

Daily automatic collection of price quotes from 3 online supermarkets, 6,500 price quotes a day



Chapter 4: Effectiveness of ONS

- 4.1** Economic statistics are an important public good, critical to policy development, business decisions and democratic accountability. As we saw in the preceding chapters, the rapid pace of change in today's economy makes it even more challenging for national statistical institutes (NSIs) to keep economic statistics relevant, accurate and timely. This chapter assesses the effectiveness of ONS in the provision of economic statistics, taking on board the perspectives of users, experts and previous reviews of ONS.
- 4.2** After documenting the recent history of ONS and the resources allocated to the production of statistics, this chapter considers the full statistical process from data collection to dissemination. It covers key data sources, including both surveys and administrative information, and explores ONS's capacity to exploit these sources to their full potential. This demands a consideration of ONS's current analytical and technological capabilities, how they can be advanced, and how they can be best utilised. The chapter also looks at the organisation's readiness to deploy new data science techniques. The chapter ends by looking at the communication of ONS statistics and access to the data behind them.

Recent history of ONS

- 4.3** ONS is the primary source of economic statistics in the UK, having been formed in 1996 by the merger of the Central Statistical Office and the Office for Population Censuses and Surveys. The Statistics and Registration Service Act 2007 reformed the governance of ONS by creating the UK Statistics Authority (UKSA) as an independent body with the statutory objective to promote and safeguard the production and publication of official statistics that serve the public good.
- 4.4** The governance of the UK statistical system is the subject of the following chapter and is discussed in greater depth there. However, the successive governance reforms that have led to the current arrangements provide an important backdrop to this Review. The 2007 Act meant ONS became the executive office of UKSA. It also resulted in the creation of a regulatory function, which was tasked with producing a Code of Practice for Official Statistics (the 'Code'), and assessing compliance against it. This is discussed in more detail in Chapter 5.

- 4.5** As a result of successive mergers, the main UK economic statistics are produced almost exclusively by ONS. But there are other important statistics, including some used in economic policy making, that are produced by civil service departments and agencies, as well as the devolved administrations. The wider UK statistical system is consequently more decentralised and devolved than that of most other countries. Current responsibilities for statistical releases partly reflect the structure and evolution of government in the UK. For example, statistics on tax receipts, agriculture and transport are all published by the relevant government departments. The Terms of Reference for this chapter focus on ONS, because of its central role in the production of UK economic statistics. But ultimately the effective functioning of the statistical system relies on there being good cooperation across the Government Statistical Service (GSS)¹ and many of the lessons and recommendations contained here are likely to be of relevance to other producers of economic statistics. The inter-dependence between departments can be expected to increase if greater statistical use is made of data derived from the administration of public services.
- 4.6** The UK statistical system has already been the subject of a number of earlier reviews. Many of these reviews have focused on particular statistical outputs, and a number have had a significant impact at an organisational level. A list of the most significant reviews is set out in Table 4.A. A consequence of these frequent reviews, together with the fluctuations in resourcing documented below, has been to generate almost continual changes of emphasis, direction and operation for the organisation.

Table 4.A: Timeline of significant reviews of ONS and predecessors

1966	<i>Fourth Report of the Estimates Committee on the Government Statistical Service</i>
1980	<i>Review of Government Statistical Services</i> , led by Sir Derek Rayner
1989	<i>Government Economic Statistics – A Scrutiny Report</i> , led by Stephen Pickford
2004	<i>Review of Statistics for Economic Policymaking</i> , led by Christopher Allsopp
	<i>Independent Review of Public Sector Efficiency</i> , led by Sir Peter Gershon
	<i>Independent Review of Public Sector Relocation</i> , led by Sir Michael Lyons
2005	<i>Measurement of Government Output and Productivity for the National Accounts</i> , led by Sir Tony Atkinson
2014	<i>National Statistics Quality Review: National Accounts and Balance of Payments</i> , led by Dame Kate Barker and Art Ridgeway
2015	<i>Consumer Price Statistics: A Review</i> , led by Paul Johnson

- 4.7** The 1966 Estimates Committee Report and 1980 Rayner Review² set the stage for the changes to the UK statistical system in the following decades. The Rayner Review was principally concerned with identifying the scope for financial savings. While the review included a prescient call for the greater use of

1 The Government Statistical Service is the community for all civil servants working in the collection, production and communication of official statistics. It is spread across ONS as well as most UK government departments and devolved administrations.

2 Rayner, D., (1980). 'Review of Government Statistical Services'.

computers, it also gave rise to the misguided ‘Rayner doctrine’ that official statistics should only be collected if needed to meet the needs of government and were not seen as being a wider public good.

- 4.8** Concerns about the quality of National Accounts statistics led to the 1989 review by Stephen Pickford.³ That review recommended a consolidation of the statistical system, realised by the absorption in 1991 of the Business Statistics Office and other statistical functions within government departments into an enlarged Central Statistical Office. This was shortly followed by packages of additional resources for statistics which marked an end to the Rayner doctrine.⁴
- 4.9** In 1999, the government published the White Paper ‘Building trust in statistics’,⁵ directed at improving public confidence in statistics. This led to the first designations of key outputs as National Statistics. In 2000, ONS launched its first series of National Statistics Quality Reviews (NSQRs), aimed at assessing and improving the quality of those National Statistics. A year later, ONS began an extensive modernisation programme to update its data processing systems and tools – the Statistical Modernisation Programme (see the section on technology and data infrastructure below). Like many IT modernisation projects, this lasted longer than expected, did not deliver the anticipated efficiencies, and ultimately fell short of achieving its excessively ambitious goals.⁶
- 4.10** In 2004, Christopher Allsopp delivered the first broad review⁷ of ONS since Pickford. A key theme of that review was the need for better regional statistics, as well as a broader need for economic statistics to reflect the changing economic structure of the UK. At the same time, Sir Peter Gershon and Sir Michael Lyons carried out reviews into public sector efficiency and relocation, respectively. Neither review was ONS-specific, but together they resulted in an effort to reduce costs, in particular by moving most ONS functions out of the capital and consolidating economic statistics in Newport. Many staff members were, however, unwilling to move and instead left the organisation. The resultant loss of expertise is widely believed to have had a significant adverse impact on the subsequent production and development of UK economic statistics and the National Accounts in particular.
- 4.11** Since the establishment of UKSA in 2008, National Statistics, produced by ONS and others, have been subject to UKSA’s programme of assessment against the Code.⁸ By 2012 each statistic designated as a National Statistic had been assessed and necessary improvements identified. ONS has also instigated a new programme of NSQRs. The first statistics to be scrutinised as part of the

3 Pickford S., (1989). ‘Government Economic Statistics – A Scrutiny Report’.

4 Jenkinson, G. and Brand, M., (2000). ‘A decade of improvements to economic statistics’, *Economic Trends*.

5 HM Treasury, (1999). ‘Building trust in statistics’.

6 Penneck, S., (2009). ‘The Office for National Statistics Statistical Modernisation Programme: What went right? What went wrong?’ ONS.

7 Allsopp, C., (2004). ‘Review of Statistics for Economic Policymaking’. Available [here](#).

8 UKSA, (2009). ‘Code of Practice for Official Statistics’. Available [here](#).

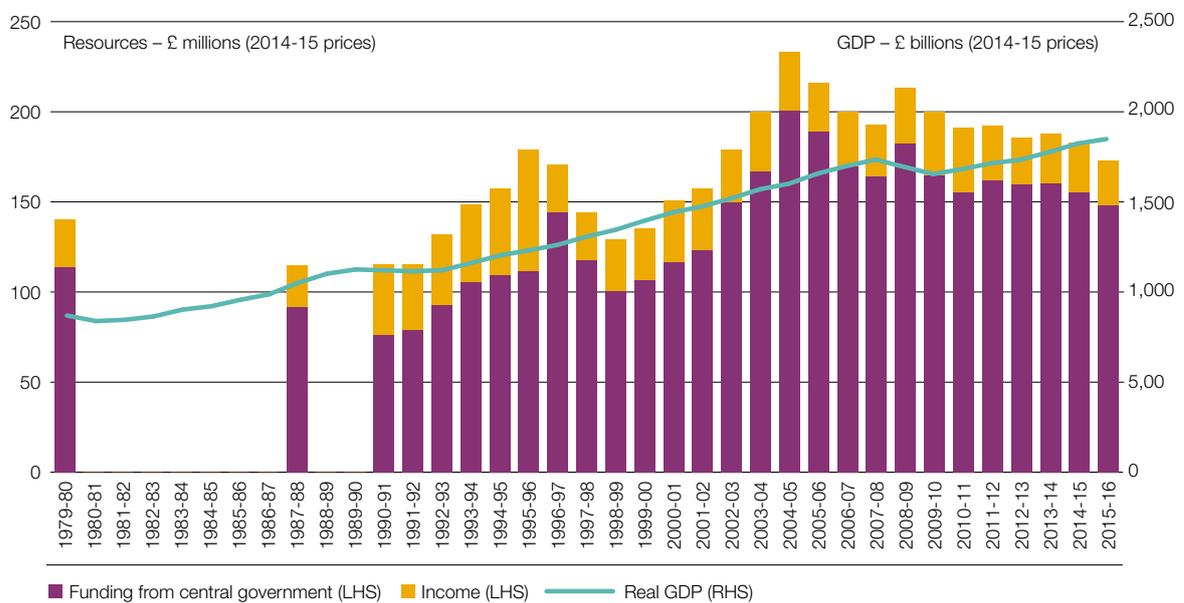
programme were those associated with the Labour Force Survey, followed by the National Accounts and Balance of Payments. The latter, led by Dame Kate Barker and Art Ridgeway, made several recommendations on ONS capability which are still to be implemented, including establishing a small expert economics team to provide quality assurance and fresh thinking, as well as establishing a formal external advisory panel, including international experts, to consult on methods and processes.⁹ More recently, Paul Johnson has carried out an external review of consumer price indices, published in 2015.¹⁰

ONS resources

- 4.12** As can be seen from Chart 4.A, the resources provided to ONS, as a share of GDP, have fluctuated significantly, in part reflecting the recommendations of the various reviews and programmes mentioned above, as well as the state of the public finances. So the effectiveness of ONS needs to be assessed in the context of the resources that were available at the time. It should also be remembered that statistical methodologies and outputs have changed considerably since 1980; for example, the 1995 and 2010 European Systems of Accounts (ESA) have been introduced and the Labour Force Survey has changed from a biennial survey to a rolling quarterly survey.
- 4.13** In the 1970s the statistical system was relatively large and well-funded, although exact comparisons are complicated by the fact that many functions carried out by ONS today were split between several departments or not carried out at all. The 1980 Rayner Review led to reductions in the resource available across the GSS, proposing cuts of a third in the Central Statistical Office. By 1989, when concerns about the quality of economic statistics had led to the commissioning of the Pickford Review, resources for statistics were starting to rise again and rose further with packages of extra funding in 1990 and 1991.
- 4.14** Steady funding increases up to the establishment of ONS in 1996 were followed by cuts in the late 1990s, only for funding then to increase again in the early 2000s. Greater pressure for efficiencies across the public sector began in 2004, resulting in ONS's relocation out of London, though some of the savings were then invested in its Statistical Modernisation Programme. Funding increased temporarily in 2008-09 with the establishment of UKSA. However, the broad trend since then has been one of a steady decline in real resources, bringing it back – as a share of GDP – to the sorts of level seen in the early 1990s before the impact of the Pickford Review had been felt.

9 Barker, K. and Ridgeway, A., (2014). 'National Statistics Quality Review: National Accounts and Balance of Payments'. Available [here](#).

10 Johnson, P., (2015). 'UK Consumer Price Statistics: A Review'. Available [here](#).

Chart 4.A: Approximate deflated core ONS resources against real GDP

Source: Review calculations, further information in Box 4.A.

Box 4.A: Estimating core ONS resources over time

There is no readily-available time series of the financial resources available to ONS. This Review has estimated the resources allocated to what is now ONS from a range of different sources. Doing so has required a number of judgements. Chart 4.A shows a best estimate for the resources used by ONS on a reasonably consistent basis over time. In recent years that has been based on Total DEL (that is the departmental expenditure limit on resources and on capital, less depreciation) plus income, as published in UKSA and ONS Annual Reports and Accounts. Spending on census, regulation and (prior to 2008) the General Register Office has been removed, as has the one-off cost of relocation. Numerous changes in ONS outputs over the period have not been adjusted for. For earlier years, particularly before the creation of ONS, estimates have been made from available sources including Appropriation Acts and the Pickford and Rayner reviews. Figures have been deflated using the GDP deflator.

- 4.15** In the 2015 Spending Review, the Chancellor of the Exchequer announced the UKSA's spending settlement for the period 2016-17 to 2019-20. Excluding funding for the Census, resource funding is set to increase from £145 million in 2015-16 to an average of £162 million per year over the four-year period to 2019-20. As part of the settlement, ONS committed to deliver on all its programme and known legislative demands which, when combined with other pressures, will in reality mean a heavier level of efficiencies than the headline figures might appear to imply.

- 4.16** To deliver on its planned efficiencies and outputs over the spending review period, ONS has already embarked on several projects aimed at transforming its workforce, technology and data collection. The Review identifies several additional actions that would support the needed changes in the organisation and alter its culture. Some of these would benefit from a modest additional investment of public funds.

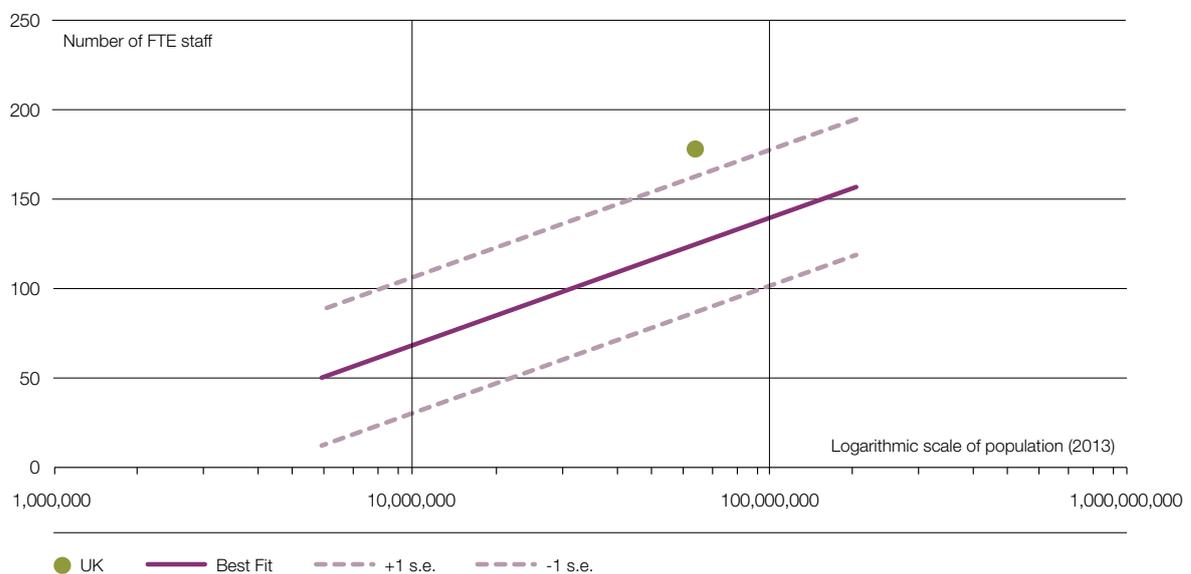
Comparing ONS resources internationally

- 4.17** Comprehensive information on the resourcing levels of different countries' statistical systems is virtually impossible to obtain. Even if such data were readily available, broad comparisons would not be very meaningful because the breadth of statistics collected varies greatly across NSIs. However, despite these dissimilarities, other NSIs provide the best yardstick against which to measure ONS and this section considers the comparative evidence that is available.
- 4.18** One area where some comparative analysis is possible is for the compilation of the national accounts. Though working to a common agreed international standard, the task of producing the national accounts is not uniform across countries. Larger countries tend to have more staff involved in this activity, and further differences can be explained by the different structure of countries' statistical systems. For example, unlike the UK, in some countries the central bank or the finance ministry has a role in compiling the financial accounts and government finance statistics.
- 4.19** In 2006, the OECD's National Accounts Working Party organised a survey of national accounts resourcing in 27 of its member countries. The key variable collected was the number of full-time equivalent (FTE) staff producing the national accounts, split between 'core' tables and activities and 'additional' activities; no information on expenditure was collected though. The Interim Report provided some analysis based on the information collected for that exercise. In order to provide a more up-to-date picture of ONS resources relative to its international peers, this Review has re-run a shorter version of the OECD's survey with a group of 13 countries.
- 4.20** Much has happened since 2006. Many of the countries involved in the survey pointed to the introduction of the UN System of National Accounts 2008, or its equivalent European regulation ESA 2010, as significant achievements made in the intervening years. The framework for balance of payments statistics has also been updated in this time. The UK has been one of the slowest to implement these changes and is only completing the transition now. There have also been further factors specific to the UK, for example in 2006 ONS was about to relocate its national accounts teams from London to Newport.
- 4.21** As documented in the Interim Report, in 2006, resourcing of the national accounts in the UK was broadly in line with its European counterparts and the median of G7 economies, once account was taken of differences in population sizes. Returns from countries that participated in both studies show an average increase of 14% in staffing levels involved in 'core' national accounts activities

between 2006 and 2015. The National Accounts teams in ONS have grown substantially more than the average over that period, from 107 FTE in 2006 to 169 FTE in 2015.

- 4.22** With an increase of 58%, ONS now has one of the larger national accounts operations, even once staff involved in related functions (such as short-term indicators) have been excluded so as to improve comparability. Chart 4.B compares the observation for the UK against the regression line (and one standard error band) relating the number of staff working on the national accounts to the corresponding (logarithm of) population size.¹¹

Chart 4.B: Staff working on core National Accounts tables by population, 2015



Source: *Review survey of NSIs*

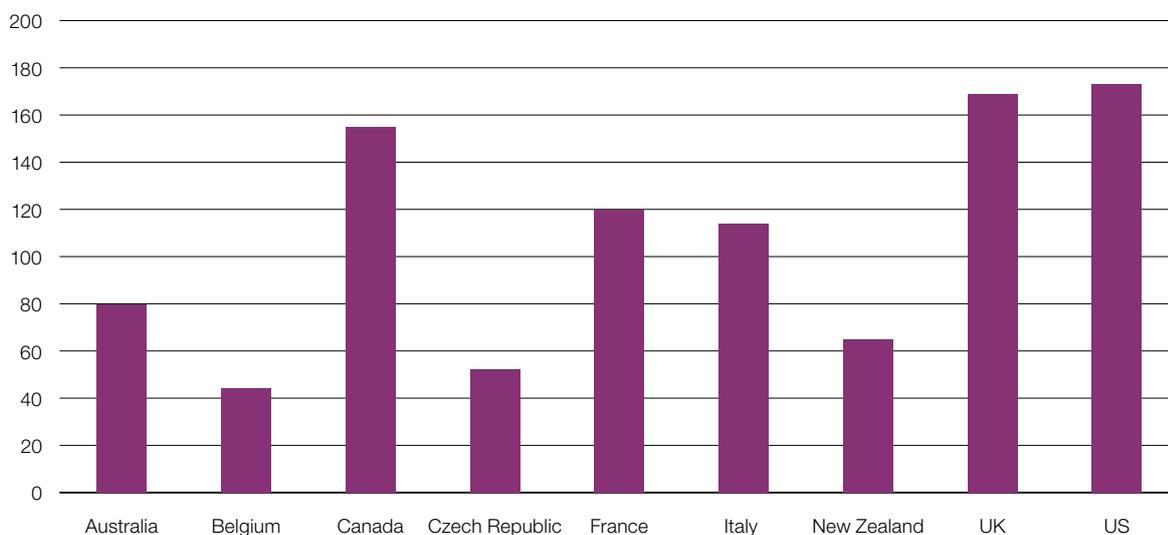
- 4.23** ONS attributes most of the additional staff to the implementation of new international standards in 2014. If staff working on this programme are excluded, UK national accounts resourcing is in line with that of other countries. However, the majority of NSIs who responded to the Review's survey managed this transition with few or no additional staff. With the available data it is difficult to identify why ONS has found this such a challenge, yet it has been slow to roll out the changes and had to bolster its baseline capability of 123 FTE with 46 temporary staff to do so.
- 4.24** While ONS deserves recognition for successfully rolling out the change to ESA10, it appears that ONS started out poorly-equipped for the task. This may be related to the loss of experienced staff through relocation, the comparatively

¹¹ Observations for the other countries are not marked, as not all participating NSIs gave consent for their returns to be published.

low qualification levels among staff or a reliance on outdated technology. But the emerging picture is consistent with the finding later in this chapter that ONS is characterised by a relatively weak capacity to innovate and improve.

4.25 As some NSIs who participated in the survey preferred not to make their individual returns public, Chart 4.C below shows the individual results for just the subset who consented.

Chart 4.C: Staff working on core National Accounts tables, 2015



a [Canada:] Canada produces a very detailed set of provincial and territorial economic accounts used by the government of Canada to determine transfer payments from the federal government to the provinces and territories. Given the importance of these data, the government requires high quality detailed national accounts information. This requirement for detailed regional national accounts is one reason national account resources in Canada are higher when compared with other countries.

b [USA:] The number of FTEs provided by the US in their survey return differ from that provided in the United States Bureau of Economic Analysis' budget presented to Congress because the latter includes support staff (for example, administrative, information technology, and communications support) who do not work directly on the national accounts. The budget numbers are 155 FTEs for national economic accounts, 59 FTEs for industry economic accounts, and 87 FTEs for regional economic accounts. The FTEs provided in this response include only staff who work directly on the national accounts.

Source: Review survey of NSIs

Financial management capability

4.26 As part of the Review's engagement with stakeholders, concerns were raised about the past effectiveness of the finance function at ONS. This is relevant because any progress made on reducing costs or finding efficiencies, across the whole of ONS, would release resources that could, in part, be directed into the production and development of economic statistics. The scope for such reallocation could be considerable, given that the core functions of National Accounts and Economic Statistics only account for direct gross expenditure of £24 million out of a total of £180 million for the whole organisation – in other words, just 13%. The scope for ONS to reallocate funding may, though, be constrained by several factors, including legal requirements to meet EU regulations.

- 4.27** In 2013, the Chartered Institute of Public Finance and Accountancy (CIPFA) were asked by ONS to undertake an assessment of ONS financial management. It found significant failings, including: a lack of appropriate financial management capability, ownership and accountability beyond the central finance team; an absence of basic financial discipline in programme management; inadequate medium-term financial planning; limited integration between financial and business planning; insufficient focus on securing value for money; and a culture that militated against the finance function supporting transformational change.
- 4.28** Stakeholders supported the view of CIPFA but noted that improvements were being made. Since the assessment, ONS has taken steps to improve its financial management, including restructuring its finance function, greater engagement with HM Treasury, and the development of medium-term financial plans. The planned introduction of updated business management software will further improve ONS capability. CIPFA are expected to review progress in 2016-17.

Programme and project management

- 4.29** In June 2014, ONS commissioned the consultancy Atkins to conduct an internal review of ONS's project and programme management (PPM) capability and capacity to deliver the current and future project portfolio, including the 2021 Census. In their conclusions, Atkins raised some general concerns about the state of ONS PPM capability, in particular its ability to deliver on time and within budget. The study recommended raising understanding of ONS's PPM standards, improving governance structures including clearer management of dependencies, as well as implementation of a better planning and resource allocation tool.
- 4.30** The need to improve ONS PPM skills was also raised during engagement with stakeholders and in response to the Call for Evidence. HM Treasury said, "ONS could improve processes such as project management to ensure all their goals are met and resources are used to the best of their ability." Some stakeholders thought that ONS could go a long way to meeting most of their goals with the resources already available through better project management.
- 4.31** Historically, ONS has been slow to recognise PPM as a profession. Since the Atkins review ONS has sought to strengthen its capability in this area. For example, ONS has recruited two professional planners tasked with embedding a newly created planning and dependency management standard across its project portfolio. ONS's flexibility and the responsiveness of its approach to prioritisation and resource allocation are discussed further in Chapter 5.

Recent ONS performance

4.32 For users to have confidence in ONS economic statistics, those statistics both need to be of high quality and seen to be of high quality — a proven track record as an institution is needed. However, it is not just mistakes that can damage the reputation of ONS; when inadequately explained, revisions resulting from new data or methodological changes can also do harm. This Review has sought the views of a wide range of users, stakeholders and experts on ONS's recent performance. One particular point, noted by several users, was that this Review would not have been commissioned if all had been well.

Public confidence

4.33 UKSA has commissioned two surveys of Public Confidence in Official Statistics, carried out by Natcen Social Research in 2009¹² and 2014¹³ respectively. There are also similar surveys for earlier years. The 2014 survey found that a relatively low proportion of respondents were aware of ONS, but of those who expressed an opinion, 88% either trusted ONS a great deal or tended to trust it, a higher proportion than some other major institutions including the courts and the police. The survey found that those who had used official statistics were more likely to trust them than those who had not used them.

4.34 The survey also asked respondents whether 'official figures are generally accurate', to which 59% agreed. The results from 2014 and similar questions in previous surveys are shown in Table 4.B. The omission of a 'neither-agree-nor-disagree' option in 2014 makes comparisons difficult, but if anything it appears that accuracy is perceived to have improved since 2004.

Table 4.B: 'Official figures are generally accurate', percentages of respondents

	2004	2005	2007	2009	2014
Strongly agree	2	2	2	1	7
Tend to agree	32	35	34	31	52
Neither agree nor disagree	27	28	27	26	option not offered
Tend to disagree	28	25	25	32	17
Strongly disagree	7	6	8	8	5
Not sure or don't know	3	4	4	1	19

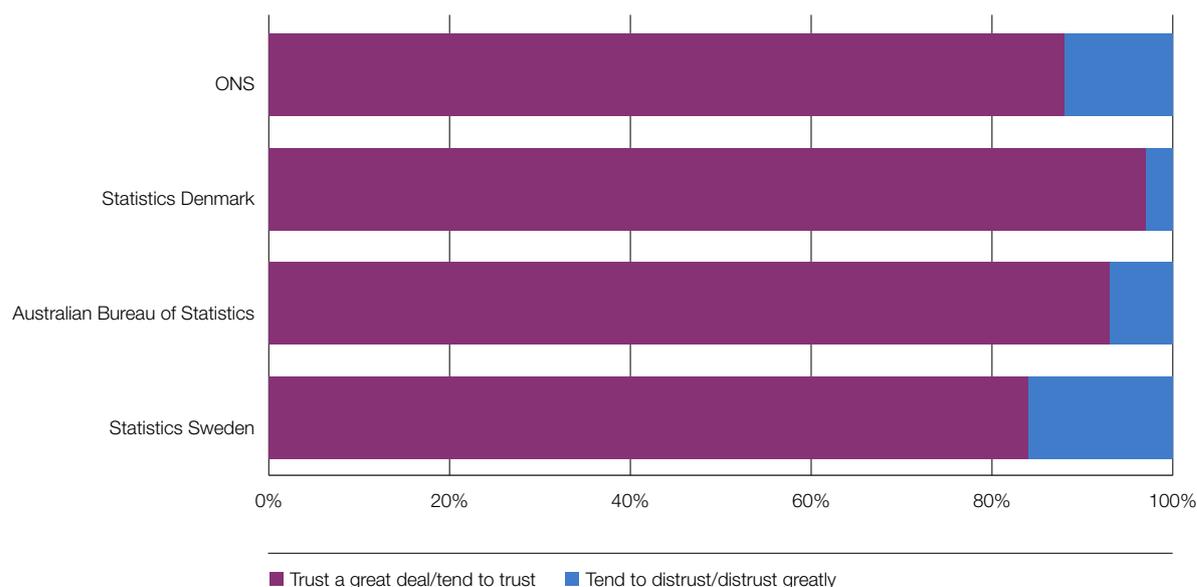
Source: Natcen Social Research, 2010 and 2015.

12 Bailey, R., Rofique, J. and Humphrey, A., (2010). 'Public Confidence in Official Statistics 2009', Natcen Social Research. Available [here](#).

13 Simpson, I., Beninger, K. and Ormston, R., (2015). 'Public Confidence in Official Statistics', Natcen Social Research. Available [here](#).

- 4.35** The 2014 survey was based on an OECD questionnaire, but only Australia, Sweden and Denmark have so far carried out similar surveys to the UK. In these countries, awareness of the NSI was higher. Trust in the NSI was higher in Australia and Denmark, though lower in Sweden (see Chart 4.D below).

Chart 4.D: Trust in National Statistical Institutes, % of respondents (excluding 'don't know')



Source: Natcen Social Research, 2015.

User perspectives

- 4.36** Almost everyone who responded to the Call for Evidence or who engaged with the Review team, wanted ONS to do more in one area or another, though many also acknowledged that a greater focus in one area would necessitate doing less in others. Many respondents also welcomed the direction charted by ONS's new senior management team, led by the National Statistician, John Pullinger, believing that it represented an opportunity for strategic reform and cultural change.
- 4.37** Some respondents were quite critical. Some referred to its sluggishness in embracing new developments. ONS had fallen behind in adapting and improving its methodologies to reflect changes in the economy and was insufficiently strategic when deciding its statistical priorities. Many argued that more use should be made of administrative data, though current legislation was recognised as being a barrier. There was also scepticism as to whether ONS had grasped the transformational opportunities of big data more generally and had sufficient ability in data science techniques to exploit them. Some also noted ONS data collection methods were out-dated.
- 4.38** There was also some criticism of ONS behaviours and capabilities. Many respondents said ONS needed to do more to engage with users, both within and outside government. A number of users commented on the failure to sense-

check some statistics before release, arguing that greater use of economic expertise could help prevent embarrassing errors. Some respondents saw a need to invest in improving systems and skills, while ONS was also criticised for operating in silos.

- 4.39** The ONS website also attracted a lot of comment from users. While a new website has since been launched, there was consensus that the website at the time of the Call for Evidence was very poor. Others made wider comments on the general accessibility of official statistics: key data is not prioritised as well as difficult to find and access. Users would like to be able to access and manipulate underlying microdata as well as have better access to real-time data sets.
- 4.40** Full lists of the individuals and organisations that the Review team engaged with, either through the Call for Evidence or through meetings, are included at Annexes E and F respectively. The responses to the Call for Evidence have also been published online.

Recent failings and criticism

- 4.41** In recent years ONS has been the subject of much public criticism regarding the quality of some of its statistics. There have been several media reports citing doubts about some of the core economic series produced by ONS. As but one example, in discussing investment statistics, the Governor of the Bank of England, Mark Carney, told the Treasury Select Committee in 2013 that the Bank of England “are not putting full weight on that [ONS] data, and it has to be said that it does not entirely feel right that investment is measured falling at a time when we see continued strengthening in investment intentions.”¹⁴ Similarly critical views were voiced in several responses to the Call for Evidence and it is fair to say that many users lack confidence in the quality control surrounding ONS statistics.
- 4.42** UKSA, as the statistics regulator, assesses the production of statistics against the Code. The Code has eight principles, the first of which is the need to “meet the requirements of informed decision-making by government, public services, business, researchers and the public.”¹⁵ Statistics that meet the standards set out in the Code are designated with the quality mark ‘National Statistics’. No fewer than seven ONS outputs have had the National Statistics designation removed since the start of 2014, six of them in economic statistics.

14 Treasury Select Committee, (2013). ‘Oral evidence: Bank of England November 2013 Inflation Report’. Available [here](#).

15 UKSA, (2009). ‘Code of Practice for Official Statistics’. p.5. Available [here](#).

Table 4.C: List of de-designated National Statistics produced by ONS

List of de-designations	Date of de-designation	Current Status
Retail Prices Index	14 Mar '13	de-designated
Police Recorded Crime Statistics for England and Wales	15 Jan '14	de-designated
UK Trade Statistics for April 2014	18 Jun '14	re-designated 25 Jun '15
Consumer Prices Index including Owner-Occupiers' Housing Costs (CPIH)	14 Aug '14	de-designated
UK Trade Statistics	14 Nov '14	de-designated
Statistics on Overseas Travel and Tourism	14 Nov '14	re-designated 15 May '15
Statistics on Construction Output and New Orders	11 Dec '14	de-designated
Statistics on Claimant Count	10 Jun '15	de-designated

Source: UK Statistics Authority.

- 4.43** It is important that ONS produces statistics that are of high quality and error-free if users are to have confidence in them. Since March 2012, ONS has issued on average close to two corrections a month to its data and has also been criticised for its handling of erroneous statistics.¹⁶ Over the course of this Review ONS has had to correct processing errors in its labour productivity statistics,¹⁷ as well as its experimental price indices based on web-scraped data,¹⁸ one of its most cutting-edge outputs. Looking further back, in 2014 alone there were two particularly notable cases where ONS had to respond following processing errors in the production of National Statistics.
- 4.44** First, in July 2014 when the first quarter UK Trade Statistics were published, estimates of tourism expenditure were much lower than expected. This issue had already been queried by many users since preliminary tourism figures were published in March. In November, ONS found that the underestimate resulted from a processing error on an updated questionnaire introduced in January 2014 into the International Passenger Survey (IPS), a key source of data. The mistake was not identified during the regular quality assurance phase, but rather during a review of IPS processes, raising serious doubts over whether sufficient measures were in place to assure the quality of many other ONS statistics. The following day the National Statistician wrote to UKSA, who de-designated both UK Trade Statistics and the underlying UK Travel and Tourism figures as National Statistics.¹⁹ An internal review highlighted areas of concern, including a lack of contextual awareness by staff, as the figures were completely at odds

16 ONS, (2016). 'Corrections to data'. Available [here](#).

17 ONS, (2015). 'Labour Productivity: Q3 2015'. Available [here](#).

18 ONS, (2015). 'Consumer Price Indices, Research indices using web scraped price data'. Available [here](#).

19 UKSA, (2014). Correspondence from Sir Andrew Dilnot to John Pullinger on 'Estimates of expenditure for UK residents' visits abroad and overseas residents' visits to the UK. Available [here](#).

with others that were publically available. While UKSA restored the National Statistics designation to the Overseas Travel and Tourism statistics in May 2015, it concluded that “confidence in the UK trade statistics has been diminished by the errors.”²⁰

- 4.45** Second, also during 2014, concerns were raised regarding another National Statistic produced by ONS. Developing a measure of consumer price inflation including a proper measure of housing costs had long been a government priority^{21, 22} and the Consumer Prices Index Including Owner-Occupiers’ Housing costs (CPIH) was duly introduced in March 2013 and designated a National Statistic shortly thereafter.²³ But within a year, users were already querying the housing costs component. In particular, statistics published by the Valuation Office Agency (VOA) and ONS, while based on the same underlying data, gave a starkly different picture, leading to doubts about the validity of the methodology used to calculate CPIH.²⁴
- 4.46** After initially defending the series, ONS subsequently wrote to the regulator explaining that analytical errors had been found in the methodology used to calculate CPIH. Estimates of the CPIH annual growth rate were up to 0.2 percentage points higher than those originally published by ONS. This prompted the subsequent de-designation of CPIH as a National Statistic.²⁵ It appears that the error was caused by the combination of a dependence on VOA data, where the underlying administrative microdata was not accessible to ONS, and a lack of proper understanding regarding how to use the data in calculating the statistic. An UKSA review into administrative data suggested this may be a common issue, stating that there was a need for “critical judgment of the underlying data from administrative systems before the data are extracted for supply into the statistical production process.”²⁶
- 4.47** As well as these two particularly notable instances, 2014 also saw the de-designation of ONS statistics on construction output and new orders. The fact that so many errors and de-designations took place in such a short period and were not picked up by quality-assurance procedures suggests that there are deeper issues involved rather than just simple oversight. Subsequent reviews

20 UKSA, (2015). ‘Statistics on UK Trade (Office for National Statistics)’. Assessment Report 304. p.2. Available [here](#)

21 Cabinet Office, (2010). ‘The Coalition: Our Programme for Government’. Available [here](#).

22 HM Treasury, (2010). Correspondence from the Chancellor of the Exchequer to the Governor of the Bank of England on ‘CPI Inflation’. Available [here](#).

23 UKSA, (2013). ‘Statistics on Consumer Price Inflation’ Assessment Report 257. Available [here](#).

24 Campbell, R., (2014). ‘CPIH Announcement 14 August 2014 – Explanatory Note’, ONS. Available [here](#).

25 UKSA, (2014). Correspondence from Sir Andrew Dilnot to John Pullinger on ‘Consumer Price Indices including Housing Costs (CPIH) Indicator’. Available [here](#).

26 UKSA, (2015). ‘Quality Assurance of Administrative Data – Setting the Standard’. p.4. Available [here](#).

and assessments of other statistics have produced similar explanations, such as a lack of contextual awareness regarding the statistics and a lack of engagement with users of the statistics to understand potential shortcomings.

- 4.48** Another criticism of ONS has been that a lack of expertise has led to the publication of erroneous data, particularly in the wake of relocation to Newport. An example of this occurred in 2011, when ONS published construction statistics which quoted quarter-on-quarter growth as 2.3%, rather than the correct figure of 0.5%.²⁷ This resulted in an incorrect revision to GDP. The error was identified by a journalist during a press lock-in briefing and was described by ONS as the most fundamental and basic of errors, whereby a mistake had occurred while copying and pasting figures from different columns in a spreadsheet. Media response to this issue was not surprisingly wholly negative and a subsequent review found that a lack of experience was the underlying root cause. It also cited two occasions where the error should have been picked up, firstly through the completion of more rigorous checks and secondly, if critical thinking had been applied by staff when considering the scale of the revisions. In response to this error, ONS is trying to minimise the use of spreadsheets and manual copying and pasting wherever possible.
- 4.49** A lack of critical evaluation and the failure of quality assurance procedures, specifically after changes in methodology, are other issues that have surfaced on several occasions. For example, in 2013 the measurement of gross fixed capital formation was subject to a methodological change, which led to the data exhibiting both greater volatility and an apparently implausible change in trend.¹⁰ Doubts about the new series then led ONS to revert to the earlier methodology.
- 4.50** As set out in the discussion in Chapter 2 regarding the measurement of GDP, ONS has sometimes been slower than its peers to introduce methodological improvements. This became an issue of considerable significance when, in 2010, ONS made some routine changes in the way the basic data for clothing prices were collected. This led to a widening of the wedge (or ‘formula effect’) between the CPI and the RPI. It eventually transpired that this was due to ONS using an inappropriate formula (‘Carli’) to aggregate individual price quotes in the calculation of RPI. The deficiencies of this formula had been well known to statisticians since at least the 1970s. Indeed almost all other countries have long since stopped using it.¹⁰ This shows that while keeping up with international best practice seems optional, departing from it over a period of time can incur considerable costs.
- 4.51** While it is unrealistic to expect to eradicate all errors, greater effort is needed to quality assure the production of statistics. It is the role of ONS to present the most accurate and reliable picture possible of the economy. Failing to do so raises serious challenges for decision makers. As well as effective and rigorous quality assurance procedures, there also needs to be sufficient expertise

27 UKSA, (2011). ‘Statement on the release of Output in Construction estimates by the Office for National Statistics’. Available [here](#).

embedded across the organisation to identify rogue data before it is released into the public domain. Closer engagement with experienced users can also help to ensure that significant errors that do slip through get picked up quickly.

International comparison of performance

- 4.52** In early 2015, the UK was reviewed on its compliance with the European Statistics Code of Practice by a team from other European NSIs.²⁸ The peer review's findings were largely positive, praising ONS for its transparency and openness. The review's report went on to mention ONS efforts to develop stronger relationships with users; it noted ONS's growing ties with academia and the role this served in developing methodology. It also acknowledged ONS's focus on improving the quality of its work.
- 4.53** The review did find some areas of weakness and made a number of recommendations, several of which are echoed in this Review. One particular finding is, though, worth recording in full. This was to seek greater use of administrative data for statistical purposes, subject to appropriate safeguards. The peer review noted that:
- “In recent years, many European countries have purposefully increased their use of administrative data. As a result, the availability of source data has increased and the NSIs have succeeded in augmenting their existing survey data or even replacing their own surveys with the use of administrative data. The combined effects have been increased data supplies for statistical purposes, reductions in response burden and cost by businesses and household and cost reductions and increased efficiencies for the NSIs. Such developments have only taken place to a limited extent in the UK where there are substantial cultural and legislative obstacles to utilising administrative microdata for statistical purposes.” (p.14-15)
- 4.54** The peer review had other recommendations on ONS's capability, increasing the efficiency of the statistical system and making UK statistics more accessible. The recommendations included the need for changes to ONS's tools and systems, modernisation of data collection, coordination with European counterparts, an updated website and improved access to microdata for researchers.
- 4.55** In June 2014, ONS also conducted their own survey to improve their understanding of other countries' national accounts operations and processes and to identify common challenges and opportunities for cooperation and sharing of best practice. The survey received responses from 16 NSIs with comparably mature national accounts operations, activities and structures (covering the range of GDP, balance of payments, financial accounts and public sector finances).

28 Snorrason H., Byfuglien J. and Vihavainen H., (2015). 'Peer Review Report on compliance with the Code of Practice and the coordination role of the National Statistical Institute: United Kingdom'. Available [here](#).

- 4.56** ONS asked questions about NSIs' systems and data sources, as well as staff retention and reporting processes. The survey concluded ONS was one of the weakest performers in all of these areas, though this was in part due to the relative complexity of ONS's systems compared to the less integrated systems used in some other countries. ONS's choice of technology was largely consistent with that used by other NSIs, but it was the only statistical institute that reported major concerns about systems performance. The UK scored lowest on overall self-evaluation of the agility and flexibility of its systems. ONS was also one of only two countries with major concerns about the coherence of internal data sources and data quality. Twelve NSIs reported a tightening of their budgetary restraints, with only four stating no concerns in this area.
- 4.57** While ONS has been criticised for making mistakes in recent years, it is by no means the only NSI that has had to correct errors in published statistics. For example, in 2008 Statistics Sweden reported an error in its CPI, meaning that the inflation rate was overestimated by 0.3 percentage points and which had significant consequences for the Riksbank's monetary policy as well as benefit payments.^{29, 30} And even the highly-regarded Statistics Canada faced widespread criticism for an imputation error which significantly understated employment in its July 2014 Labour Force Survey results.³¹ Even very good NSIs make errors now and again.

Culture, Capability and Collaboration

- 4.58** As the principal source of statistics regarding the economy, an NSI should be an organisation with analysis at its heart. Its role in society and the economy, and the work it is responsible for, are unique and specialised. As noted by the Chartered Institute of Personnel and Development (CIPD) in its response to the Call for Evidence, "ONS is still better placed than any other body in the UK to collect economic statistics." But that alone is insufficient to make it the thriving centre of expertise in economic measurement that it should be. Culture and capability matter too.
- 4.59** This section looks at the institutional culture and organisational capability within ONS. It recommends a set of actions which could help ONS become a more analytic, more cutting-edge and more responsive institution. It also suggests how partnering with other institutions can help drive those improvements. Successive errors and other shortcomings in the production of economic statistics have put the focus on analytical capability within ONS. Most regular users of economic statistics – including HM Treasury, the Office for Budget

29 UN Statistical Commission and Economic Commission for Europe, (2009). 'The shoe problem – and what we are doing to prevent it'. Available [here](#).

30 UN Statistical Commission and Economic Commission for Europe, (2010). 'Corrections at Statistics Sweden'. Available [here](#).

31 Statistics Canada, (2015). 'Review of the July 2014 Labour Force Survey release'. Available [here](#).

Responsibility and the Bank of England – have raised concerns about quality assurance and the need for greater economic expertise in sense-checking releases.

- 4.60** It ought to be the case that ONS knows more about the strengths and limitations of its statistics than anyone else, and should be in the vanguard of understanding and explaining them and how they relate to indicators produced by other organisations. In that sense, ONS has the ingredients of an institution like the Met Office, which has undoubtedly made a strength of its specialism and defined itself as world leader in its field (Box 4.B). As a data-driven organisation it provides a healthy model for ONS to look to.
- 4.61** If ONS can garner a similar reputation as ‘best-in-class’, in other words become *the* centre of expertise in economic statistics, the advantages would be manifold, offering a virtuous circle that draws in talent and opens up opportunities for collaboration and partnership. But this is only an achievable goal if sufficient analytical capability is available. The new ONS leadership is responding to these criticisms with a series of efforts to transform the core of the organisation, but demonstrable progress over a sustained period will be needed if ONS is to build a reputation for excellence.

Box 4.B: The Met Office – a world-leading data-driven organisation

The Met Office, the UK’s national weather service, is an example of a data-driven, highly innovative organisation that has successfully established itself as a world-leader in its field. It is at the forefront of meteorological forecasting and impact predictions across all timescales, including predicting climate change.

As a renowned leader in its field, the Met Office is able to attract applicants with backgrounds in mathematics and technology among other fields, including through a highly competitive training scheme akin to an apprenticeship. While it has historically owned the complete value chain of all its data (from research and analysis to publishing), its business model is now adapting to incorporate alternative data sources and new intermediaries for promulgating its forecasts.

The Met Office’s reputation as ‘best-in-class’ means it benefits from a surfeit of opportunities for collaboration, including other weather services who want to pool expertise, as well as academic partners for whom collaboration with the Met Office will raise their profile, increase citations and make it easier to secure funding. Having successfully relocated to Exeter in 2003, it established the Met Office Academic Partnership and has since strengthened its ties with universities.

While it has a real-time operational role providing up-to-the-minute forecasts, the Met Office also maintains highly skilled research staff of its own. Its informatics lab is led by a renowned scientist supported by a multi-disciplinary team with backgrounds in mathematics, engineering, technology as well as the creative industries and is a contemporary example of how the Met Office adapts. Researchers operate in close collaboration with operational staff to understand the problems facing the organisation, exchange ideas and develop solutions.

Culture

4.62 Providing economic statistics that are relevant, timely, accessible and of high quality not only requires the right skills, methods and systems – it also requires a pro-active, open and creative approach that keeps pace with developments in the modern economy and understands and responds to the changing needs of statistics users. There was widespread agreement among respondents to the Call for Evidence that ONS needs to be more inquiring and self-critical about the statistics it produces, including, but not limited to, in the narrow process of quality assurance:

- The Royal Statistical Society said, “We have seen a deterioration in the capacity for ONS to think beyond production of its routine statistics and to be able to respond to new developments” and that, “Sometimes there is resistance to listen to users who may be suggesting new ideas or criticisms.”
- Professor Diane Coyle said, “It is an inward-looking body and has far too little appreciation of what users need to get from its outputs.”
- The Office for Budget Responsibility said, “In recent years external users have raised a number of issues with the quality of specific ONS series [...] it is possible that some of these issues may have been mitigated (or even avoided) had there been greater quality assurance or sense-checking within ONS at an earlier stage of the production process.”

4.63 The need to maintain ‘continual curiosity’ was explicitly identified in the 2014 Barker-Ridgeway Review: “ONS will need to foster an organisational culture that respects the historical record of the UK economy while at the same time maintaining continual curiosity about the ever changing world that will assure sound information for current users and a historical record the next generation can build upon.”³² One of the key themes that has emerged over the course of this Review is the need for ONS to move beyond focusing largely on the production of statistics (the ‘factory’), and instead embrace a role as a service-provider, supporting users with confidence, curiosity and enthusiasm.

32 Barker, K. and Ridgeway, A., (2014). ‘National Statistics Quality Review: National Accounts and Balance of Payments’. p.67. Available [here](#).

4.64 ONS is in a unique position to understand the limitations of its statistics and their sources and its role should be as a trusted voice explaining those limitations to users, rather than instinctively defending its statistics when questions are raised about them. While many respondents recognised that the new senior leadership team was moving ONS in the right direction, some respondents thought more was needed by way of fostering a change of culture and working practices.

4.65 Three inter-linked ingredients are needed to help meet this objective of building a ‘curious’ ONS that is more responsive to changes in the economic environment and better meets evolving user needs:

- **Improved understanding of the ways and context in which its economic statistics are used.** This could be facilitated by building up the economics capability of existing staff through training, shadowing and secondment opportunities at HM Treasury, the Bank of England and other relevant organisations, and by the recruitment of more economic analysts, including at a more expert level. ONS should also seek to strengthen its engagement with the economic statistics user community; regular events such as the ONS ‘Economic Forum’ are helping and this section includes further recommendations to foster collaboration and the exchange of ideas.
- **Raising staff knowledge of the systems, methods and data sources for the production of economic statistics.** An environment of continual improvement requires a good knowledge of the limitations of existing approaches and the opportunities presented by new developments and technologies. It appears that while some training is offered, it mostly takes place within directorates. A broader range of career paths and training opportunities would both help. This could be complemented through more interchange of staff with other NSIs and relevant organisations. Rationalising the complex and aging range of systems used by ONS would also make it easier for staff, especially new recruits, to get a fuller understanding of processes. Such in-depth knowledge would make it easier to ‘sense-check’ outputs by comparing them to information available from other sources.
- **Strengthening ONS’s quality-assurance processes and analytical capacity to spot mistakes and inconsistencies, including building in sufficient time for meaningful and rigorous internal challenge.** Several stakeholders who spoke to the Review team thought that current quality-assurance processes were too formulaic and noted that relatively simple checks could have prevented many of the recent errors. There was a strong feeling that ONS staff also needed to be more sceptical of their statistics and have a greater ability to apply a ‘smell-test’. This requires that time be set aside for critically evaluating outputs in the production process. Management has recently launched a range of initiatives under the banner of a ‘curiosity agenda’ to raise staff’s ability and confidence to question methods and outputs. This includes workshops to share examples of the successful application of curiosity, as well as a programme of external speakers focused on how other organisations have instilled a more questioning culture.

Innovation

- 4.66** There is also a wider value to putting curiosity at the centre of ONS's culture, not limited to quality assurance. Curiosity should reach into every part of the organisation's business, encouraging staff to ask themselves 'is this really what is needed?' and 'how can this be done better?' There are pockets of good practice: ONS has an existing programme of continuous improvement for some of its processes which has received plaudits.³³ However, it is clear that more still needs to be done. For example, ONS's approach to international standards is defined by the need to comply with them, rather than an ambition to shape them. One user mentioned to the Review that while international comparability is important it should not be an excuse to avoid developing innovative methods and approaches.
- 4.67** Successful innovation cannot be imposed on staff, but must be driven by those closest to the production of statistics, who can see the problems and inefficiencies in their daily routine. It is possible to draw parallels between innovation and quality assurance of ONS's operation, as the requisite skills are the same – a good understanding of the purpose of the process, experience working with it and with alternatives, and a willingness to question it. There is a further ingredient too, which is that innovation must be even more clearly championed by senior management, so that ideas for improvements are recognised, prioritised and brought to those with the skills to implement them.
- 4.68** The extent of the changes envisaged in the coming years, by both this Review and ONS's leadership, is transformational. Transformation is necessary if ONS is to carve out for itself a position among leading statistical institutes. One challenge is that the near-continual succession of unsuccessful change programmes over recent years has left many in ONS weary of change altogether. The modernisation programme of the mid-2000s has cast a shadow that persists today and little has been done to counter the perception that change programmes do not mean real change, and certainly do not mean change for the better. The most recent survey of ONS staff showed less than half believed their managers would take any action in response to the results of the survey.³⁴
- 4.69** There is a strong likelihood that opportunities for innovation are missed because, regardless of the potential of their ideas, staff do not have the confidence to question existing practices unless they believe that they will be listened to by managers. Senior management need to make clear to the rest of the organisation that they are open to innovative suggestions and are eager to implement them and recognise those responsible. And once the expectation is set, they must then make sure that they follow through with it.

33 British Quality Foundation, (2014). '2014 Awards'. Available [here](#).

34 Cabinet Office, (2015). 'Civil Service People Survey: 2015 results'. Available [here](#).

- 4.70** Statistics Canada offers an example of what can be done with only a little effort. In a drive to improve, management instituted an online suggestion box to seek proposals for change from all staff. They then paired the best ideas with sponsors at the most senior level and reported back openly to staff on plans to implement them. Suggestions from this kind of approach are likely to include measures that improve staff welfare or make small tasks less burdensome, right up to proposals that fundamentally change the way statistics are produced.
- 4.71** Innovation does not come easily in a factory-like environment focussed on getting the product out. That is why ‘lean’ manufacturing focuses on giving ownership to those on the shop floor and encouraging collaboration between workers and teams to come up with better ways of doing things. Innovation can also be encouraged by assembling multi-disciplinary teams, with a variety of skills and knowledge, to look at broad issues as well as specific problems.
- 4.72** ONS has plans to make its teams more multi-disciplinary, including by embedding more economists across the organisation. However, this should be just the start. The next sub-sections look at the need for ONS to collaborate more, and the need to raise capability across ONS. Both of these steps open the door to a more innovative organisation by bringing ONS’s own knowledge and expertise closer to the cutting edge and supplementing it with that of partner institutions.
- 4.73** This leads to the following recommendation:

Recommended Action 5: ONS should take action to ensure that the primary objective of statistical producers is to meet user needs, by encouraging staff to: understand better how their statistics are used; be more curious and self-critical in identifying statistical issues; collaborate with users and experts; and create a culture of rewarding innovation.

Collaboration and user engagement

- 4.74** Respondents to the Call for Evidence recognised that the diverse, complex and at times contradictory demands of the broad statistics user community posed challenges for ONS’s prioritisation of engagement and responsiveness. The need for closer ties between ONS and users of its economic statistics was raised by several respondents:
- John Holden of New Economy said, “There needs to be increased dialogue with end users to understand demands and uses/expectations. An outcome of this would be to provide better linkages to current policy drivers, for example devolution and addressing the productivity gap.”

- The Royal Economic Society said, “The analytical and measurement capacity of ONS relating to economic statistics can be increased by closer and wider relations with outside expertise, particularly in university economics departments, but also in research institutes such as IFS and NIESR.”
- The Royal Statistical Society also said to the Review, “In our view, effective user engagement requires consistent structure for long term, deep engagement, rather than one-off exercises. We recognise that the ONS has shown goodwill toward user engagement, however too often we have seen a lack of a consistent and properly resourced effort for engaging with a wide range of users.”

- 4.75** Engagement is more effective when it is a two-way process between users and producers of economic statistics. This would allow ONS teams to share their understanding of the statistics they publish, as well as their knowledge of the underlying data sources used in the production process. It would also mean ONS could make better use in the production of statistics of users’ insights and expertise. UKSA regulatory staff suggested to this Review that ONS frequently forgoes opportunities to assimilate intelligence from external parties into improving the quality of statistics.
- 4.76** User engagement is explicitly recognised in the Code and an area that UKSA has looked into closely across the statistical system. In June 2010, it published a monitoring report on the need to strengthen user engagement. That report concluded that, while there was already plenty of engagement, there needed to be: “(i) better understanding of the use currently made of official statistics and the value to society that flows from that use; (ii) better communication with a wide range of users; and (iii) better exploitation of the existing consultation structures and technologies to ensure that user engagement is effective.”³⁵
- 4.77** As an organisation, ONS is at times overly cautious when it comes to sharing work-in-progress, testing new methods, and drawing on data from elsewhere. An important part of developing a space for collaboration with other users of economic statistics is to enable ONS to be more experimental in its approach. This requires a different approach to dissemination, which allows ONS to be open with the user community when discussing experimental approaches, initial results still subject to change and methods that will likely evolve as research progresses. As Simon Briscoe proposed in response to the Review’s Call for Evidence, “ONS ought to be much more open than it is – users would then see what is happening, believe (hopefully) that the office is doing its best to improve the statistics, and be able to help.”
- 4.78** A small, but significant step in recent years towards better user engagement has been the inclusion of a name and contact details for the responsible statisticians on releases. This was acknowledged in the Call for Evidence by among others the New Economics Foundation, who said the practice “significantly improves

35 UKSA, (2010). ‘Strengthening User Engagement’. p.2. Available [here](#).

the usefulness of the statistics produced.” There have been other positive steps too, such as the establishment of the ONS Economic Forum, and the greater use of external experts in the quality assurance of major statistical releases.

- 4.79** A particularly desirable aspect of communication with users should be to make them aware of any limitations or qualifications surrounding a statistic when it is released. A statistic can be mis-measured, for instance because of sampling error. Or the statistic may give a distorted picture at because some of the assumptions used to construct may not be fulfilled; Chapter 2 provided several examples. Or the statistic may fail to properly capture some new phenomenon; Chapter 3 provided several examples. Rather than concealing such problems, the producer of a statistic is the best person to explain its limitations to users and to avoid their misinterpretation. ONS does some of this, for example through its regular Economic Forum and by giving information on sampling errors in the notes to releases when they are available and providing commentary. But it could do this more prominently and systematically. That leads to the following recommendation:

Recommended Action 7: Statistical releases should contain clear and prominent commentary on the quality of those statistics, noting any significant limitations and also highlighting any scope for misinterpretation.

- 4.80** The onus here does not lie solely with the provider. Much media and market commentary and political discourse treats statistics with a precision and reverence that is totally unwarranted. A statistic is *not* a fact but an often highly imperfect estimate that may be subject to revision as more information accrues. Users should acknowledge that and pay more attention to those imperfections. It is also striking how little professional economists today are taught about measurement issues. Accordingly the Review suggests:

Recommended Action 8: Users and commentators should be more alert to the limitations of economic statistics and economics courses should pay more attention to the problems of economic measurement.

- 4.81** ONS should not constrain itself to just its own in-house expertise in trying to understand and address emerging statistical challenges. Various models for encouraging closer working have been suggested. At a high level these include mechanisms to put in place formal relationships with external advisors or international experts. At working level it is important that microdata is made available to researchers, subject to appropriately stringent data confidentiality safeguards. Both approaches are explored in later sections of this chapter. The Review also contains specific recommendations in relation to a centre of excellence in the measurement of the economy (Recommended Action 4) and a data hub (Recommended Action 14), both of which will generate more collaboration with outside experts.

- 4.82 As the following section documents, the relocation of ONS to Newport had a significant impact. One legacy of this move is a lack of facilities in London, where a number of key users are located. This is likely to be a barrier to greater use of partnerships by ONS. While Newport is now established as the home of economic statistics, and should remain so, this Review has heard from several respondents to the Call for Evidence, including the Confederation of British Industry (CBI) who supported the idea of a greater ONS presence in London, alongside continuing to build skills and expertise in Newport, in order to facilitate more effective engagement and collaboration with users. An increased presence in London would help to strengthen links between ONS, HM Treasury, the Bank of England and many private-sector users. It would also facilitate staff interchanges and secondments. That leads to the following recommendation:

Recommended Action 6: While building up the capability of its operation in Newport, ONS should also increase its London profile in order to facilitate stronger engagement with users of economic statistics, as well as expanding its engagement with users across the rest of the UK.

Background to the capability and culture of ONS

- 4.83 Capability and culture must be built up slowly but steadily over time. This Review sets out recommendations to nurture their development to support the delivery and improvement of economic statistics. However, even if this Review's recommendations were fully implemented, they would not bring about change overnight. Likewise it is helpful to recognise that ONS's present situation is the legacy of past decisions over many years.

Scarce resources

- 4.84 As with any organisation, ONS has had to make choices in order to make the best use of its resources. As noted earlier in this chapter, the resources available to ONS have fluctuated noticeably over time. Not unreasonably, when resources are tight the obligation on ONS to collect and publish particular sets of statistics results in these activities being protected at the expense of interpretive or innovative projects that may help to raise analytical capability and support core functions in the longer term.
- 4.85 Boxes 4.C and 4.D in this section provide examples where ONS responded to limited resources by cutting back on such investment-like activities. In both examples, this meant halting work that had been recommended by major reviews. Both initiatives also relate to statistical outputs identified in the previous chapters of this Report as still representing important measurement challenges in the modern economy.

Box 4.C: UK Centre for the Measurement of Government Activity (UKCeMGA)

The UK Centre for the Measurement of Government Activity was launched within ONS in 2005, in response to increasing demand for improved measures of public service output, and in particular to implement the recommendations of a review led by Sir Tony Atkinson. Guided by an expert advisory board, the centre operated as a collaborative hub, working with the departments delivering public services to develop a framework of measures for government output. The progress made by the centre, which was at the cutting edge internationally, is set out in the earlier chapter on public sector services.

At its peak in 2007-08 the centre had a budget of £1.6 million and was made up of 35 staff (five of whom were working on a related, but separately-funded project). However, from 2009 onwards, with much of its original agenda fulfilled, changing priorities and user demands led ONS to divert its resources elsewhere. The centre was merged with related National Accounts work on the public sector, and the combined functions are now supported by just twelve staff. When National Accounts activities relocated from London to Newport, many staff with relevant expertise moved to fill vacancies left by those who did not relocate.

As a result, work to measure public sector activity was reduced to a minimum and the development of methodology ceased. ONS reported to this Review that the methods in use to measure public services remain largely as they were in 2008. The chair of the cross-Whitehall Public Sector Efficiency Group told the Review that “ONS remains a world leader in producing public sector productivity statistics.” However, he also pointed to the scaling back of resources in recent years and listed a number of areas for improvement including timeliness and quality adjustment. Further detail on the potential for improvements in these areas can be found in Chapter 2 of this report.

- 4.86** Some prioritisation should be welcomed as ONS must respond to changing user needs. But the experiences of the Atkinson and Allsopp reviews show that a continuing resource commitment is needed to maintain expertise. Furthermore, it is inefficient to invest in building cutting-edge expertise in one area, only to let it run down shortly afterwards. ONS cannot afford to chase each topical question as it arises. Rather, it needs to adopt a strategic approach and identify areas that warrant a sustained commitment to build up expertise or the development of new regular statistical outputs.

Box 4.D: ONS Regional Statisticians

The Review of Statistics for Economic Policymaking in 2004 by Christopher Allsopp recommended a significant statistical presence in each English region, as a source of regional expertise and as a link to regional bodies.⁷

ONS Regional Statisticians were established in April 2007, with the initial funding provided by the Regional Development Agencies. However, only four years later funding for the Regional Development Agencies was withdrawn along with funding for the Regional Statisticians.³⁶ As a result the small locally-based teams of statisticians were stopped, except in London where the Greater London Authority maintained its funding.

Location

- 4.87** Responding to the Call for Evidence, many users argued that the weaknesses in ONS's analytical capability were linked to the relocation of functions previously based in London to Newport. This resulted in a significant loss of experienced staff, in particular the National Accounts coordination role. Box 4.E gives further details on the impact of the relocation. It is the judgement of this Review that the loss of statistical expertise which resulted from the relocation decision has had a significant – though not necessarily permanent – detrimental effect on the capability of ONS and the quality of its outputs over the past decade.

36 UKSA, (2011). 'Annual Report 2010/11'. Available [here](#).

Box 4.E: Relocation from London

The move out of London began in 2005-06. Over the following years, ONS presence in London fell to just 50 staff. Although some functions and staff moved to ONS's Titchfield site, economic statistics production was consolidated at the Newport site, which has steadily expanded as a result.

Chart 4.E: Headcount at ONS sites, 2004 to 2015



Source: Office for National Statistics

Prior to the relocation, in April 2005, ONS employed just over 1,000 staff in London. Over the course of the relocation, only 101 staff opted to move to either Newport or Titchfield, of whom seven were Senior Civil Servants. In other words, close to 90% of the London-based staff left ONS in just a few years, a far higher proportion than might be expected to depart under normal circumstances.

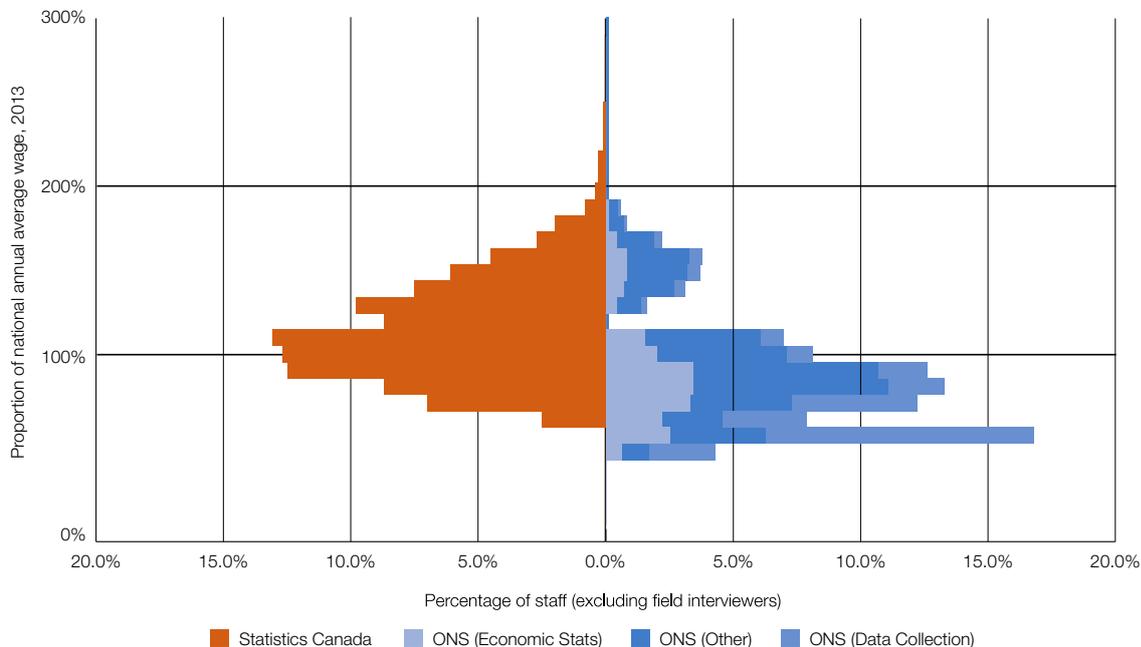
- 4.88** National accounts skills are highly specialised and, to a large degree, acquired on the job. It was unrealistic to expect that the loss of knowledge and experience could be replaced overnight. However, new recruits and less experienced staff will over time acquire the required skills and expertise. Having now brought the production of economic statistics together in Newport and begun to develop skills and experience there, it would make little sense to contemplate reversing the original move, as that would just be likely to create new transitional costs with the loss of staff who do not wish to relocate to London.
- 4.89** Moreover, because the production of economic statistics is so specialised, it is likely that wherever an NSI is located it will become a regional hub for statistics. Consequently, there is considerable potential for the current site to become the centre of a 'hot spot' in economic statistics and data-related professions. The next section looks at how ONS can increase its analytical capability. In doing so ONS should concentrate on building up the long-term capability of its Newport

site. That can be furthered by developing strong links with universities and government agencies in South Wales and the West of England, a theme that is explored further below.

Analytical capability

Workforce structure

- 4.90** As described above, ONS's present strengths and weaknesses reflect its history. Its structure, and associated skills and capabilities, are largely those of a traditional NSI, gathering data from an extensive survey operation and producing a standard set of statistics according to internationally-agreed templates. This model works well in a stable environment, but is less well-suited to the demands placed by a rapidly changing economy and where other sources of data are available. In particular, the workforce needs to be: agile in responding to the changing requirements of users; comfortable working with large administrative datasets; and have sufficient specialism to put ONS at the cutting edge. There are pockets within ONS where each of these capabilities exist, but they need to extend across the whole organisation.
- 4.91** The first of these drivers was outlined earlier in this chapter – that ONS needs to move beyond focusing largely on the production of statistics and instead use data and statistical expertise to help users answer their questions about the economy. Official statistics risk becoming increasingly marginalised if statistics producers cannot offer the insights demanded by policy makers and market commentators. Analytical expertise is needed to be able to respond effectively to users, and relates closely to each of the three ingredients of curiosity listed above – it is the *sine qua non* of a modern NSI.
- 4.92** The second driver – the need to embed the skills necessary to exploit administrative data sources – is discussed in more detail later. But it is clear that ONS lags several steps behind some other NSIs that have been heavy users of administrative data for a while. However, if the legal and other barriers can be removed, working with administrative datasets would become an integral part of the day-to-day operation of ONS, just as in many other NSIs. The structure, provenance and application of administrative data are different to those for survey data, and the tools and techniques in ONS teams will need to adjust accordingly.
- 4.93** These first two points affect the general skill levels of staff across the organisation. Chart 4.F below compares the distribution of salaries (a proxy for skills) for staff at ONS and Statistics Canada (relative to the respective average national wage levels). At present, ONS's workforce is heavily skewed towards relatively low-paid positions, consistent with the bulk of the workforce being occupied in non-specialised, process-orientated roles. By contrast, Statistics Canada, regarded as a leading NSI, has the bulk of its staff concentrated around the middle of the distribution, reflecting the higher proportion of staff with analytic and other more specialist skills. To become a high-performing NSI, ONS will need to shift its skill distribution up.

Chart 4.F: Staff by salary relative to national annual average wage, ONS and Statistics Canada

Source: Office for National Statistics, Statistics Canada, Organisation for Economic Co-operation and Development.

- 4.94** Third, to tackle established and emerging measurement challenges, such as those considered in Chapters 2 and 3, ONS needs people who can bring critical thinking and research skills to bear. That means moving beyond a focus on just getting the next statistical release out on time, and requires not only greater expertise to be available within the ONS but also more collaboration with experts outside.
- 4.95** The sections that follow look in more detail at each of these three aspects. First, analytical proficiency at entry-level and across the organisation. Second, the need for professional analysts, within the structure of the Civil Service professions. Finally, the development of deeper specialised knowledge, to provide leadership within the field of economic statistics and measurement and to facilitate collaboration with external experts.

Recruitment and training

- 4.96** As Chart 4.F suggests, professional economists, statisticians and other specialists, represent only a small proportion of ONS staff. Efforts to raise ONS's capability need to include the many staff occupied running surveys, chasing responses and processing results. The transition away from a 'factory' means changing how surveys are operated and data is collected – as ONS becomes less reliant on survey data sources, and makes greater use of administrative data, these functions will require fewer people, but with improved skills in analysis, technology and data science.

- 4.97** The changing nature of the organisation will need to be reflected in the recruitment and training of staff. The skills of new hires are particularly important, not only because they are the future workforce, but also because they can help to reinvigorate the organisation.
- 4.98** In Statistics Canada, the majority of staff belong to one of three groupings broadly covering economics and social sciences, statistics and computer-science. Recruitment programmes for the groups bring in between over 100 people each year and are structured much like the UK Civil Service Fast Stream. Entrants on these programmes join the organisation at a lower level and follow a series of learning activities and rotations in different positions, progressing up through a series of steps to a graduation level, subject to satisfactory performance.
- 4.99** The established gateway for recruiting most staff into ONS feeds directly into data-gathering roles within its survey operation. However, simply exposing new entrants to the traditional production process merely perpetuates the ‘factory’ model and does not really provide the skills needed to challenge and change those processes. In future, ONS should seek to bring in a greater proportion of its staff through the various Fast Stream programmes, or else set up a similar scheme of its own for graduates with analytical aptitude. A number of other institutions, such as HM Treasury and the Bank of England, run their own recruitment programmes which include in-house training to further develop analytical skills that are tailored to the organisation.
- 4.100** Regarding non-graduates, ONS is about to introduce an apprenticeship scheme in several key fields. The aim is to recruit 40-45 apprentices each year across a range of disciplines: statistics; data science; digital; commercial; and project management. Offering longer and more formal training programmes should give these new recruits a better foundation of analytical skills. If successful, these apprenticeships could become the principal route for non-graduates to enter the organisation.
- 4.101** As with in-service applications to the Civil Service Fast Stream, these opportunities should also be offered to existing staff. That would provide a further means to accelerate the required transformation in analytical skill base of the organisation.

Professional specialists

- 4.102** ONS will also need to have greater depth in several more specialised roles. There are a range of analytical professions in the Civil Service, including economics, statistics and social research, as well as increasingly important new disciplines such as data science. The scale of change required will no doubt also call for effective project management and digital skills too. As part of its efforts to embed an analytical culture throughout the organisation, ONS will need strong representation in all these professions.

- 4.103** In order to put ONS's present specialist capability in context, it is worth looking at the growth in the Government Economics Service and the Government Statistician Group.³⁷ The number of professional analysts in government as a whole has risen substantially since ONS was created and, although the comparison is not perfect, it provides a benchmark against which to measure the evolution of ONS analytical capability. Across the Civil Service, the headcount of both economists and statisticians has increased by over 150% since 1996 (see Table 4.D). Combined with a decrease in the overall size of the Civil Service over that period, that has meant statisticians and economists rose from filling approximately one in every 480 posts to one in every 150 posts.
- 4.104** Those two professions naturally should make up a much larger proportion of the workforce in an analytical organisation such as ONS than in the wider Civil Service. However, while the overall number of statisticians within ONS has also grown, it has not grown by the same rate as elsewhere. One should not necessarily conclude that this indicates a shortage of statistical expertise relative to other government departments. It may well be that a historical tendency of ONS to employ statisticians in a wide range of roles, such as project management, is giving way to greater specialisation.
- 4.105** It seems plausible that the increase in the number of economists across government departments represents greater appetite for economic analysis for policy and operational reasons. The number of economists at ONS has increased to over 40 in 2015 which represents a very high rate of increase, but from a very low base. However, ONS still has far fewer than many other departments such as HM Treasury or even the Ministry of Justice. It is also a long way behind other analytical institutions like the Bank of England or the OECD. It seems clear that ONS is not only much less dominant as a centre of statistical expertise than it once was, but that it is also lagging as a centre of economic expertise.

37 The Government Statistician Group is the professional statistician group within the Government Statistical Service.

Table 4.D: Statisticians and economists, for ONS and Civil Service in 1996 and 2015

Headcount	1996	2015
Civil Service	538,000	431,000
ONS	2,725 ^a	2,332 ^b
All economists	515	1,386
ONS economists	– ^c	41
All statisticians	595	1,535
ONS statisticians	172	210

Source: Public Sector Employment Statistics, Office for National Statistics, Government Economic Service and Government Statistical Service

a Figure in table excludes General Register Office staff; published Civil Service statistics give a headcount of 3,500 in 1996.

b Figure in table excludes field interviewers re-classified as Civil Servants in 2008; published Public Sector Employment Statistics give a headcount of 3,740 in 2015.

c No reliable data, on some estimates this could be as low as two. However, the Government Economics Service Directory for 1996 implies the number could be as high as ten.

- 4.106** Since the Interim Report, ONS has announced plans to increase the number of professional economists, including by embedding more of them within statistical production teams. This will bring together staff trained in economics with those with backgrounds in statistics and other fields to create multi-disciplinary teams for statistical production. This is a very welcome first step in augmenting the capability of production teams and encouraging them to be more self-critical; it may also yield some quick returns in moving to a smarter approach to quality assurance and a reduction in the frequency of unnecessary errors.
- 4.107** This is associated with the following recommendation:

Recommended Action 15: Increase the economic expertise within ONS and implement a smart and effective system for quality assurance and sense-checking across the production of all economic statistics.

Research and development

- 4.108** If it is to become a world-leading NSI, ONS must not only increase the number of professional staff but also deepen their expertise. As part of a wider and ongoing strategy to ensure economic statistics reflect the changing economy, ONS should undertake more research into measurement issues in economic statistics, particularly in collaboration with external experts. This could help ONS push forward the frontier of economic measurement by identifying where its statistics are failing to properly reflect economic phenomena and suggest ways forward. Since the Interim Report, ONS has announced the recruitment of its first 'ONS fellows'. That is a very welcome step in this direction.³⁸

38 ONS, (2016). 'First ONS Fellows announced'.

- 4.109** In tackling difficult measurement challenges, ONS should also collaborate with other NSIs, as the issues will typically be common. Working in concert with other leading NSIs not only represents a more efficient use of resources but also potentially helps in shaping the international statistical agenda.
- 4.110** The model proposed by this Review seeks to build a link between the teams within ONS responsible for the regular production of statistics and experts at the cutting-edge. Projects to improve methodology and measurement should be informed both by the practical experience of producers and by the conceptual insights provided by researchers. ONS should have some research capability of its own but it will also need to draw in expertise from outside. Fostering such partnerships not only advances knowledge but also represents a conduit for building expertise within the organisation.
- 4.111** The recommendation in Chapter 3 that ONS establish a centre of excellence in the measurement of the economy (Recommended Action 4) is a concrete embodiment of this idea. It would allow ONS to augment its own capability by drawing on expertise in academia and the broader research community. Although labelled as a centre, it is better to think of it as a partnership with one or more leading universities or a network connecting outside experts in academia and the private sector to a central hub attached to ONS. The precise structure would be for ONS to develop in conjunction with potential partners (possibly selected through open competition). The centre could also offer a base for secondees from other analytical institutions, such as the Bank of England and HM Treasury. Such a body, in various guises, was suggested by several respondents to the Call for Evidence.
- 4.112** The purpose of the centre would be to pursue a programme of research in the measurement of economic phenomena to inform the future development of better economic statistics. Led by a suitably high-profile and credible director, the centre would have freedom to pursue its research agenda but its broad work programme should be agreed with ONS executives and key users to ensure the most pressing issues are given appropriate priority. It should work openly and collaboratively, with close ties to the users and producers of economic statistics, domestically and internationally.

Managing capability

- 4.113** Review team discussions with staff below Senior Civil Service level at Newport highlighted that a lack of prospects for career progression could be hampering ONS's ability to recruit and retain staff. Similar concerns were raised by ONS members of the various Civil Service Fast Stream programmes. Staff surveys put employee engagement at ONS around the Civil Service average, when a small organisation with such a clear purpose could reasonably expect to be scoring higher.³⁴
- 4.114** Greater investment by ONS in its workforce will mean ONS has a correspondingly greater need to retain its staff. Some other NSIs have very low turnover rates, with many staff working entire careers within the organisation.

However, the interchange of staff with other departments and institutions – particularly inter-change with institutions who are big users of ONS economic statistics – has an important part to play in driving the cultural change within ONS. In addition, the decentralised structure of the UK statistical system and the number of other departments in South Wales provide many opportunities for staff to move around, learn and develop, and enrich the ONS workforce when they return.

- 4.115** Trying to cling on to the talent ONS attracts is not a long term-solution to ONS's capability needs. Instead it needs to make sure that leaving ONS does not mean leaving its community, whether people stay within the GSS or not. ONS must also ensure that it is an attractive place to work, at all stages in a career. The draw of an organisation that is best in its class, and offers unique opportunities to work with rich data on world-class analysis should not be underestimated.
- 4.116** Following other government departments, ONS is in the process of changing its pay structure to remove contractual progression and replace it with a more performance-based system. This needs to go hand in hand with improvements to performance management within ONS. There are many possible approaches to performance management. However, ONS has so far fallen short in its attempts to effectively identify high and low performers. To thrive, ONS needs to manage performance more actively, both at the top and the bottom of the scale. With such a fundamental transformation in the organisation needed it is vital that managers are able to hold meaningful conversations on performance and that the outcomes are acted upon.
- 4.117** To manage its workforce strategically, ONS also needs a good understanding of its present skill base, as well as its future requirements. It is somewhat surprising that ONS has hitherto not considered it worthwhile to collect such basic management information regarding its workforce. Remedying this will be a necessary first step now that ONS has started its own workforce transformation plans. This is not as simple as it may sound, analytical university courses increasingly have a strong programming component – now of critical relevance to ONS – and over a career in the organisation many people are likely to have gained experience with a plethora of systems and processes unrelated to their current post. Though mundane, building a detailed understanding of the skills at its disposal, and how they compare to the needs of today, let alone tomorrow, is a vital task.
- 4.118** The present structure of ONS offers a relatively narrow career pathway, with staff moving up the Civil Service ladder of increasing management responsibility. But not everyone is suited to a management role and some people can add more to the organisation by becoming leaders in their chosen specialism. ONS needs to offer rewarding career paths for such individuals too. Not only would the opportunity to progress through specialist career paths incentivise more staff to put their energy into innovative work, it could help to attract more good analytically-minded individuals to join ONS and to stay longer. It would also make it easier for people to split their careers between spells in the world of official

statistics and spells in other organisations and academia. Such flexible career paths are offered by the Bank of England and some NSIs, such as Statistics Norway.

- 4.119 This aim of building ONS workforce capability is therefore underpinned by the following recommendation:

Recommended Action 16: Introduce recruitment and training schemes to raise analytical skills across ONS, including offering opportunities for specialists to progress in their careers by contributing to research and development of value to the organisation.

Survey data sources

Current ONS use

- 4.120 At present, ONS relies on conducting regular surveys of businesses and households as the source of the bulk of its economic statistics. The activity is industrial in scale – ONS sent out more than one and a half million survey forms in 2014 – and consumes a quarter of ONS resources.
- 4.121 In the Review’s engagement with stakeholders, some argued that surveying was an expensive and outdated method of collecting data and could be greatly reduced in scale if more use were made of administrative data and similar information that was in principle already available. Others told the Review that the reporting burden surveys placed on businesses was a concern. But some users noted that administrative data was not always well-structured or did not provide sufficiently focused information, while a well-designed sample survey was a very powerful tool.

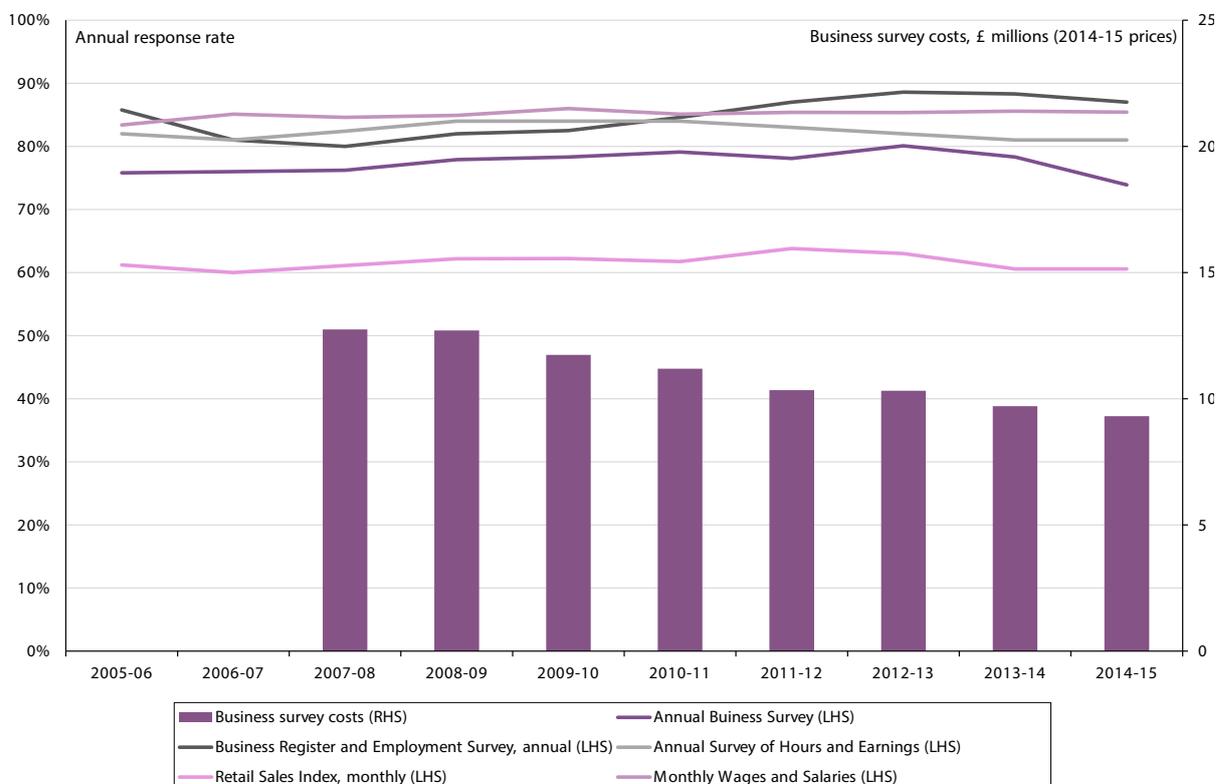
Business surveys

- 4.122 ONS conducts a total of 69 business surveys, sampling almost 350,000 businesses a year, over a third of whom will be contacted more than once.³⁹ Some surveys are very detailed while others are quite simple: for instance, the standard monthly business survey sent to many businesses contains only a single question on revenue.
- 4.123 Under the Statistics of Trade Act 1947 it is compulsory for businesses to complete these surveys, but there is still a cost to ONS in chasing and validating the raw data to meet deadlines. The volume of complete returns from businesses has been maintained by ONS at a stable level, despite savings being made in recent years (see Chart 4.G).

39 Online List of Government Statistical Surveys. Available [here](#).

4.124 Business surveys have been collected by ONS and its predecessors in Newport since 1969, so they are a well-understood and trusted data source. In addition, because large companies make up the bulk of economic activity, a comparatively small number of responses can produce reliable headline figures. ONS relies on this fact in constructing short-term estimates of activity, but unstructured data and the application of data science techniques have the potential to provide an alternative basis for early indicators.

Chart 4.G: Business survey costs (2007-08 to 2014-15) and response rates for five business surveys (2005 to 2014)



Source: Office for National Statistics

Response rates are for calendar years and business survey costs are for financial years

4.125 To reduce the burden on respondents and to cut costs, a well-designed survey asks the minimum number of questions of the smallest sample of respondents necessary to achieve a representative picture of the parent population. ONS is adept at this – the Annual Business Survey, one of the most complex, asks a ‘short form’ questionnaire of most businesses, and only requests further detail in a ‘long form’ version sent to a smaller number of the surveyed businesses, as set out in Table 4.E. However, the fact that the sample is only made up of a small proportion of businesses means that it lacks sufficient granularity if the sample needs to be stratified finely by size, industry or region.

Table 4.E: Annual Business Survey 2014 sample size, by questionnaire type

	Short form	Long form
Production and construction sectors	10,340	6,415
Service sector	28,958	17,177

Source: Office for National Statistics

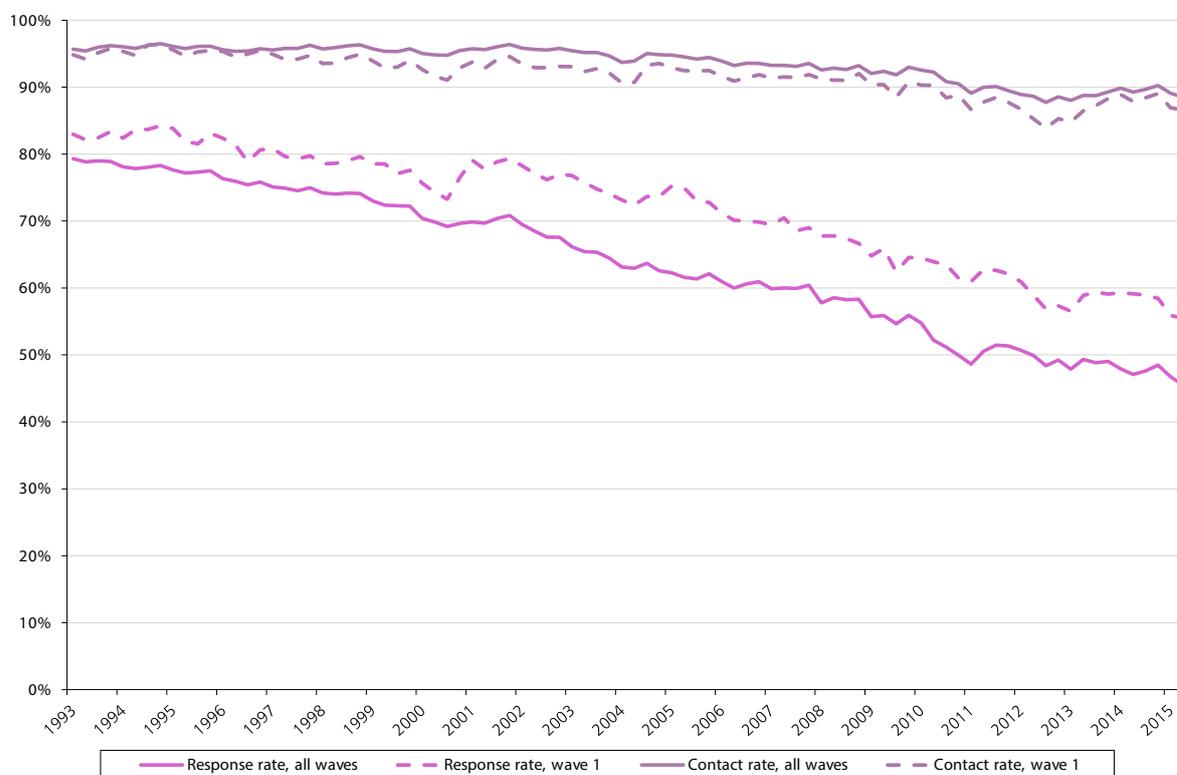
Household surveys

- 4.126** Unlike business surveys, surveys of households are voluntary (except for the census). When randomly-sampled respondents fail to complete the survey, either because they cannot be contacted or because they refuse to participate, it raises the likelihood that the respondents to the survey will be unrepresentative of the parent population. Lower response rates therefore indicate a greater risk of bias in the data collected, and response rates have generally declined steadily over the past two decades.
- 4.127** Declining response rates are not unique to the UK. A 2002 analysis of surveys in 16 countries showed that response rates have been declining internationally for a large variety of official household surveys.⁴⁰ ONS continually investigates the reasons for non-response and reports from interviewers indicate a widespread lack of public engagement with surveys – common reasons given include ‘can’t be bothered’ and ‘don’t believe in surveys’. This is an important issue for ONS and other NSIs. The effect of this issue is illustrated here by looking at two household surveys that play a central role in the production of UK economic statistics: the Labour Force Survey (LFS) and the Living Costs and Food Survey (LCF).

Labour Force Survey

- 4.128** The quarterly LFS is the largest of the ONS household surveys – ONS completes 36,000 interviews each quarter and the data collected underpins UK employment statistics. The survey design involves contacting each cohort of respondents five times in successive quarters to follow patterns in the labour market. The cost of LFS fieldwork has fallen slightly in recent years, from £6.5 million in 2007-08 to £6.3 million in 2013-14.

40 de Leeuw, E., and de Heer, W., (2002). ‘Trends in Household Survey Nonresponse: A Longitudinal and International Comparison,’ in Groves, R. et al. (eds.). Survey Nonresponse.

Chart 4.H: Labour Force Survey response and contact rates, 1993 to 2015

Source: Office for National Statistics

- 4.129** The census provides an opportunity each decade to examine the representativeness of the LFS sample and assess the impact of falling response rates (see Chart 4.H). A recent ONS study used data from the 2011 Census to evaluate the potential size of non-response bias and concluded that it was relatively small (although there were notable differences in response rates across ethnic groups).⁴¹ A subsequent NSQR, published in 2014, concluded that the LFS enabled the production of “good quality estimates” of labour market statistics.⁴² However, it noted that were response rates to continue to fall it would constitute a threat to the representativeness and quality of the data.
- 4.130** The NSQR also compared the LFS with international equivalents, which often have higher response rates. One factor clearly identified as affecting response rates was compulsory participation in some countries. However, the response rate of 62% for the UK was low even compared to European countries with voluntary surveys, where the average response rate was 74%. The report suggested that a number of factors may have contributed to this, including

41 ONS, (2013). ‘Non-response Weights for the UK Labour Force Survey? Results from the Census Non-response Link Study’. Available [here](#).

42 ONS, (2014). ‘Review of the Labour Force Survey’, p.8. Available [here](#).

stringent fieldwork rules and a lengthy questionnaire. For instance, the equivalent (voluntary) survey in Ireland, has a first interview that is one-third the length of the UK survey, and achieved a response rate of almost 80%.⁴³

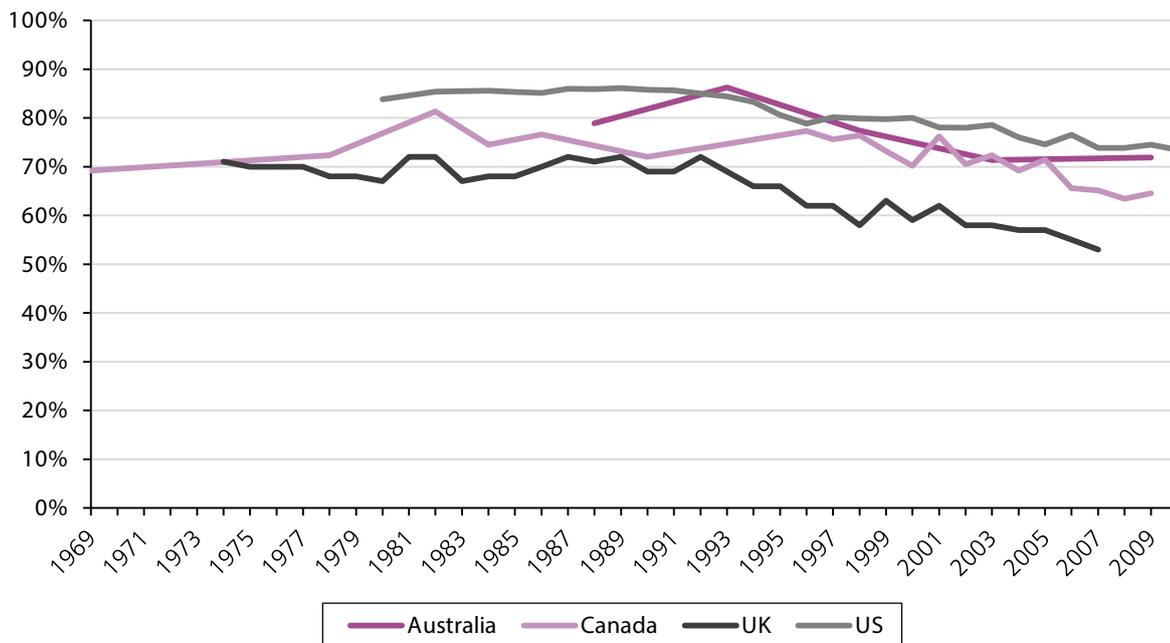
4.131 The NSQR noted that the LFS lacked a standing research and development team to identify areas of concern and opportunities for development. Faced with declining response rates and an array of potential drivers this is a clear example where curiosity should come to the fore. ONS needs to experiment to understand better the causes behind this problem and yield improvements. Moreover, getting the most out of the development of online surveys and administrative data will require a pioneering approach that can use all the tools at ONS’s disposal in combination.

Living Costs and Food Survey

4.132 The LCF is the UK’s principal data source on household consumption. Participants keep a diary in which each household member records their purchases over a fortnight. The data feed into the National Accounts as well as consumer price indices.

4.133 Paul Johnson, in his 2015 review of consumer price statistics, referred to the work of Barrett et al, which showed the long-term deterioration in aspects of data quality from the LCF as well as equivalent surveys overseas, including response rates (see Chart 4.I).⁴⁴ The most recent ONS figures for 2013 show that response rates have continued to decline. A NSQR of the LCF is underway and will be published shortly.

Chart 4.I: Household expenditure survey response rate, 1969 to 2010



Source: Office for National Statistics

43 2011 figures.

44 Barrett, G., Levell, P. and Milligan, K., (2012). ‘A comparison of micro and macro expenditure measures across countries using differing survey methods’. Paper prepared for “Conference on Improving the Measurement of Consumer Expenditures”. Available [here](#).

Surveying prices

- 4.134** Surveys of prices constitute another key data source. Information on producer prices are collected through surveys of businesses, as detailed earlier, and used to construct the Producer Price Indices. Perhaps of more interest, though, is the regular survey of retail prices that underlies the construction of the Consumer Prices Index. For the majority of components of the basket of consumer goods and services that enter the index, this involves the physical collection each month of specific prices at shops across the country. Around 110,000 price quotes, from around 140 locations, are collected by contracted price collectors visiting shops and other outlets. The collection of this information is contracted out, but subject to ONS quality control.
- 4.135** Although the quality of price data appears to have been maintained over time, the Johnson Review concluded that the collection method was outdated and could be improved upon. He identified three alternative sources: shop scanner data, web scraping, and consumer panel data. He concluded that ONS needed to exploit these sources better if it were to catch-up with international best practice.

Survey costs

- 4.136** Surveys are costly, both for ONS and for respondents. To elicit responses in household surveys, ONS employs a one-thousand strong field force interviewing people face-to-face and by telephone. Securing individuals' cooperation is a difficult and expensive process, but securing a reasonably high response rate and a representative sample are important if statistics are to be reliable.
- 4.137** Interviewing a first-time respondent to the LFS takes around 40 minutes, followed by somewhat shorter interviews in each of the following four quarters. Substantial effort goes to waste: broadly speaking, only three in five people agree to participate. On average, each complete LFS response costs ONS about £40. The LCF is an even more burdensome survey that absorbs about three hours of each respondents' time. Each complete LCF response costs ONS about £360.
- 4.138** Compulsory surveys of businesses are less costly for ONS and efficiencies have been made in recent years. But there are still costs associated with running the surveys and quality-assuring the data. In total ONS spent £9.6 million on collecting data from businesses in 2013-14.
- 4.139** Of course the surveys also place a burden on respondent businesses. ONS publishes estimates of these compliance costs for each business survey. The total cost to businesses of ONS surveys in 2013-14 was estimated to be £24 million.⁴⁵ But it is likely that this underestimates the total burden on business. For example, the calculation is based on the median cost to firms, which understates the much more significant burden reported by a minority of

45 ONS, (2015). 'Annual report on government statistical surveys for official statistics of businesses and local authorities: 2013/14'. Available [here](#).

businesses. In addition, much of the data behind the calculation is old or imputed. ONS have launched a study to provide more up-to-date information for three of the business surveys, albeit employing the same methodology. The Review team's engagement has focused on the use of statistics, rather than the experience of responding to surveys, but nevertheless businesses groups suggested that compliance costs are a non-negligible cost for some.

Future developments

- 4.140** Given the ubiquity of electronic data today, it is incongruous that the production of ONS economic statistics still relies so heavily on the posting of paper forms and knocking on doors. ONS is presently developing and trialling a system for online data collection, which should reduce costs and ease the burden on respondents. Moving surveys to an online platform will make it easier to flexibly adapt, shorten and combine them in response to changing needs for survey data.
- 4.141** Improved collection will not, however, address one of the more fundamental limitations of survey data, namely a limited ability to stratify the sample into more finely defined units (e.g. by industry or region) unless the sample is very large. The costs of producing sufficiently granular data to meet all future needs with traditional surveys would be prohibitively expensive. Furthermore, while the data collected might answer one question, it might lack the flexibility to answer novel, emerging questions as the structure of the economy changes.
- 4.142** The next section therefore explores the scope for greater exploitation of other sources of data – particularly, but not exclusively, administrative data – that has the potential to meet these needs. Greater use of alternative data sources may allow some surveys to be discontinued or reduced in size, thus reducing costs for both ONS and respondents. But it is important to stress that surveys will necessarily remain a central ingredient of ONS's operations. Instead, these alternative data sources constitute a presently under-utilised complement to surveys, whose exploitation would allow ONS to provide decision makers and the public with more accurate, timely and relevant economic statistics.

Administrative data and alternative data sources

Current ONS use

- 4.143** The term 'administrative data' refers to information obtained by a public or private sector organisation in the course of undertaking its normal operations, rather than with a view to its use for statistical purposes. The amount of administrative data has increased exponentially since the birth of modern statistical collection two centuries ago. John Rickman, the Director of the British Census at its inception in 1801, had to start the process of collecting data on baptisms, marriages and funerals from parishes to populate the first Census. In 1801 the services provided to citizens by the state, charities and businesses were fairly basic, with correspondingly rudimentary administrative data as a result. As the provision of services increased, so did the amount of administrative

data. But it was not until the 1980s that the potential for administrative data to be used for statistical purposes began to open up, largely as a function of rapid advances in IT.⁴⁶

- 4.144** ONS today has access to many tools and techniques for producing economic statistics that Rickman could not have even dreamt of. It is somewhat remarkable, therefore, how little use is made of such administrative data. But this problem is not new – the 1989 Pickford Review, for instance, recommended that greater use be made of administrative data, particularly information available to the tax authorities.
- 4.145** The 2007 Act was in part designed to facilitate increased access to departmental administrative microdata in order to support statistical production. Yet just two microdata sets have been shared with ONS for the purpose of statistics production under the Act's provisions. The first was VOA data, used in the construction of the House Price Index. The second was HMRC VAT data, whose potential is presently being explored. While ONS has access to aggregate administrative data, it only has very limited access to the microdata. The aggregated information is certainly useful, but it is the richness of the underlying microdata that really carries potential. This can be used to clarify the source of puzzles in the aggregate data and, through the use of linked data sets, allow a far more detailed perspective on economic developments.

International context

- 4.146** Many other NSIs make far more use of administrative and alternative data sources in the production of economic statistics than is the case in the UK. NSIs in Scandinavia and Canada, for instance, had already begun to embed tax microdata in statistical production in the 1980s and 1990s. In Canada, the use of microdata from tax returns allowed a 20% reduction in survey burden, cutting the costs of both processing the surveys as well as filling them in; Canadian businesses are estimated to have saved over CA\$600,000 a year in compliance costs as a result.⁴⁷ Statistics New Zealand has also been able to significantly trim sample sizes through the use of administrative data and achieved a 66% reduction in response burden between 2002 and 2015,⁴⁸ saving New Zealand businesses approximately 34,000 hours per year.
- 4.147** In Finland, 96% of input data in the production of statistics comes from administrative sources,⁴⁹ and in Sweden and Denmark national accounts production is based on the extensive use of such administrative data. Statistics

46 Struijs, P., Braaksma, B. and Daas, P. (2014). 'Official Statistics and Big Data', *Big Data and Society*. Available [here](#).

47 Statistics Canada, (2006). 'The Integrated Approach to Economic Surveys in Canada'. Available [here](#).

48 Stewart, J., Costa, V., Page, M. and Chen, C., (2012). 'Maximising the Use of Administrative Data in Sub-Annual Business Collections'. Available [here](#).

49 Jeskanen-Sundstrom, H., (2008). 'Overview and challenges in the use of administrative data in official statistics'.

Netherlands has access to public sector administrative data at negligible cost and is legally obliged to make best use of this information for the production of all its statistics. In practice this means it is only allowed to secure funding for and conduct new surveys if it can prove that the information is not available through administrative data sources.⁵⁰ By the same token, in Canada the expectation is that Statistics Canada will only use surveys where it cannot obtain the information from administrative data sources.

- 4.148** The use of tax data in the compilation of business statistics, which also feed into the national accounts is not the only example of innovative use of administrative data. The NSIs of Australia, the Netherlands, Norway, Sweden and Switzerland all make extensive use of scanner data, using actual data on prices and volumes collected by retailers. As the Johnson Review noted, the UK lags behind international best practice in this area too.

Barriers to the use of administrative data

- 4.149** Why has there been so little progress in the UK, despite the early identification of the possibilities of administrative data in the Pickford Review and the passage of the SRSA almost a decade ago? The countries that do make greater use of such data generally seem to have both more permissive legal environments – the NSIs in Canada, Ireland and across Scandinavia all have a right of full access to microdata held by government departments and businesses – and a greater ambition to exploit the opportunities from new data sources. A recent peer review of UK statistics concluded that, “The use of administrative microdata for statistical purposes is relatively limited in the UK, mainly due to cultural and legal obstacles.”⁵¹
- 4.150** In particular, there seem to be three obstacles to ONS making greater use of administrative data. Each individually limits progress, but taken together they constitute a significant barrier to the effective exploitation of such information in the production and interpretation of UK economic statistics:
- **Legislative framework.** If ONS wishes to access administrative microdata, the 2007 legislation requires it first to gain the consent of the public authority holding the data. To do so, it must set out how that microdata will be used and this access agreement must then be approved by Parliament in an Information Sharing Order (ISO). In practice, this process has proved to be cumbersome and protracted. Since 2007 only two ISOs have been passed, one allowing ONS to access micro VAT data from HMRC and the other VOA data on council tax. If legislation after 2007 creates new microdata, ONS may only have access to it if that is specified in that legislation – ISOs cannot be issued unless explicitly stated in the new legislation. Furthermore, because the legislative framework requires ONS to specify how the data will

50 Statistics Netherlands, (2015). ‘Annual Report for 2014’. Available [here](#).

51 Snorrason H., Byfuglien J. and Vihavainen H., (2015). ‘Peer Review Report on compliance with the Code of Practice and the coordination role of the National Statistical Institute: United Kingdom’. p.4. Available [here](#).

be used, it inhibits its exploratory investigation and feasibility work. Cases of bad execution – being too prescriptive in specifying how the microdata might be used in the early ISOs – have compounded these difficulties.⁵²

- **Reluctance to provide access.** The current legislation requires the data-holding department to be willing to grant access. However, there is often a natural resistance within Whitehall to making data freely accessible. Recent high-profile losses of data by data-holding departments, an aversion to risk, and the fact that the benefits of data sharing accrue not to the provider but to the recipient all make for excessive caution. It can often seem easier just to say ‘No’ rather than ‘Yes’.
- **Insufficient ambition in exploiting new data sources.** Although there are legal and cultural obstacles, ONS also appears to have been slow to grasp the opportunities presented by administrative and other alternative data sources, preferring instead to rely on trusted survey methods. The new ONS leadership team have, though, shown more appetite to exploit these new opportunities.

4.151 As the recent Peer Review of the UK statistical system concluded, “The Peer Reviewers are of the opinion that removing the current obstacles and allowing the use and linking of administrative data under proper governance and confidentiality arrangements would result in cost reductions, greatly improve operational efficiency and increase the supply of data and statistics.”⁵¹ Administrative data is not, however, a panacea. By its nature, it is the by-product of another activity that is not immutable. Services may change, altering the type of administrative data provided; in the private sector, entities can exit the market; and systems may change in ways that affect its usability in the statistical production process. In addition, administrative microdata may not always correspond exactly to the concept that the economist or statistician is interested in. For example, understanding the prevalence of zero-hours contracts is probably more easily achieved through an additional survey than through the use of administrative data.

Making better use of administrative data and alternative data a reality

4.152 Greater use of public and private administrative data has the potential to transform the provision of economic statistics in the long term. It cannot happen overnight, as it will take time to work out how best to exploit such information and to develop the necessary skills and systems. And the pace of change will obviously depend on the resources ONS allocate to developing that capacity. But progress in securing access will be absolutely critical.

4.153 Under the present framework, the onus is on the holder of public administrative microdata to decide whether or not to grant access. This framework should be significantly amended. A better framework would start from the presumption that, subject to appropriate measures being in place to preserve confidentiality,

⁵² ONS (2015), Response to UK Peer Review recommendations. Available [here](#).

data held by public authorities should be available to ONS for the purpose of producing statistics by default, unless there are very strong grounds in exceptional circumstances (e.g. national security) for that not to be so. The public may indeed already believe that this is what happens, but crucially, this would be a reversal of the burden of proof.

- 4.154** An example of the sort of legislation needed to underpin the access to administrative data is the Budget Responsibility and National Audit Act 2011, which gave the Office for Budget Responsibility (OBR) “a right of access (at any reasonable time) to all Government information which it may reasonably require for the purpose of the performance of its duty.” In order to ensure that access is not abused, an independent ombudsman (or similar) could be appointed to adjudicate difficult cases, for example to check that use is consonant with legislation, and more generally to ensure that the regime operates ethically.
- 4.155** Since the Interim Report called for better access to administrative data in early December, the Cabinet Office has published a consultation paper ‘Better Use of Data’ outlining some proposed draft legislation in this area.⁵³ The draft legislation represents a significant advance on the status quo, though it falls short of the ideal. It proposes that ONS be given the right to request access to private sector data from large to medium-sized enterprises for the purposes of statistical production. As far as government departments are concerned, it gives them a right to provide information to ONS if they are satisfied that is required by ONS to exercise its functions. But it does not compel them to provide it. In other words, the burden of proof still lies with ONS, rather than the department. This Review would prefer something closer to OBR’s right of access, or else departments can still drag their feet in providing data to ONS.

Box 4.F: Implications for the devolved administrations

Any changes to the current legal framework will also need to carefully consider the implications for official statistical producers in the devolved administrations. In their engagement with the Review, devolved administrations flagged concerns that ONS survey-based data sources which they currently have access to could in future be replaced by administrative data only accessible to ONS. Any future legislation will need to ensure that changes to the framework are not to the detriment of devolved administrations’ abilities to produce statistics. With increasingly more policies being set a devolved level, the need for devolved statistics will continue to grow.

- 4.156** Changing the current framework will not happen overnight. While the consultation is continuing and reforms to the current framework are under consideration, ONS should try to make the most of the existing legal framework, including seeking new ISOs where the gains appear substantial. Work is already underway with HMRC to develop two separate ISOs to allow access to Income Tax and Corporation Tax microdata.

⁵³ Cabinet Office, (2016). ‘Better use of data in government: consultation paper’. Available [here](#)

Recommended Action 10: Remove obstacles to the greater use of public sector administrative data for statistical purposes, including through changes to the associated legal framework, while ensuring appropriate ethical safeguards are in place and privacy is protected.

Future opportunities

4.157 As well as the administrative data held by the public sector, vast quantities of data are also generated every day by retailers, employers, payment processors, search engines and the like. According to an IBM study in 2012, some 2.5 billion gigabytes of data is created every day.⁵⁴ Though only a small fraction of this might be useful in the production of economic statistics, its exploitation could nevertheless be transformational.

4.158 One can envisage three ways such information could be employed:

- **Directly in the production process.** Such information could replace or complement existing survey information, thereby reducing survey costs, improving accuracy or increasing timeliness. For this to happen, ONS needs to be confident that the data source will continue to be available (this will not be the case for some private data sets in particular). It could also be used in 'nowcasting' data that is presently missing; in this case it might matter less if the information subsequently ceased to be available.
- **Indirect use in the production process.** Such information can also be helpful in sense-checking and cross-referencing statistical estimates. For instance, official data could be compared with information on internet searches for key words (such as 'unemployment benefit'); several central banks already use such approaches to derive real-time indicators of economic activity.
- **Agility and future-proofing.** Such information, when used creatively, can also offer a window on newly emerging trends in the economy, in advance of developing new, or adapting existing, surveys to measure them. It can also be employed in one-off studies into new or unaddressed issues. When used in this way, it is also clearly less important that the data continue to be available.

Data science capability

4.159 In addition to a less cumbersome legal framework, significant investment in both technology and staff will be needed to exploit the opportunities from administrative data and other sources of big data. Four aspects of data science capability will be needed if ONS is to unlock the potential of such very large data sets:

54 IBM. 'Demystifying Big Data: Decoding The Big Data Commission Report'. Available [here](#).

- **High-end technical expertise and multi-disciplinary skills** to store, access, anonymise, clean and link data, and keep up with constantly evolving technologies, techniques, quality treatments and algorithmic approaches.
- **Confidence and creativity** to explore new data sources and test techniques to improve economic statistics. This requires freedom from ‘handle-turning’. It should be both for application in regular production processes as well as in one-off studies, sense-checking and cross-referencing of statistical output.
- **Strong communication skills** to explain the benefits and limitations of new sources and approaches in a clear and transparent manner, to seek feedback from and promote exploratory work more effectively with users, including through greater use of data visualisation techniques.
- **Effective and targeted collaboration** with a wide range of relevant partners in academia, research institutes, private and public sector organisations, as well as internationally, in order to pool expertise for research and development, and to help attract and retain fresh data science talent.

4.160 The UKSA strategy ‘Better Statistics, Better Decisions’ explicitly recognises the need to build greater data science capability in ONS,⁵⁵ but only a few high-level actions were set out in its business plan, covering the period up to March 2018. Reflecting the difficulties of getting access, ONS lags behind many other data-driven organisations, including several other NSIs, in terms of its capability to exploit administrative and other big data sources. Access to HMRC VAT administrative data was secured in 2011, but ONS has made slow progress in scoping out the full potential of this data since. While good examples of exploratory data science work can be found, these have tended to be ad hoc projects and isolated, one-off experimental work, with limited prospects of being operationalised soon.

Technical expertise and multi-disciplinary skills in data science

4.161 To date, the most significant action by ONS has been the creation of an ‘Innovation Lab’ in late 2013, operating across Titchfield and Newport sites. This lab operates as a ‘sand pit’, allowing stand-alone experimentation with new techniques and for staff to gain experience, but is not set up to mainstream administrative data sources into statistical production processes. The lab is relatively small-scale with set-up costs of under £100,000.⁵⁶ It is mainly used by ONS’s Big Data team, established in 2014 largely from existing staff: of the eleven full-time statistical analysts only a couple are new recruits at graduate level, and the team also has a one-year placement student. Current staffing levels are comparable to those in the Bank of England’s data science lab of

55 “We will create a coherent and cutting edge cadre of analytical staff to blend statistical methods with data science, empowering people to achieve high professional standards throughout their career,” UKSA, (2015). ‘Better Statistics, Better Decisions: Strategy for UK statistics, 2015 to 2020’. p.10. Available [here](#).

56 Abbott, O., (2014), ‘ONS Methodology Working Paper Series 1: ONS Innovation Laboratories’. Available [here](#).

twelve FTE staff which it seeks to expand. But the Bank's team is more multi-disciplinary and somewhat more highly qualified, with staff recruited externally from a wider range of backgrounds.

Box 4.G: ONS Big Data Projects (January 2014 to March 2015):

In 2014 ONS launched the Big Data Project to investigate the potential advantages of using alternative data, and to understand the analytical and technological challenges.⁵⁷ The initial phase was restricted to pilots using data from social media applications, smart meters and internet price data. Most of these projects were funded by the Census directorate resulting in a strong focus on deriving meaningful geo-locational and socio-demographic information from the data.

The project with the biggest potential to be operationalised in the near future is ONS's web scraper. Web scrapers are software tools for extracting raw data from web pages, which can be stored and analysed. ONS's web scrapers collect prices for 35 items in the CPI basket from three leading UK supermarkets' websites. The web scrapers collect approximately 6,500 price quotes per day, which is a much larger collection of prices than gathered under the traditional approach. ONS produced experimental consumer prices indices using web scraped data from June 2014 to June 2015, and published its findings in September 2015. The research provided chained daily, weekly, fortnightly and monthly frequencies and included a fixed-base index which followed CPI methodology as closely as possible. However, the published web-scraped prices data contained an error and on 23 October 2015 ONS issued a correction.²⁰ An error had been identified in the chained daily index, illustrating the labour-intensive effort needed to monitor, clean and manipulate the collected raw data. In October 2015 ONS secured Eurostat funding to continue its web scraping work, which will be used to improve and expand the existing web scrapers to cover all grocery items from websites currently scraped and add additional supermarkets to the collection. Scrapers will also be built to cover other areas of the CPI basket such as package holidays and airfares. Development of better data cleaning techniques such as unsupervised and supervised machine-learning for the classification of products will also be funded.

4.162 Looking at the experience of other NSIs, one key insight is that the transition from a statistical production system largely based on surveys to one that is capable of making best use of administrative and other data sources takes time and requires a significant investment in skills and expertise. For example:

- Statistics Netherlands started exploratory work with alternative data sources in the early 2000s and is seeking to further increase its capability. At present it has a core data science team of five staff. But it also has a wider circle of approximately 80 staff in its research and innovation division able to apply

⁵⁷ Naylor, J., Swier, N., Williams S., Gask K.; and Berton, R., (2015). 'ONS Big Data Project Q1 Report'. Available [here](#).

data science techniques and mainstream approaches into the statistical production process. It is worth noting that even with this level of resource, it took the Netherlands five years to embed web scraping into their CPI.

- Statistics Sweden's staff have been working with administrative data sets across the organisation since the 1970s, in close collaboration with the NSI's IT department. It also maintains a small data science team dedicated to cutting-edge exploratory work but also functioning as a consultancy.
- The majority of Statistics Canada's staff are capable of sophisticated manipulation of large administrative datasets, and it maintains a team of twelve highly-specialised data scientists with cutting-edge skills in computer science and statistical analysis for exploratory work.

Box 4.H: Examples of applications of data science in other NSIs

The Review team have spoken to a number of NSIs to find out about their approaches to using alternative data sources and data science techniques for better statistical outputs.

Statistics Netherlands successfully re-designed its business register incorporating administrative tax data under an ambitious modernisation programme of its economic statistics during 2008-2011. It uses this information for its monthly and quarterly turn-over data and annual business statistics. Its pursuits of gaining free access to supermarkets' scanner data date back to 1992 and it first introduced scanner data from one leading supermarket chain into its CPI in 2002 and later expanded data access to five more supermarket chains in 2010.⁵⁸ Efforts are underway to expand the use of scanner data beyond supermarkets to department and DIY stores and progress experimental work to test the use of text mining and machine learning to retrieve item characteristics from product descriptions in order to match comparable items in the absence of detailed characteristics information.⁵⁹ Statistics Netherlands are also a true pioneer in the development of web scraping technologies: a pilot of daily web scraping of air ticket and fuel prices started back in 2009,⁶⁰ and in 2011 it tested web scraping of property websites to provide supplementary information on the Dutch housing market. In 2012 work started to develop an in-house web scraping 'robot tool' which will collect further retail prices information.⁶¹ Some elements of this work are now also fully embedded in the official CPI production process.

58 Zwijnenburg, J., (2011). 'Redesign of the system of economic statistics in the Netherlands', Statistics Netherlands.

59 De Haan, J., (2015). 'A Framework for Large Scale Use of Scanner Data in the Dutch CPI', Statistics Netherlands.

60 Hoekstra, R., Ten Bosch, O. and Hartevelde, F., (2010). 'Automated Data Collection from Web Sources for Official Statistics: First Experiences', Statistics Netherlands. Available [here](#).

61 Ten Bosch, O. and Windmeijer, D., (2014). 'On the use of internet robots for official statistics', Statistics Netherlands. Available [here](#).

Statistics New Zealand has a long history of using administrative tax data as well as public sector finance data from the New Zealand Treasury for its economic statistics outputs and has successfully operationalised the use of scanner data for its CPI. In 2006 Statistics New Zealand started using scanner data from a market research company to inform expenditure weights and sample selection. Since September 2014 it has been using monthly scanner data to measure the price change of 12 consumer electronic products, including televisions, computers and mobile phone handsets.⁶² Its indexes are free of chain drift, use all the information in the data, and reflect the implicit price movements of new and disappearing products. It is also exploring access to supermarket data for its food price index, and options for web scraping around electronic goods, travel and accommodation. More recently, Statistics New Zealand has started using financial transaction data from credit card companies as a direct input into its tourism satellite account.

Worldwide, only a handful of NSIs have implemented scanner data into their CPI. Apart from New Zealand and the Netherlands, Norway, Sweden and Switzerland have included scanner data, using different methods and practices. A number of European countries are investigating the use of web scraping for their price statistics. Apart from the Netherlands and the UK, Eurostat has supported projects in Germany, Italy, Luxembourg, Norway, Sweden, Austria,⁶³ Belgium, Finland and Slovenia.

- 4.164** There are many private-sector companies across the economy that are eagerly embracing the opportunities offered by the application of data science techniques to big data. For instance, Bloomberg L.P. told the Review team that their employment of data scientists, coders and engineers was in the thousands, drawn from a varied educational background, including mathematics, statistics, information technology but also physics, chemistry, neuroscience and biology. And PricewaterhouseCoopers plans to triple its existing pool of 500 data scientists over the next two years, reflecting increasing demand for advanced data-led insight into acquisitions and other investment decisions.⁶⁴

62 Krsinich, F., (July 2015). 'Implementation of consumer electronics scanner data in the New Zealand CPI', Statistics New Zealand. Available [here](#).

63 Boettcher, I., (2015). 'Automated data collection on the Internet (webscraping)', Statistics Austria. Available [here](#).

64 Agnew, H., (2016). 'PwC seeks more data analysts to analyse deals', Financial Times. Available [here](#).

4.164 In December 2015, ONS ran a survey across analytical and policy professions in the GSS,⁶⁵ asking participants to self-assess their current skills set. Encouragingly, the study found around half of the 290 respondents self-identified as data scientists, listing skills in structured data manipulation and visualisation, classical statistics, mathematics and science. However, the results also showed a conspicuous lack of expertise in working with unstructured data, big and distributed data, graphical models, back-end programming, systems and relational database administration.

Confidence and creativity in data science

4.165 Users have a big appetite for ONS and other producers of economic statistics to seize the challenge and embrace a more proactive and confident approach to different data sources and new techniques in the production of their statistical outputs. This came across in several responses to the Call for Evidence:

- HM Treasury said, “ONS is sometimes hesitant to experiment with new methods” and risk-averse “to share new data with its users or test new ways of working.”
- The Department for Communities and Local Government highlighted the benefits of “an innovative, exploratory and experimental approach to the delivery of economic statistics. [...] this would involve the application of data science techniques to glean data from real-time administrative and operational systems, social media, the web etc., with a view to producing a set of parallel, faster and more immediate outputs.”
- The Bank of England said, “The growth in data generated by activity in the modern economy is both a challenge and an opportunity.”
- Simon Briscoe said, “Big data seems not to be a topic that the ONS (or government more generally) has yet fully got to grips with. [...] A country’s National Statistical Institute should be at the cutting edge.”

4.166 While the limitations of survey data are well-known and the methodologies for mitigating problems relatively well-established, it must be recognised that the techniques to extract value from big data are relatively new and considerable care is needed in their application. The scope for biases is not always apparent and needs to be better understood in order to apply effective mitigation techniques. Alert sense-checking is required to spot inconsistencies and contradictions in the data, especially when linking data from different sources that will have been stored and quality assured in different ways. Big data is not a magic bullet.

4.167 Instead, a ‘hybrid/mixed data source’ model is called for, combining different types of big data with more targeted surveys. ONS will need to learn which are the most relevant data sources and disregard the less useful ones, applying a

65 Oates, B., (2016). ‘Surveying the Data Science Skills Landscape in UK Government’. Available [here](#).

critical analytical eye at all times. This was also reflected in some of the responses to the Call for Evidence. For instance, Professor JP Macintosh of University College, London said, “The fundamental issues in eliciting genuine information from Big Data is that of knowing which data to ignore – which could easily be over 99 per cent of the total available in any particular context. Filtering the data through the lens of economic theory is often a valuable step to take.”

- 4.168** Exploitation of administrative tax data is an obvious place to start in improving ONS’s statistics on economic activity. Private-sector financial transaction data could also be useful for Flow of Funds. But further development of ONS’s webscraper as well as text-mining techniques to extract more qualitative information, should also be pursued. ONS’s current exploration of text-mined data from property websites (Zoopla and Rightmove) has the potential to improve its understanding of the private rental market and could also be used within census or survey field operations or to enhance ONS’s address register.

Box 4.I: Examples of applications of data science in the UK

NESTA’s work on mapping the UK’s video gaming industry

This is an example of a creative approach used to shed light on a vibrant and growing sector of the economy, but also one that is traditionally poorly measured. Instead of relying on official industry (SIC) codes, NESTA scraped textual information from video gaming and review sites to build a list of games companies based in the UK. This enabled identification of the companies through their creative outputs rather than the box they tick in the business register. The approach enabled NESTA to construct a granular and timely data set currently not available from official sources. The analysis reinforced concerns about the poor coverage of the games industry by official SIC codes – the official size of the sector is only around one third of its size in NESTA’s analysis. An implication is that the sector is likely to be larger than previously thought, NESTA’s initial calculations suggest a value added of as much as £1.7 billion, double previous official estimates.⁶⁶

The Health and Safety Laboratory’s National Population Database

Another example of an organisation which has made innovative use of different data sources and new techniques in its field is the Health and Safety Laboratory (HSL). The HSL provides health and safety solutions to industry, government and professional bodies and the main focus of its work is on understanding and assessing risks to inform the Health and Safety Executive’s regulatory work. Over the past ten years, the HSL has developed a sophisticated National Population Database (NPD) that combines local and national information from providers like the Ordnance Survey with population information on specific locations to assess the risks to society of major hazard sites such as oil refineries, chemical works and gas holders. The NPD

66 Mateos Garcia, J. and Bakhshi, H., (2014). ‘Using big data to map the UK video games industry’. Available [here](#).

combines over 70 different private and public sector data sets (including administrative and survey data) and can be applied in a variety of other areas, for example agricultural regulatory intelligence work or to inform flood policy (in collaboration with the Environment Agency). HSL has strong links with Southampton and Manchester universities based on joint research projects.

Further examples are included in Box 2.D of this Report

Strong communication skills in data science

- 4.169** An innovative business model that draws on alternative data sources for the production of economic statistics will need to be underpinned by an effective communications and engagement strategy. ONS needs to explain the sources of its data and the techniques and treatments used in a clear and transparent way, accessible to all users.
- 4.170** The need for clear communication is equally important for ONS's experimental outputs and its one-off studies. ONS will need to strike a balance between promoting and show-casing its experimental work effectively, while being fully transparent about the uncertainties and limitations of the data sources and techniques employed so as to maintain trust and integrity.⁶⁷ This will mean engaging users much earlier in the process – at the initiation and development stages of exploratory work – to manage expectations pro-actively and stimulate an ongoing dialogue on techniques and methods.
- 4.171** Greater use of data visualisation techniques and interactive formats should help ONS to explain the granularity and limitations of its outputs and may also be a way to reach out to more users. As the number of data sources and the sheer volume of accessible data grows, so will the demand for data visualisation and infographics that help make sense of the data. Effective visualisation also engages users better and can encourage them to make comparisons for themselves.
- 4.172** The need for strong communication skills alongside technical data science capability is being increasingly recognised across the private and public sectors. Statistics Netherlands is specifically seeking data scientists with strong communication skills as part of the current expansion of its data science team. The need for strong soft skills – the ability to use data to tell compelling stories, communicate assumptions and limitations as well as work across disciplines – was also highlighted by companies participating in a recent joined study conducted by NESTA and the Royal Statistical Society on data science recruitment.⁶⁸

67 Bostic Jr, W., Jarmin, R. and Moyer, B., (2014). 'Modernizing Federal Economic Statistics', US Census Bureau and Bureau of Economic Analysis'. Available [here](#).

68 Bakhshi, H., Mateos-Garcia, J. and Whitby, A., (2014). 'Model Workers – How leading companies are recruiting and managing data talent'. Available [here](#).

Effective and targeted collaboration in data science

- 4.173** Work is underway in agencies across government to raise skills and recruit staff that are equipped to use data in innovative ways in order to gain new insights and deliver better policy outcomes. Through recent recruitment and training, it is estimated that there are around 100 data scientists across central government and this figure is continuing to grow.⁶⁹
- 4.174** ONS is actively participating in cross-departmental efforts to revise the capability framework for the statistical and analytical professions, which include data science skills. This is a collaborative effort, taking place under the Government Data Programme through the Data Leaders' Network and includes the Cabinet Office, the Government's Digital Service (GDS) and the Government's Office for Science. ONS is also working with some departments to negotiate joint access to private sector data. ONS should maintain these efforts, with the aim of establishing itself as the centre of expertise in data science and statistical research across Government.
- 4.175** As part of this, ONS's current collaboration with universities and research institutes should be significantly expanded. Engagement so far has tended to focus on Census-related work with universities in proximity to the Titchfield site, such as Southampton and Winchester, as well as University College, London. There is regular engagement with the Royal Statistical Society, the Royal Economic Society and the Economic and Social Research Council. There have been some attempts to build links with the newly established Alan Turing Institute. But more could be done to strengthen ties with academia – particularly around Newport. The region includes universities that offer a strong curriculum in data science, data engineering and related subjects, such as Cardiff, Bristol, Bath and Exeter. ONS should consider more placements for summer and sandwich students and bring in research students to work with staff on analytical problems in statistical services and policy delivery.

Creating a data science hub

- 4.176** There are good arguments for taking this even further by launching a dedicated new centre in Newport for the development and application of data science techniques (a 'data hub'). ONS is the ideal place for such a hub, for one excellent reason: it has the data (and lots more of it once access to administrative data is made easier). The data hub would serve as a focal point for the development of data science and data analysis techniques, bringing in collaborators from both academia and the private sector. It could also act a centre for the training of data scientists across the public sector. Such a data hub, by establishing ONS's reputation as a centre of excellence for data analysis, should also help the organisation to attract and retain high-quality staff.
- 4.177** Greater exploitation of administrative data and other sources of big data is therefore underpinned by the following recommended actions:

69 More information on the Cabinet Office's Data Science Accelerator Programme can be found [here](#).

Recommended Action 11: Exploit new methods for collecting data and explore the scope for using information gathered by private sector entities in the production of economic statistics, nowcasting and one-off studies of emerging measurement issues.

Recommended Action 13: Build ONS's capacity to clean, match and analyse very large datasets, including through the recruitment of a cadre of data scientists.

Recommended Action 14: Establish a new centre for the development and application of data-science techniques to the production of economic statistics.

Technology and data infrastructure

4.178 The previous sections noted the transformational opportunities from better exploitation of administrative and alternative data sources and the capability needed to fully embed approaches in the production of economic statistics. However, the full potential of the wealth of this information can only be realised with a robust technology estate and an agile data infrastructure. ONS's progress into a world-class service provider in the provision of economic statistics rests on the successful transformation of its hardware, applications and infrastructure.

Current state of ONS technology

4.179 ONS's current technology estate reflects its present focus on production and is in dire need of replacement. Different statistical outputs are produced in isolation and the supporting IT systems are poorly interconnected. There are hundreds of applications, on 25 different platforms. Many of these are outdated or bespoke and costly to maintain. This complexity of the technology estate has impeded improvements to the core statistical and analytical functions and has been a constant source of frustration for ONS staff. The Barker-Ridgeway Review noted that, "One of the pressures and strains on the staff that was evident [...] was the continued use of multiple systems." Review team discussions raised similar concerns.

4.180 The complexity of ONS systems has probably also been a contributory factor to some of the recent statistical errors and corrections. The internal ONS review into the 2014 error in the International Passenger Survey uncovered a wider range of issues with the systems for collecting and processing that data. The review found that researchers could not directly interrogate data in the processing system and checking routines had not been incorporated because they slowed processing to an unacceptable degree.

- 4.181** The legacy of a fragmented technology infrastructure and outdated systems is fundamentally contrary to this Review's vision of a flexible and agile NSI. ONS's technology infrastructure needs to be transformed if it is to get the best out of the data it collects now and the large volumes of administrative data it may have access to in the future. ONS's new senior leadership is determined to turn things around and has started to implement a technology transformation plan running up to 2020 through which it plans better to meet GDS standards and reduce the number of different platforms to fewer than ten. ONS is also proposing to build modular tools to acquire, process and publish data, using open source technology wherever possible.
- 4.182** These are important and much-needed developments. However, ONS historically has a poor track record in project delivery and must avoid repeating past mistakes, such as those that afflicted the Statistical Modernisation Programme, which sought to revolutionise the ONS technology estates in the 2000s. Looking back at that programme in 2009, Stephen Penneck, who was Director of Methodology at the time, concluded that ONS had lacked the core skills needed to deliver the modernisation programme – in project and programme management, in business analysis, in IT architecture, and in development and testing – reflecting a lack of investment in such skills over many years. He also noted a lack of accountability, an initial approach that had been far too ambitious, and poorly thought-through requirements.

Box 4.J: Progress on implementing Electronic Questionnaires

As part of its wider Electronic Data Collection programme, work in ONS is currently designing and prototyping a highly scalable electronic questionnaire (eQ) solution to support the design and execution of all surveys, including the Census. The initial scoping and discovery phase of the project was successfully completed in December 2015 and ONS are currently progressing to a Beta version.

Outcomes from the discovery phase confirmed the way forward for a generic tool to meet different survey requirements across ONS and that should scale easily, as well as allow for multiple languages to be used.

The approach taken in the discovery phase has been heavily informed by user research to understand the needs of respondents as well as front-line staff. This has been based on a variety of approaches including usability lab testing, observational research at contact centres and pop-up testing in local libraries. In trying to understand the needs of respondents to social surveys, the team have made sure to consider those with limited digital skills.

The Government Digital Service recently reviewed ONS's progress with design and implementation of the eQ. It concluded ONS was on track to deliver a tool in line with digital service standards. However, while the beta phase of the project is progressing well, ONS has already identified a need for an additional front end development resource at a cost of £150,000 to deliver at the required pace.

- 4.183** Given the criticality of the technology transformation programme and the historical backdrop of poor implementation, success of the current technology transformation programme will be absolutely fundamental. It can only be achieved by steady incremental progress supported by capability in depth and strong senior buy-in. ONS should also continue to work closely with GDS to ensure it draws on cross-departmental best practice.

Recommended Action 12: Ensure ONS's technology and data systems are capable of supporting the flexible exploitation of very large data sets.

ONS data infrastructure

- 4.184** Apart from a robust technology estate, ONS also requires a flexible data infrastructure that allows staff to clean data of duplicates and errors, and to compare and combine different data sources to fully exploit their analytical value. One area that forms a key part of statistical data infrastructure is registers. Traditionally registers have provided the framework for sample surveys and allow statisticians to estimate national totals. However, with the growth in administrative data they are needed to provide an interlocking framework across different sources of information.
- 4.185** Registers are essentially databases of specific, clearly defined entities – such as schools or hospitals – and need to be continuously kept accurate and up-to-date. In an ideal world, a register for a specific entity should be the only authoritative list when the data is used for different statistical, administrative or service-delivery purposes to avoid inconsistencies and duplications.
- 4.186** Currently, the most important register for economic statistics is the Inter-Departmental Business Register (IDBR), a register of businesses maintained by ONS for statistical purposes. Introduced in 1994, the IDBR brings together data from a range of sources including HMRC, Companies House and commercially-acquired data. The data are compared, cleaned and classified by ONS to provide a database of the population of businesses above a certain size. Estimates of the total business population are published by BIS. The register includes key information about businesses, including their size, location and classification. The register is used by ONS to apportion economic activity to sectors of the economy or to regions within the UK, making it vital for constructing regional statistics.
- 4.187** One of the challenges for digital services in government is the existence of duplicate, occasionally contradictory, data sets underpinning different services. For example, at present, several parts of government collect, manage and use data about businesses and do so on their own systems. This means businesses are subject to the burden of providing the same information multiple times in different formats as they interact with different service providers. Inevitably, each independently gathered set of records uses slightly different definitions. There is an urgent need to reconcile competing systems and establish authoritative sources for different records that all of government can use and trust.

- 4.188** Currently, the data on businesses in the UK is incomplete and of relatively poor quality; linking different data sources and formats usually requires statisticians to put in place complex matching processes. Clear definitions of what constitutes a business and a unique identifier for businesses that is fit for all administrative and statistical purposes across Government would bring great benefits to economic statistics as well as public service delivery and policy development more widely.
- 4.189** Led by BIS, work is currently underway to explore how government collects, uses and manages business data. The work is considering what could be done to link and reconcile different sources of information on businesses in one place, including proposals to establish common definitions, consistent core data and an appropriate list of variables.
- 4.190** The consistent use of unique identifiers in particular has the potential to simplify the process for statistical production by providing a straightforward framework to cross-reference and link large microdata sets. In addition, common variables embedded in the register – such as each business’s name, address, offices, branches, number of employees and size – would enable ONS to drill down into much greater detail for its analysis of economic activity in specific sectors or regions. This would make viable the use of administrative data in a greater range of outputs and analyses, in a more timely fashion than is currently possible.

Box 4.K: Business registers in other NSIs:

Many NSIs have a long tradition of using administrative registers in the production of their statistics. Norway and Sweden both established their business registers in the early 1960s, followed by Denmark in 1977 and Finland in 1975; they all started using their registers for the production of business statistics a few years later. In the Netherlands, the business register plays a central role in the system of business statistics. All companies, legal entities and other organisations that participate in the economy are registered in the Dutch Chamber of Commerce’s Business Register: it contains name and address of owners, officers, signatories and branches, as well as the number of employees.

The Australian Business Register was created in 1999 to reduce the administrative costs to businesses and government. Business operators can register for an Australian Business Number and register for goods and services tax. Annual returns were abolished in 2003. Government agencies, including the statistics office, can download bulk non-public data through a special platform to minimise direct data collection. New Zealand has a companies register which enables companies to be registered and file information such as addresses and the details of directors using one login portal. This reduces the manual data entry costs with a savings target of approximately £1 million per annum.

Dissemination of ONS statistics

4.191 This section looks at how ONS makes its outputs available to users. As the House of Commons Library pointed out in response to the Review’s Call for Evidence: “Statistics are only valuable if used.” The first half of the section looks at the publication of regular ONS releases, while the second half looks at how access is provided for researchers to the underlying microdata.

The ONS website

4.192 The ONS website is the principal channel through which users access ONS economic statistics. A clear, user-friendly website is therefore a pre-requisite for an effectively functioning ONS. Yet for several years, the ONS website has been the subject of widespread criticism and ridicule. There have been several unsuccessful attempts to rectify this, until a totally new website came on line on 25 February, just as this Report was being finalised.

4.193 Having been re-launched towards the end of August 2011, the old website had been live for less than a month before ONS issued its first statement apologising to users for its performance. It transpired these were not teething problems. Criticism of the poor accessibility of statistics online continued to dog ONS for years to come. The website was, for example, raised on numerous occasions during the last parliament by the (as was) Public Administration Select Committee. Following their 2013 inquiry,⁷⁰ the respected economics commentator and author Tim Harford branded the website “a national embarrassment” in the Financial Times.⁷¹

4.194 More recently, in response to this Review’s Call for Evidence, while some respondents acknowledged that a new website was being developed, comments on the old site were scathing:

- Professor Diane Coyle said, “The website is almost unusable [...] It is a producer-oriented site really only navigable by people who know how the old paper publications used to be structured.”
- The Welsh Government said, “The ONS web-site is widely recognised as a major weakness and should be a priority for improvement.”
- The Confederation of British Industry (CBI) said, “The website does an exceedingly poor job at ordering the extensive amount of work undertaken by ONS and facilitating easy access to information... the search engine is exceptionally poor and access to data been rendered exceedingly complex.”

70 Public Administration Select Committee, (2013). ‘Communicating and publishing statistics’. Available [here](#).

71 Harford, T., (2013). ‘A statistical needle in a bureaucratic haystack’, Financial Times. Available [here](#).

- 4.195** The final straw for the existing website came after a catastrophic failure in early 2014, the result of introducing improvements to the site's taxonomy. Though ONS deserves some credit for its handling of the crisis including through social media, it led to the commissioning of a review by experts from an external company – Thoughtworks – who identified wider issues with the website and digital capability at ONS.⁷² The instability of the web platform and consequent risks of any further improvement work meant that all future development was scaled back to business critical updates only.

The new website

- 4.196** Accepting that the old website had “never really delivered on user expectations”,⁷³ in mid-2014 ONS embarked on a first prototyping phase, or alpha, for a new website. In the period since, the team behind the new website has brought in external technical experts and worked closely with the Government Digital Service (GDS) to deliver numerous iterations of the new site, including a public ‘beta’ prototype launched in July 2015. User feedback has played a crucial role in the development of the new site, both via openly gathered feedback and through a user-testing lab in Newport.
- 4.197** Prior to going live, the programme to develop the website has undergone regular reviews and been assessed against the GDS Digital by Default Service Standard.⁷⁴ In their very positive assessment, the GDS panel acknowledged several aspects of the ONS team's achievement, including their agile approach, their use of user research and their groundwork for iteratively developing the website further. In the context of past ONS technology projects, and the previous website in particular, these are all very welcome findings.
- 4.198** Crucially, the ONS website is now designed to be usable on mobile devices too. Key features of the new site include a customisable visualisation tool that permits over 35,000 time series to be easily plotted. It is also set up to allow other tools and applications straightforward access to the underlying data in a structured, machine-readable format.
- 4.199** It is too soon to make a fully-informed judgement on the new website. But initial reactions have been extremely positive. Will Moy, Director of Full Fact, welcomed the news as a “liberation”, the organisation having previously stated that “the overall experience of finding statistics is one of frustration.”⁷⁵ The leader of this Review certainly found the layout intuitive and very user-friendly, and the data exceptionally easy to locate, visualise and download.

72 UKSA, (2014). Papers from UK Statistics Authority meeting on 01 May 2014'. Available [here](#).

73 ONS Digital Blog, (2014). 'Now Generation website – presentation to staff' Available [here](#).

74 ONS Digital Blog, (2015). 'Result of service assessment'. Available [here](#).

75 Public Administration Select Committee, (2013). 'Communicating and Publishing Statistics: Written evidence submitted by Full Fact'. Available [here](#).

- 4.200** ONS is clear that development of the site will continue, with the aim of having the kind of functionality that is available on the US Federal Reserve Economic Data (FRED) website, generally being regarded as best-in-class. ONS also has plans to trial mapping technologies. At present, some ONS products are still published on different websites, including its neighbourhood statistics and labour market statistics sites. Consolidating these onto the new website represents an obvious improvement. However, the key driver of the next stages of development for the website should be feedback from users.

Recommended Action 9: ONS should continue to develop its new and greatly improved website in order to ensure that its full range of statistics can be easily accessed and viewed.

Release practices

- 4.201** ONS publishes an array of statistical outputs that represent the application of successive degrees of analysis and processing from the raw data. At one end of the spectrum, releases include initial outputs from a single survey, whereas complex releases like the National Accounts represent the combination and confrontation of a wealth of different data sources. After yet further interrogation, ONS often publishes analytical articles such as its monthly Economic Review which aims to offer additional insight into the economy from the available data.
- 4.202** With the presentation of any statistics there are clearly trade-offs to be made in meeting the needs of different users, some of whom will be experts and others more casual users, each with individual interests and questions. Not satisfied with headline statistics, there is a legitimate demand from many users to dig down into the data more closely. In responding to the Call for Evidence a number of users expressed the need to be able to understand the distributional or geographical aspects of data. The London Mathematical Laboratory argued, “Having only aggregate measures available [was] to the detriment of informed policymaking.”
- 4.203** The introduction of a new website provides an opportunity for ONS to fundamentally change the kinds of products it offers. There is no longer a need for releases of statistics to be built around a traditional bulletin, designed to be consumed page-by-page. ONS has already consulted in December 2015 (as part of a series of efficiencies) to replace some single source statistical bulletins with key bullets or shorter summary bulletins alongside the data tables and metadata.⁷⁶ ONS should go further and seize this opportunity to help users clearly understand statistics, including through the increased use of data visualisations to tell the story in a more accessible way.

⁷⁶ ONS, (2015). ‘Consultation on Changes to ONS Products 2015’. Available [here](#).

Access to microdata

- 4.204** Microdata is the set of individual observations that underlie official statistics. There is an increasing demand for this data, with researchers seeking to combine data from a diverse range of sources for better measurement and insight into puzzles within aggregate data.
- 4.205** Making microdata available to users outside of government (including academics, researchers, businesses, civil society and individuals), subject to appropriately stringent data confidentiality safeguards, could help foster greater collaboration between ONS and experts, and shine a collective light on how the economy is changing. It “can stimulate business, innovation, provide transparency and accountability... and improve data quality.”⁷⁷ This is a view that has been echoed by the UN Statistics Division and a number of respondents to the Call for Evidence.⁷⁸

Current ONS approach

- 4.206** Research Data Centres (RDCs) allow researchers to access sensitive but de-identified data. The Virtual Microdata Laboratory (VML) is one such facility run by ONS, where researchers can access de-identified microdata for statistical research purposes. Researchers are provided access to requested datasets in a secure environment and VML staff must approve any results that researchers wish to use publically. The secure environments are currently located in London, Titchfield, Newport, Glasgow and Belfast.
- 4.207** The VML facility allows access to ONS microdata alongside some data from other government departments. Access to data is provided through the Approved Researcher Scheme, a legal gateway provided through the 2007 Act. There are currently more than 200 active projects involving more than 300 researchers, including from the Bank of England, BIS and academia. To be granted Approved Researcher status requires that the researcher has appropriate knowledge and experience to handle potentially disclosive information and the project is deemed to deliver a public benefit.⁷⁹
- 4.208** Approved Researcher status is project, person and time specific. ONS ran a public consultation in early 2015 regarding the criteria, process and safeguards used in this scheme, which identified that the current scheme no longer fully met the needs of the research community. The consultation found that 80% of respondents wanted ‘on-going’ access to datasets for an agreed time, as reapplying for access to the same data every quarter or year is a significant burden.⁸⁰ Moreover, there was a need to clarify the definition of a ‘public good’ that needs to be satisfied for a project to be approved. Many respondents felt

77 Science and Technology Committee, (2016). ‘The big data dilemma’. Available [here](#).

78 UN Statistics Division, (2014). ‘Microdata dissemination best practises’. Available [here](#).

79 ONS. ‘Virtual Microdata Laboratory’. Available [here](#). This also contains information on what is deemed to deliver a public benefit.

80 ONS, (2015). ‘Consultation on the Approved Researcher scheme’. Available [here](#).

that the current criteria are too narrow and this was a view that was corroborated by this Review. ONS is currently finalising improvements and plan to launch the improved scheme in mid-2016.

Box 4.L: Administrative Data Research Network, (ADRN)

The Administrative Data Research Network was established by the Economic and Social Research Council as part of its Big Data Network is a “UK-wide partnership between universities, Government departments and agencies, national statistics authorities, the third-sector, funders and researchers.”⁸¹ It provides administrative data to researchers wishing to carry out social and economic research which “has the potential to benefit society.”⁸²

For researchers to access the data, they must go through a separate process, which requires the support of an approvals panel. After approval, the ADRN undertake negotiations with data custodians on behalf of the researcher and will provide access to the data via research centres. Research centres in England include the VML and secure environments in universities.

The ADRN is not a data repository as current protocol requires ADRN staff to securely delete the de-identified data once it has been sent to the researcher. The ADRN also allows linking of data, subject to the approval of the data owner and the data linkage is carried out using a trusted third party model, where the trusted third party facilitates the secure matching of the data. This allows for the research data and the identifying personal information, such as names and addresses to be kept separate throughout.

However, the Review found that widespread use of the ADRN has been limited due to the cumbersome processes to access data from government departments.

Lessons from other microdata access facilities

4.209 Table 4.F compares ONS’s VML with the HMRC data lab and microdata access facilities in Canada and New Zealand. All three operate in a similar manner to the VML, in requiring researchers and projects to be approved prior to allowing access to data in a secure research environment.

81 ESRC. ‘Big Data Network Phase 1 – Administrative Data Research Network’. Available [here](#).

82 Administrative Data Research Network. ‘Application process’. Available [here](#).

Table 4.F – Comparison of microdata access using VML, HMRC data lab and facilities in Canada and New Zealand

	ONS VML	HMRC Datalab	New Zealand	Canada
What data is available?	ONS data include social and business surveys, census and longitudinal study. There is also selected BIS and other government department data.	HMRC Datalab is not a data repository and data is not stored. HMRC microdata is made available if projects are approved and if clearance is given from the data guardian. ⁸³	Access to survey microdata, synthetic data and an integrated data infrastructure (IDI) is provided. ⁸⁴ IDI is a linked longitudinal data set comprising of data from different source agencies.	Access to survey and administrative microdata is provided through a range of options, which include direct access at RDCs and remote access through Real Time Remote Access (RTRA) system.
Key project approval requirement	The project must deliver a public benefit, as defined by the Approved Researcher scheme and assessed by the ONS Microdata Release Panel. Each project must also be approved by data owner and researcher must be accredited via the Approved Researcher scheme.	The project needs to fulfil a HMRC function which involve areas that overlap with HMRC's work such as understanding customers, compliance and policy making or analysis.	The project must serve a public good and access is only provided if the 'five safes' framework criteria is met. ⁸⁵	Projects requiring direct access need to be approved by the agency for feasibility and to ensure that there is no conflict of interest. Arrangements to have access to the RTRA portal are made at the institutional level. Researchers, affiliated with the licensed institution, must sign a contract agreeing to follow the terms and conditions of use. These projects are not subject to a review process.
Training	✓ Standard training to access either facility	✓	✓	✓
Access mechanism	Direct VML access provided through 5 secure locations: Belfast, Glasgow, London, Newport and Titchfield. Government departments can remotely access the VML via a secure connection.	HMRC secure environment in Bush House, London.	Direct access provided through a secure virtual private network. There is a Data lab in each of the 3 Statistics NZ offices as well as 13 remote Data labs in approved agencies and universities across the country.	Direct access to social survey data through secure RDCs across country. Economic data can only be accessed within the Statistics Canada site in Ottawa. Remote access is available where researchers do not see the data but can submit queries to Statistics Canada and aggregate tables will be sent back to researcher. ⁸⁶
Cost	*	*	Charges for creation of non-standard data sets and disclosure checks.	Charges depend on the time needed to access the facility, creation of non-standard data sets and disclosure checks. ⁸⁷
Time taken to access data	In practice, requests are reviewed 1–4 weeks from application. Some applications can take longer if further discussions are required.	Up to 3 months from sending in an application to accessing the data in the data lab.	Approval is granted within 2 weeks.	Academic researcher: On average 2 months (social data) and 4 months (business data) from sending in project proposal to accessing data in secure environment. Government researcher: On average 10 weeks from sending in project proposal to accessing data in secure environment.

83 Approval is subject to the 'Commissioners for Revenues and Customs Act 2005' which also defines a HMRC function. Available [here](#).

84 Statistics New Zealand. 'Access our microdata'. Available [here](#).

85 Statistics New Zealand. 'Microdata access protocols'. Available [here](#).

86 Statistics Canada. 'Real time remote access system'. Available [here](#).

87 Statistics Canada. 'Pricing Policy'. Available [here](#).

Need for consistent data access requirements

- 4.210** Currently, ONS does not have the authority to permit access to microdata it has received from other departments without their explicit permission. Within the VML, any data that a researcher wishes to access needs the approval of the data owner, which may be a team within ONS or another government department. There is also no consistency between ONS and other public bodies on the requirements to access microdata. For example, legislation requires access to ONS data must deliver a public good, whereas to access HMRC data, a researcher needs to serve a HMRC function.
- 4.211** This may be an area where ONS could learn from the approach of Statistics New Zealand. The UK has a largely decentralised landscape for accessing microdata, with many departments having their own data labs giving access to departmental datasets. The VML is a dissemination point for mainly ONS data and limited data from other departments. As stated in Table 4.F, the integrated data infrastructure produced by Statistics New Zealand allows a researcher to access a wealth of data in a single location. It is arguable that this is the sort of arrangement the UK should be moving towards, with the VML being best placed to achieve this as the infrastructure is largely already there.
- 4.212** The requirement to seek approval for every research project is a frustration felt by many users of the VML. In this instance, a similar approach to that of Statistics Canada could be utilised. A Memorandum of Understanding (MoU) could allow trusted organisations, such as academic research institutions or other government departments, to vouch for research projects and the persons who will be accessing the data, subject to appropriate safeguards being in place which are reviewed regularly. It would allow a move away from the current process that is project, time and person specific towards a licence to access the data for trusted institutions.

Communication

- 4.213** Statistics New Zealand have a dedicated website which shows past and current projects and what datasets have been used for them.⁸⁸ Case studies are also presented, showcasing where research project outcomes have been used within government departments and in academia. This is something that ONS should be doing and can promote knowledge sharing both within the organisation and beyond, while improving the methodology of the statistics produced.

Usability of microdata

- 4.214** Users of the VML, such as the Bank of England and Institute for Fiscal Studies, told the Review that there were often significant issues regarding the usability of the microdata that is available. This has led to some researchers needing to spend months cleaning the data prior to using it for research. A lack of documentation and clear labelling of the contents of the data set, naming of variables, history regarding series breaks, etc, is also quite common.

⁸⁸ Statistics New Zealand. 'Microdata research'. Available [here](#).

Discussions with the VML team suggest that ONS is moving to improve matters. An increase in the use of administrative data sources, however, will make the need for high standards here even more important.

Box 4.M: Case study of further use of research projects conducted within the VML

Alongside publishing results for academia, research within the VML has been used internally within ONS, an example of this was the recreation of the Annual Respondents Database (ARD) by Academic experts from the University of West England.

Prior to 2008, ONS and its predecessors produced a composite dataset, the ARD, using various data sources dating back to 1973. The resulting dataset had a consistent structure over time and was a key data source for researchers in ONS, other government department and academia. This dataset was discontinued when the Annual Business Inquiry (ABI) was replaced with the Annual Business Survey (ABS), due to structural differences between these surveys, a loss of key staff and limited resources within ONS.

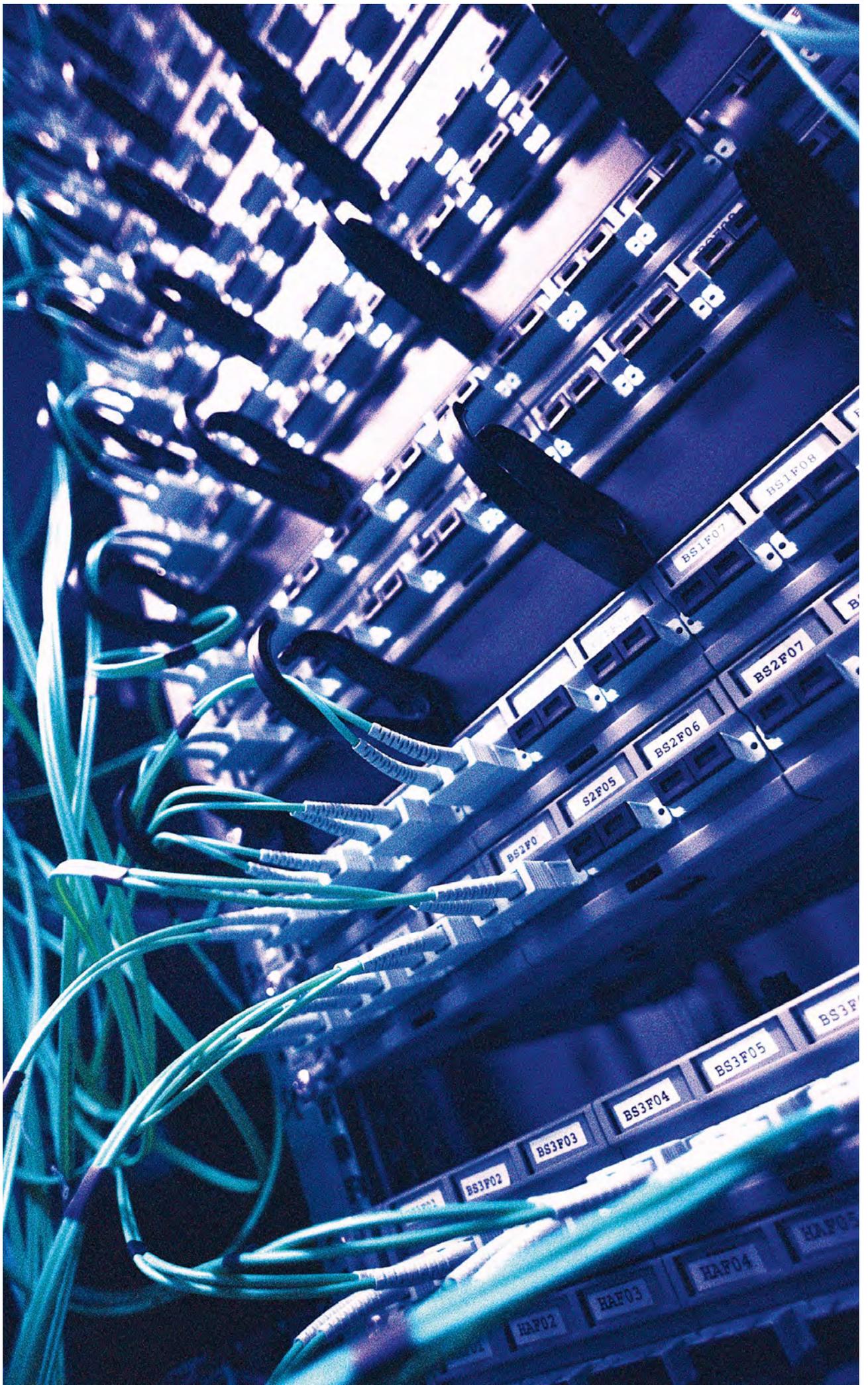
In 2015, discussions with users within and outside ONS identified this as a dataset that could be of considerable value in analysing and understanding productivity, if it could be recreated using the ABS data from 2008 onwards. To meet this need, the VML team commissioned experts to undertake this project, as ONS staff did not have the expertise or knowledge of historical ARD data to do so, and the updated ARD was completed in autumn 2015.

The new dataset is being used for research projects within the VML. Senior economists within ONS have now commissioned a further academic project to build on this data-set, adding a range of new information, including capital stocks, foreign ownership flags and export status of businesses. This project will be completed in spring 2016, and the new data set will be made available through the VML to all researchers undertaking projects to investigate productivity.

- 4.215** The VML facility, as a microdata dissemination point, is an example of good practice and a model which is being imitated in other countries. The ultimate aim of the VML and similar facilities used by researchers, within government and otherwise, should be to provide access to the underlying data in order to allow official statistics and the methodology used to create them to be challenged, validated or critiqued. This is a necessity for an NSI that aims to be open and transparent. Transparency exposes it to criticism and challenge and it is important that ONS is open to this. The best way to engender trust in ONS's statistics is to enable researchers to work from the same data to try to replicate and improve ONS's findings. This has to be seen as an opportunity to learn, improve methodologies and reach consensus among experts.

4.216 To that end, the Review recommends:

Recommended Action 17: Support the greater use of microdata by ONS and approved researchers by improving the available metadata, and simplifying approval processes, while continuing to respect confidentiality issues.



Chapter 5: Governance

- 5.1** This Chapter considers whether the current governance framework is effective in supporting the production of high-quality economic statistics. It is split into six sections, covering: the background to the current governance arrangements; the independence of the statistical system; ensuring high-quality economic statistics that meet users' needs; effective prioritisation to tackle emerging and existing issues; the effectiveness of the UKSA Board; and oversight of UKSA. The Chapter incorporates several recommendations for improvement.
- 5.2** Briefly, the 2007 legislation establishing the present framework was focussed on safeguarding the independence of the production of official statistics in what is, comparatively speaking, a fragmentary statistical system. And, for the most part, it has met that objective. That is because the focus in UKSA's early years was understandably on ensuring trustworthiness in the production of statistics.
- 5.3** Since 2014 steps have been taken to broaden attention to aspects of quality. But the UKSA Board and regulatory function could have paid more attention to ensuring that economic (and other) official statistics are of the highest quality in the broadest sense of not only being accurate and coherent but also relevant to user needs. For a variety of reasons, ONS's quality assurance processes have proved less effective than users might expect. And while the UKSA Board has intervened when there have been significant errors in published statistics, it could have been more proactive in generating pre-emptive action. In part, a lack of relevant, timely and digestible information is to blame, but ineffective engagement with users and key stakeholders is also an issue.
- 5.4** In order to disentangle symptoms from causes and gain a better understanding of the underlying issues, the Review team has drawn on a substantial body of evidence. In addition to user views, including from the Call for Evidence, and the evidence on statistical limitations and ONS effectiveness underpinning Chapters 2, 3 and 4, the Review team has also had access to a large body of ONS and UKSA papers. In addition, the team has met with: over 60 producers of economic statistics at middle and senior civil servant level in both ONS and departments; more than 20 ONS officials responsible for central functions such as finance, performance monitoring, risk evaluation and supporting the UKSA Board; every statistics Head of Profession (HoP) in departments producing economic statistics; attended an UKSA Board meeting; and conducted a small survey of 36 users and 35 producers of statistics to supplement the evidence gathered through meetings. This would not have been possible without the full support and openness of departments, ONS and UKSA.

Background to the current governance arrangements

- 5.5** Statistics need to be seen to be produced without political interference if users are to place weight on them. At the time the present governance arrangements were conceived, such confidence in the trustworthiness of official statistics was somewhat lacking. The primary aim of the 2007 Statistics and Registration Service Act ('the Act') was thus to restore public confidence in the official statistical system.
- 5.6** To that end, the Act established UKSA as an independent, non-ministerial department, charged with promoting and safeguarding the production and publication of official statistics that serve the public good, with ONS operating as its executive office.¹ UKSA has two main roles:
- Oversight of ONS, and the work of the wider Government Statistical Service;
 - Independent monitoring and assessment of *all* UK official statistics.

While the key posts required by the legislation are:

- A Board, comprising a Chair and at least five other non-executive members, the National Statistician and two other executive members;
 - A National Statistician, who as the Chief Executive is directly responsible for the work of ONS, is Head of the Government Statistical Service, and reports to the Board;
 - A Head of Assessment, who is UKSA's principal adviser on the assessment function.
- 5.7** The legislation did not alter the basic structure for UK statistical production, where ONS remained the UK's NSI, while the devolved administrations and policy departments retained responsibility for all the statistical outputs in their own areas of responsibility. This decentralised statistical landscape is rather different to that which applies in many other countries. For instance, in the Netherlands and Ireland over 90% of official statistics are produced by the NSI. By contrast, in the UK, ONS produces just 20% of official statistics. ONS produces the majority of key economic statistics in the UK, though a number of important economic statistical releases are produced by departments, including BIS, DWP, HMRC, HM Treasury and indeed the devolved nations. The Act was designed to build on the benefits to embedding statisticians within policy departments while at the same time managing the drawbacks, in particular the greater risk of political interference in the production process.
- 5.8** In addition to overseeing ONS, where the UKSA Board functions like a conventional unitary corporate board, UKSA has a role as a statistical regulator, monitoring and assessing all official statistics and deciding when statistics merit the label of a National Statistic (discussed further below). This dual role of UKSA as producer (through its executive office, ONS) and regulator has led some to

¹ Statistics and Registration Service Act, (2007). Available [here](#).

suggest that ONS may be subject to insufficient scrutiny – a case of ‘marking one’s own homework’. Prior to the establishment of UKSA, the Treasury Select Committee, recommended in 2006 that the government should “ensure a clear statutory separation between the role of the National Statistician in the executive (or operational) delivery of statistics ... and the board’s responsibilities for the oversight and scrutiny of the statistical system as a whole.”²

- 5.9** In 2013, the Public Administration Select Committee (PASC) published ‘A Review of the Operation of the Statistics and Registration Service Act 2007’³ which considered the dual role of the UKSA Board and the overall governance structures created by the Act. It raised concerns that the Assessment Committee which was responsible for scrutiny of production, was reporting to the whole UKSA Board, which includes ONS executives. To address this issue, it recommended that UKSA review the terms of reference for its Board sub-committees, to strengthen the independence of oversight and assessment.
- 5.10** In response, during 2013 and 2014, the UKSA Board agreed a number of organisational changes to strengthen and streamline its governance structures and to enhance the separation of production and assessment functions. The ‘Assessment Committee’ which had been responsible for considering draft reports and making recommendations on National Statistics designations was reformed as a ‘Regulation Committee’ consisting solely of non-executives and the Head of Assessment (and therefore with no executives involved in the production of statistics). It was given a broadened remit to shape the regulatory strategy and oversee the programme of assessment, and carrying the delegated responsibility for adjudicating on National Statistics designations. It thus seeks to address PASC’s concerns about the need for greater separation between the production and assessment functions. It is clear from the Review team’s engagement with users, however, that these changes are not yet well understood outside the organisation.
- 5.11** Other key changes included the abolition of the Committee for Official Statistics, which had been responsible for oversight of the entire statistical system and engagement between producers and users, and the ONS Board which had been responsible for agreeing and monitoring ONS work programmes and budgets. The National Statistics Executive Group (NSEG) was created, with a combined cross-cutting focus on ONS and GSS produced statistics. The UKSA Board role was enhanced, meeting more often, and having greater responsibility for oversight of statistical production and engagement.
- 5.12** The role of the National Statistician was also re-focused more clearly as the Chief Executive of the Authority and ONS, with a remit across the whole Government Statistical Service (GSS), and clear accountability to the Authority Board. In 2015, to support the National Statistician discharge his responsibilities across the entire

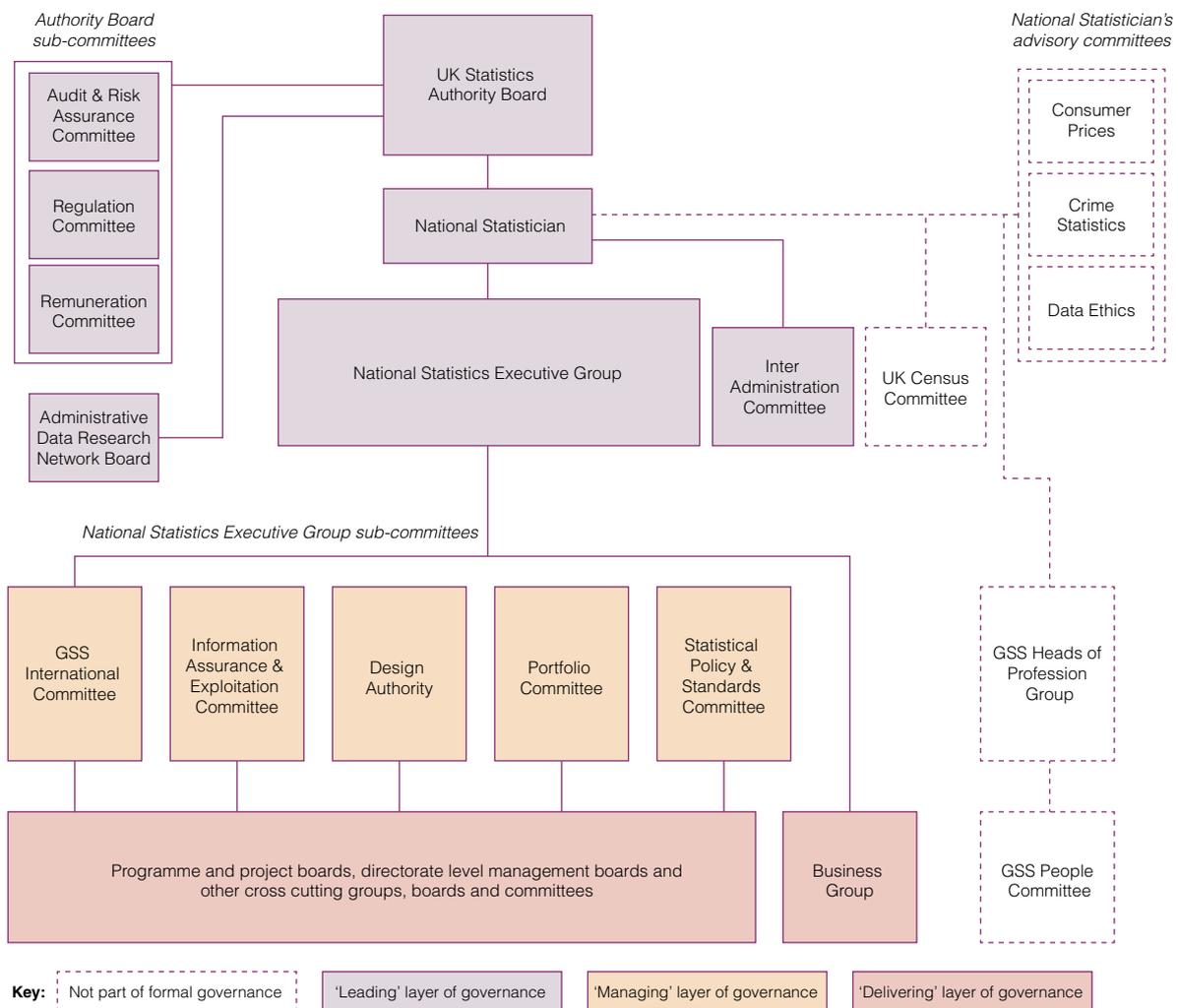
2 TSC, (2006). ‘Independence for statistics: Tenth Report of Session 2005-06’. Available [here](#).

3 PASC, (2013). ‘A review of the operation and of the Statistics and Registration Service Act 2007’. Available [here](#).

statistical system, three Deputy National Statistician roles were created, with one focused exclusively on economic statistics. This was the first time that such a senior post had been put in place purely focused on economic statistics.

5.13 Taken together, these changes have resulted in a much more sensible senior management structure, with more clearly defined and demarcated roles, responsibilities and reporting lines. As such, it now looks similar to the sort of structure that is seen in many other private and public sector organisations.

Chart 5.A: UK Statistical System Governance Map, November 2015



Independence

- 5.14** A central role in maintaining independence across the statistical system is played by the Code of Practice for Official Statistics ('the Code'). Published in 2009, this aims to provide a common set of standards for official statistics across all government statistics producers.

Box 5.A: the Code of Practice

Consistent with the European Statistics Code of Practice and the UN Fundamental Principles, the UK's Code was published in January 2009,⁴ although UKSA is currently undertaking a stocktake of the Code.⁵

The Code contains eight principles and, in relation to each, a statement of associated practices. It also contains three more detailed protocols – on user engagement; on the release of statistics; and on the use of administrative data for statistical purposes. The Code is specific but, in many cases, its requirements will need interpretation and professional judgement.

The principles of the UK Code of Practice are:

1. Meeting user needs
2. Impartiality and objectivity
3. Integrity
4. Sound methods and assured quality
5. Confidentiality
6. Proportionate burden
7. Resources
8. Frankness and accessibility

There are specific 'associated practices' that support each of these principles. These practices focus on aspects of statistical production. For example on meeting user needs, the associated practices include clear documentation, transparency of prioritisation, and transparency of publication dates but not, for example, on taking reasonable steps to improve the underlying statistical methods, coverage or accuracy in line with user needs. In particular, the Code observes that "quality in relation to a set of statistics might be said, like beauty, to be at least partly in the eye of the beholder. Statistics that are fit-for-purpose for one user, or for one purpose, may be less fit for another. The Code does not set down levels of quality". As a consequence, the meaning of 'high' or 'good' quality is somewhat elastic.

4 UKSA, (2009). 'Code of Practice'. Available [here](#).

5 UKSA, (2016). 'Statement on Stocktake of Code of Practice'. Available [here](#).

- 5.15** Responses to the Call for Evidence and interviews with the Review team suggest that the great majority of both producers and users of statistics believe that UKSA’s regulatory function in combination with the Code has substantially improved the trustworthiness of official statistics, particularly of those badged as National Statistics. In a survey conducted by the Review team, 82% of users and 85% of producers who replied either agreed or else strongly agreed that the National Statistics badge indicated that the corresponding statistic was trustworthy.

What is an official statistic and a National Statistic?

- 5.16** The Act defines ‘official statistics’ as all those statistical outputs produced by ONS, government departments and agencies, the devolved administrations, and other Crown bodies. They should aim to be compliant with the Code, though may fall short in some aspects. A National Statistic is a subset of official statistics that have been assessed against and deemed fully compliant with the Code. The difference between the two is one of verification – official statistics may be fully compliant with the Code or only partially, whereas statistics which have the National Statistics badge ought to be fully and demonstrably compliant with the Code. For existing National Statistics, UKSA has complete discretion over when they should be assessed. However, for official statistics, ministers – rather than UKSA – have the power to decide whether official statistics produced in their departments should be assessed against the Code for the purposes of National Statistics status. UKSA may suggest that official statistics be assessed against the Code, but has no power to enforce this.⁶
- 5.17** When asked about the value of acquiring National Statistic status, many HoPs said it gave ‘credibility’ to a statistic and could help defend it against criticism. But several HoPs gave reasons for not seeking assessment against the Code (even a statistic that might be fully compliant with the Code does not *have* to be badged as a National Statistic). In some cases, departments did not wish their statistics to be assessed for the National Statistics badge because the statistics were of insufficient quality; indeed one HoP suggested that rejection might result in adverse media coverage. Where there is a high profile or important official statistic, UKSA should have power not just to suggest, but to require assessment against the Code for National Statistics status.
- 5.18** Furthermore, in its 2013 review PASC flagged its concern that UKSA lacked the power to “prevent departments from circumventing the obligation to meet the standards in the Code by publishing data that is not classified as a statistic. These releases under alternative designations, such as ad-hoc ‘administrative’, ‘management’ or ‘research’ data”,⁷ are not subject to the Code because they are not classified as a statistic. In 2011, the National Statistician published updated guidance on the ‘Use of Administrative or Management Information’,⁸ which

6 Statistics and Registration Service Act, (2007). Available [here](#).

7 PASC, (2013). Available [here](#).

8 UKSA, (2011). ‘Use of Administrative or Management Information’. Available [here](#).

provides guidance on regular and recurring use of administrative and management information. However, UKSA does not have the power to enforce this guidance. At the heart of this issue lies the departmental prerogative to decide how a new data release is classified. Consequently departments can decide whether or not data is subject to the standards of the Code. That can result in some information being released on an ad hoc basis to support positive news stories and withheld at other times when their release would be problematical.

- 5.19** While it would be unduly burdensome to require that the release of *all* management information be subject to the same safeguards as official statistics, UKSA should be able to insist that information be deemed to be an official statistic if it judges that departmental discretion is being used inappropriately to subvert UKSA guidance. And in cases where the information relates to high-profile issues of interest to the wider public, UKSA should also have the power to require that the release be treated as an official statistic and therefore be subject to the Code. These changes could be accomplished via a change in the Ministerial Code.

Recommended Action 18: The government should delegate to UKSA the power to decide that a piece of data be classified as an official statistic; high-profile releases of management information by departments should be treated as official statistics and be compliant with the Code. UKSA should also decide whether an official statistic should be assessed against the Code for the purposes of National Statistic status.

Ensuring trustworthiness

- 5.20** A key objective of the Act was to ensure that the production and release of official statistics was free from political interference and seen to be so. The independence of UKSA, the Chair and the National Statistician are key elements in this. While there have been suggestions of ways to bolster their independence,⁹ the Review team found no evidence of attempts to interfere in the decisions of UKSA/ONS personnel. Indeed, as explained later, a concern to maintain UKSA/ONS independence may even have contributed to a reluctance of key stakeholders to engage actively when they held concerns about the quality of economic statistics.
- 5.21** Instead, the potential weak point in the current decentralised system lies in the major role played by departments as producers of statistics, often as a by-product of carrying out their primary functions. Within departments, the most significant safeguard against political interference is the statistics HoP. Each government department, agency and devolved administration has a designated HoP. Their primary responsibility is to safeguard the professional integrity of

⁹ TSC Chair letter to the Reviewer, 26th February 2016, available [here](#); PASC, (2013). Available [here](#); Simon Briscoe's response to the Call for Evidence.

National and official statistics produced by their department, ensuring compliance with the Code. Within their departments, they have sole responsibility for deciding on statistical methods, standards and procedures, and on the content and timing of statistical releases.

- 5.22** Many HoPs interviewed by the Review team described the Code “as a shield”, protecting their position by providing an external standard to justify why a particular course of action was appropriate or not. All HoPs reported to the Review team that they were acutely aware of their role and different reporting lines (directly to the Permanent Secretary, dotted line to the National Statistician) and found the Code an effective tool to explain the integrity of statistics publicly.
- 5.23** While most HoPs saw the exercise of such independent judgement as a matter of professional integrity, the Review team discovered some questionable behaviour within a minority of departments. One participant suggested that HoPs who followed the Code too rigidly were “doing themselves a disservice” and suggested it was important to give departments options on how to “flex within the Code”. Another admitted to occasionally subverting the spirit of the Code. Such instances were certainly not widespread, but it does illustrate the reliance of the system on the strength of character of the individuals involved.
- 5.24** Moreover, most HoPs recognised that they were ultimately employed by their departments, not UKSA or ONS, and that created a tension between maintaining statistical integrity and supporting the department’s or minister’s priorities. A majority of HoPs stressed that repeatedly refusing departmental requests on the grounds that they breached the Code could both lead to them being side-lined and could also compromise their subsequent career. But, in general, HoPs said they were able to manage this tension successfully and few felt significant pressure to compromise their professional standards.
- 5.25** In the event that a HoP feel that they are being placed under inappropriate pressure by other officials in their department or by their minister, they can appeal to the National Statistician to support them. There have been several instances where the National Statistician has been called upon to intervene to support a departmental HoP. In all instances where HoPs have sought support from the National Statistician, this process seems to have resolved the issue satisfactorily. However, this system relies on HoPs seeking support in the first place.
- 5.26** Tensions are bound to arise from time to time between departmental and ministerial priorities on the one hand and maintaining the integrity of official statistics on the other. While the present arrangements largely seem to work in managing those tensions, some further reinforcement of HoPs independence would be valuable, including routine public reporting to highlight abuses and poor practices. This is in line with UKSA’s recommendations in 2010.¹⁰

¹⁰ UKSA, (2010). Letter from UKSA Chair to the Prime Minister, 12 May 2010. Available [here](#).

Recommended Action 19: The independence of departmental statistics Heads of Profession should be reinforced, with any abuses highlighted by the Independent Regulation and Evaluation Office (see Recommended Action 24 below); there should be a formal role for the National Statistician in the appointment and performance management of the Head of Profession.

Pre-release access

- 5.27** The provision of early access to statistical releases to a restricted group of ministers and officials is a well-established practice, embedded in the Act. Although not strictly relating to independence in the production of statistics, it can – especially when abused – compromise general trust in the statistical system.
- 5.28** Pre-release access is potentially valuable for two reasons:
- Statistics that are about to be published may be relevant to current policy decisions. The most obvious example is key statistical releases around the time of Monetary Policy Committee meetings.
 - It enables ministers and officials who have to react to the release immediately to have prepared an appropriately well-informed response. Misinterpretation of the meaning of a release is unhelpful to public discourse, so there is a public benefit from this. But pre-release also allows a release to be spun for political advantage, for which there is little justification.
- 5.29** UKSA published a report advocating a significant tightening of the pre-release access rules in March 2010, to which Cabinet Office responded later that year, outlining the government’s position. It is hardly a surprise that the Cabinet Office review found a strong attachment to pre-release access by those benefitting from it in private offices, press offices and the officials responsible for briefing.
- 5.30** It is notable that other countries have rather more stringent arrangements regarding pre-release access. The Swedish, Finnish and Danish NSIs do not grant any pre-release access; according to surveys, they also happen to have some of the highest levels of trust in official statistics. In the US, the President and a small number of key officials have access to some statistics in the late afternoon before they are published the next morning, but are not allowed to comment until one hour after publication.
- 5.31** It is likely that the government will wish to retain some pre-release access. But there are strong grounds for ensuring that the list of ministers and officials with pre-release access is kept as short as possible consistent with achieving its aims, and that the duration of early access is likewise kept to the minimum necessary.
- 5.32** Whatever is agreed with UKSA, it is important that the rules surrounding pre-release access are observed rigorously. And there have been too many compliance failures on this score. Since 2011, there have been no less than ten

breaches of pre-release access rules involving economic statistics. In each instance, the statistics in question has been shared with individuals via e-mail or at meetings with unapproved individuals. Many economic statistics are highly market-sensitive and advance knowledge of them can be exploited for private gain, so such laxity in compliance with the strict protocols surrounding pre-release access is completely unacceptable.

Administrative data

- 5.33** An additional dimension to the pre-release access issue may be created if, as recommended in Chapter 4, more use is made of administrative data in the construction of economic statistics. Most market-sensitive economic statistics, e.g. GDP, are currently constructed from several different data sources, limiting the overall correlation between any one component and the final market-sensitive statistic. It is conceivable that in the future there will be greater reliance on fewer but more comprehensive sources of data, making knowledge of the content of that data more useful for predicting the final market-sensitive official statistic. But much of the data in question will be, at least to begin with, management information held within a department. That management information would, in effect, become potentially market-sensitive.
- 5.34** Current pre-release legislation applies only to ‘official statistics in their final form’, and there is limited provision for the restriction of potentially market-sensitive management information. There obviously needs to be a proportionality test here: clearly it would not make sense to restrict all access to such data. But it would make sense for UKSA and departments to develop a set of protocols and guidance to manage the risks of pre-emptive disclosure or the taking advantage of such information for personal gain. In some cases, relevant aggregated data might be published in advance of the official statistic (in a way compliant with the Code); in others, it may be prudent to restrict access to a need-to-know basis at a certain point.
- 5.35** Although Chapter 4 argues that ONS should have the right of access to departmental administrative data for statistical purposes, as acknowledged there, sometimes that may not be appropriate, such as on grounds of national security. In addition, there may be public concerns that the access to administrative data is being abused. For that reason, there is value in appointing an independent person or body to oversee the use of such data, ensuring that it is used ethically and adjudicating on any contentious issues.

Recommended Action 20: In the event of greater use being made of administrative data in producing economic statistics, UKSA should, after consultation with other departments, put in place suitable policies governing their use, together with the appointment of an independent person or body to oversee their application and adjudicate on any difficult cases.

Quality assurance and improvement

- 5.36** Trustworthiness is not the only desirable characteristic of statistics. Users also want timely statistics that are sufficiently accurate, reliably delivered and relevant to their needs – in short, they should be of high quality. This section looks at the effectiveness of different elements within the governance framework in supporting the provision of such statistics, starting at the bottom and working upwards.
- 5.37** The European Statistical System (ESS) identifies the following five dimensions of quality:¹¹
- **Relevance** – statistics should meet the needs of users; users should be consulted on whether existing statistics meet their needs and advise on their emerging needs.
 - **Accuracy and reliability** – statistics should accurately and reliably portray reality; not only should they be free of mistakes but information should be provided about possible sampling and non-sampling errors.
 - **Timeliness and punctuality** – statistics should be disseminated in a timely and punctual manner.
 - **Coherence and comparability** – statistics should be consistent internally, over time and comparable with other countries.
 - **Accessibility and clarity** – statistics should be presented in a clear and understandable form.

ONS production teams

- 5.38** Output managers in ONS production teams carry the initial burden of ensuring the quality of the statistics they are responsible for. While the vast majority of statistical releases are published without mistakes, as discussed in Chapter 4, there have been several recent high-profile errors, initially identified by users. A paucity of economic expertise, together with cumbersome systems, have meant inadequate sense checking takes place before data are released and quite basic checks, such as comparing implied deflators to actual price indices, are sometimes absent.
- 5.39** A consequence of recent mistakes, including those resulting in de-designations by UKSA's regulatory function, is that production teams have been encouraged to put more effort into avoiding mistakes. While that may seem entirely appropriate in the circumstances, in the absence of the necessary analytical support, it has resulted in additional rounds of burdensome mechanical checking. An internal audit of quality assurance processes found, for instance, that one team had no less than ten rounds of quality assurance but that only the first two rounds added any value. An important lesson from lean manufacturing

¹¹ Eurostat, (2015). 'Quality Assurance Framework of the European Statistical system'. Available [here](#).

processes is that multiple layers of checking that largely duplicate earlier rounds is typically less effective than a single round where the checker knows (s)he carries sole responsibility.

- 5.40** Excessive effort paid to the execution of elaborate, but largely ineffectual, rounds of quality assurance also crowds out the time available for identifying potential improvements to quality. While the UKSA Board has sought to emphasise the importance of quality assurance, production teams appear not yet to have taken the message to heart, in part because of the risk-averse culture that has developed as a result of past mistakes. Several ONS staff noted that they were unlikely to be praised for innovative thinking on how to improve their statistics, if mistakes were later discovered in their releases or publications.
- 5.41** The Review has found, on average, a production team devotes just 10% of their time to the identification of potential quality improvements. There are some pockets of laudable practice, e.g. embedding ‘development mini teams’ within production teams that have the capacity and expertise to look at the issue from a broader perspective. But the general approach appears to be to focus on small, iterative and contained improvements that are easier to identify and implement within the production team, such as better presentation of data.
- 5.42** Deputy Directors are particularly important for quality assurance and improvement as they are responsible for setting the overall approach of the production teams beneath them. While some have sought to bolster their analytical capability and to encourage more innovative thinking, too many appear content simply to see their teams continue to produce the same statistics – with the exception of changes that are legally mandated – month after month, quarter after quarter.
- 5.43** In sum, insufficient effort has been expended in identifying and addressing the limitations of statistics of the sort discussed in Chapters 2 and 3 of this Report, even when there is already strong user interest in an issue. The Review team found little evidence that teams either systematically assessed the limitations of their statistics against user needs or used such information to inform bids for extra resources to resolve issues. One senior civil servant in ONS described it as a “Pandora’s box of development backlog work that ONS are taking a big risk by not always being on top of what is in it”.

ONS central teams

- 5.44** The ONS methodology team has two main tools for identifying quality improvements against user needs: Regular Quality Reviews (RQRs)¹² and National Statistics Quality Reviews (NSQRs). RQRs are a recent innovation, started in November 2015, and will cover all ONS outputs on a rolling basis. An RQR entails a two-hour meeting between the manager of a statistical output, a senior methodologist and a member of the central quality team and the intention is to cover all five dimensions of output quality set out in the ESS. Two key inputs

¹² ONS, (2015). ‘Improving quality through regular reviews’. Available [here](#).

are Quality and Methodology Information (QMI) and the Value Engineering Tool, a self-assessment of the statistics produced by ONS teams. The Value Engineering Tool in principle is an excellent strategy, deployed by ONS, to ensure production teams are constantly reviewing the limitations and risks of the quality of their statistics. It should also be helpful for the UKSA Board to assess the overall performance of ONS statistics. However, comparing the self-assessment returns for relevance and quality to the findings in Chapters 2 and 3 is stark. Production teams have been far less open about the limitations of economic statistics. QMI is produced by all producers of statistics in the UK, and indeed in every NSI in an advanced economy. It should provide detailed guidance to users about the strengths and limitations of the statistics against the ESS framework for quality, in addition to documenting how the statistic could be used. RQRs, building on these two sources of information, are therefore unlikely to identify new limitations in statistics, including against user needs.

- 5.45** The NSQR is a more established tool. These range from small in-house reviews to large externally-run reviews, such as the Barker-Ridgeway review. There is widespread agreement in ONS and elsewhere that these reviews serve a useful purpose. While production teams claim to have been already aware of the need for very many of the recommendations in these reviews, most of the major improvements to economic statistics that were not already legally mandated have stemmed from NSQRs. In part, this is due to few other concrete proposals for quality improvement work, and in part due to the higher profile of NSQRs, which means they are prioritised for additional resources.

Departmental production of economic statistics

- 5.46** While ONS has introduced measures to reinforce quality assurance in the wake of recent de-designations, these have not extended to departmental producers. Departmental quality assurance is often lacking, with several de-designations emanating from departmental failures to carry out sufficiently effective quality assurance processes, rather than the ONS. Discussions with several senior civil servants revealed that ensuring effective statistical provision rarely figured as a key departmental objective given the range of their other responsibilities.
- 5.47** In part as a result of the limited focus on ensuring the quality of statistical production, practice is very variable across departments. Some do focus on producing good quality statistics, but in others, statisticians are quietly left to carry on turning the handle. While ONS may not be a paragon of ensuring its statistics are of high quality, it does at least have the backstop of the NSQR process. The lack of any analogue in departments poses the risk of a two-tier system developing if departmental statistics producers fail to keep up. For that reason, the NSQR programme should be extended across the whole statistical estate. This is set out in Recommended Action 2. Moreover, some departmental producers appear to place the needs of their own ministers ahead of wider user needs. One producer told the Review team that they were not permitted to meet

with a wide range of users, given the views of their ministers. But without engaging with users to understand their needs, how can producers ever expect to meet those needs?

National Statistician's Executive Group

5.48 The National Statistician's Executive Group (NSEG) has taken several steps to try to address the problems identified above, supported by the Board. That includes the updating of ONS's cumbersome systems and increasing the organisation's economic capability, as discussed in Chapter 4. Together, they should facilitate improved quality assurance. Greater economic capability, better systems, effective access to administrative data and a more curious and open culture will also allow the organisation to ensure that its statistics meet evolving user needs as the economy changes.

5.49 Throughout the Review, it has been clear that the present senior leadership of ONS shares an ambitious and progressive vision for putting the organisation at the international frontier of the production of high-quality economic statistics. Nevertheless, ambition can sometimes outstrip the ability to deliver. For instance: a recent UKSA regulatory report highlighted the limited progress made in implementing many of its earlier recommendations regarding the statistics on income and earnings;¹³ VAT microdata was obtained from HMRC in 2011, yet has still to be incorporated into the production of statistics; and little effort has been put in to securing access to scanner data of the sort Statistics Netherlands are now using for the production of price statistics. ONS still has a long road to travel.

UKSA regulatory function

5.50 The UK is unique in having a regulator of official statistics that publicly passes judgement on compliance with the Code of Practice. In other countries, an internal audit or quality unit within the NSI monitors compliance with the relevant Code, drawing on external expertise as necessary. Assessment of individual statistics against the Code in other countries is therefore a private, in-house matter.

5.51 The regulatory function was established in 2008, and after producing the Code, it assessed the existing 1000 plus National Statistics in 240 separate reports. Understandably, given the background to the Act, the focus initially was largely on the trustworthiness of those statistics. But while the exercise of the regulatory function has clearly been important in establishing the trustworthiness of UK National Statistics, this has been at the expense of a broader assessment of statistical quality.

13 UKSA, (2016). 'Progress report – Coherence and Accessibility of Official Income and Earnings Statistics'. Available [here](#).

- 5.52** As the Code does not set down absolute levels of quality, the regulatory function’s focus on quality was largely indirect – through improving how statistical producers communicated and engaged with users. It is unsurprising that the detailed assessment and monitoring work undertaken by the regulatory function did not evaluate statistical quality in its broadest sense during the early years of the Authority. But since 2014, assessment reports have given somewhat greater weight to issues of quality, including the relevance of statistics to users. For instance, recent monitoring reports, notably on the use of administrative data, and of income and earnings statistics, have considered issues of quality assurance and coherence.¹⁴
- 5.53** Despite recent progress, greater emphasis on quality issues – in their broadest sense - is needed. The Review team was told repeatedly by producers of statistics that the current assessment process did not fully cover all dimensions of ‘quality’, as described in the five dimensions contained in the ESS. Production teams described instead a bureaucratic “tick-box exercise” evaluating compliance with specific associated practices rather than with the spirit of the Code. One senior civil servant in ONS described the current assessment process in scathing terms, asserting that they did not engage with methodological issues. Producers described the recommendations as “distracting limited time away from actually improving statistics”. In the 60 conversations the Review team held with producers, only those working on re-designating statistics believed that the assessment process reflected quality in substance as well as process.
- 5.54** This view of producers is supported by recent assessment reports. Looking at all the recommendations and requirements contained in the assessment reports of six economic statistics in 2015 and 2016, although there was some coverage of quality issues, the emphasis was primarily on ensuring better communication with users, internal processes to avoid mistakes and greater transparency of documentation. The Review team found only around 10-20% of requirements in these recent assessments were focused on improving the substance of the underlying statistic itself.¹⁵
- 5.55** Looking forward then, it seems clear that a further strengthening of emphasis on assessing quality – in its broadest sense – is called for. In addition, it is important that the regulatory function seeks to become more proactive. Some de-designations have been the result of problems highlighted by the assessment process. But the evidence shows that in the majority of cases (see Chapter 4), the de-designations followed in the aftermath of data and processing errors that

14 UKSA, (2015). ‘Coherence and Accessibility of Official Statistics on Income and Earnings’. Available [here](#).

15 UKSA assessment reports: Re-assessment of CPIH, March 2016, available [here](#). Assessment of Public Sector Finances, October 2015, available [here](#). Assessment of House Price Index, July 2015, available [here](#). Assessment of Statistics on UK Trade, May 2015, available [here](#). Assessment of National Accounts, February 2015, available [here](#). Assessment of Supply and Use Tables, February 2015, available [here](#).

were first picked up by users, not the UKSA regulatory function.¹⁶ Production teams are ultimately responsible for the quality of the statistics they produce and the regulator cannot be expected to identify all risks before they crystallise. But a more proactive regulatory function might have brought the underlying problems to light sooner.

5.56 Given the limitations of several of the statistics discussed in Chapters 2 and 3, it may be somewhat surprising that so few statistics have been de-designated, despite the National Statistics badge requiring “the highest standards of trustworthiness, quality and public value”. It is hard, for instance, to understand – though unsurprising given the genesis of the process and function – how the provision of some economic statistics currently maintains the National Statistics badge. For example, Chapter 2 outlines the substantial limitations of regional statistics that users, such as Diane Coyle, described as “lamentable”.

5.57 A key obstacle lies in the multi-dimensional nature of the criteria relevant to whether or not an official statistic is deemed a National Statistic. The Code covers not only trustworthiness, but several aspects of quality, including accuracy, reliability and relevance to user needs. The weighting of these criteria in the decision as to whether or not a statistic is designated as a National Statistic is not made clear, although past practice suggests that a lot of weight has been placed on the underlying ‘associated practices’ for trustworthiness and rather less on the substantive factors such as accuracy and whether it meets user needs.

5.58 While the binary nature of the classification – a statistic either warrants the National Statistic badge or not – may achieve clarity, the reality is more nuanced: there are fifty shades of grey twixt white and black. It would serve users better if that were reflected in the classification process. That could be through the use of a scorecard that rated a statistic on each of the several dimensions of the Code. Or it could be encapsulated in concise commentary accompanying the statistic. Either way, it could alert users when there were concerns about a statistic without having to resort to the rather blunt weapon of de-designation.

Recommended Action 21: UKSA should provide a more nuanced assessment of the status of a statistic than is conveyed by the binary National Statistic designation.

5.59 The way statistics are used can also affect their credibility and UKSA offers an authoritative and independent voice to highlight statistical misuse. Since its inception, UKSA has made a number of public interventions highlighting the

16 UKSA Assessment reports: Statistics on Construction, assessment report, April 2014, available [here](#), de-designated December 2014. Statistics on overseas Travel and Tourism, Assessment report, May 2010, available [here](#), de-designated November 2014. UK Trade Statistics, Assessment report, February 2011, available [here](#), de-designated November 2014. CPIH statistic, Assessment report, July 2013, available [here](#), de-designated August 2014.

inappropriate or misleading use of official statistics. Anecdotally, the threat of external censure acts as a useful deterrent to wilful misuse, with one producer commenting to the Review team that “no politician likes having to stand up in Parliament and admit they were wrong”. UKSA should continue make use of these valuable powers in order to support better public dialogue in relation to official statistics.

Prioritisation

- 5.60** A high-performing statistical system needs to have effective mechanisms in place for prioritising activities and allocating resources to meet new user needs or known gaps in its statistical outputs. Three elements are necessary:
- **Information.** Sound resource allocation can only be carried out on the basis of a sufficiently comprehensive and comprehensible evidence base. In the case of an NSI, that means: granular and digestible data on the quality and costs of different statistical outputs, corresponding user needs, staff performance, etc.
 - **Transparency.** Producers need to understand how that information shapes resourcing decisions across the organisation and helps engender greater ownership. Users should also understand why the development of some statistics may be given priority over others.
 - **Capability.** Effective financial and project management capabilities to ensure decisions are properly implemented (see the discussion in Chapter 4).
- 5.61** Decision making on the prioritisation and allocation of resources occurs at several layers of the organisation. As the Chief Executive of ONS, the National Statistician is ultimately responsible for planning and prioritisation. NSEG oversees the production of business plans and regularly reviews performance, as well as the risk register. The role of the UKSA Board is to approve both the business plan and the associated resourcing decisions. An important role is also played by the Portfolio Committee, tasked with managing investment projects across the whole organisation.
- 5.62** The Review team identified several weaknesses in ONS’s current systems for prioritisation and resource allocation:
- 5.63** **Management information.** Detailed and comparable information on the quality, relevance, and costs and benefits of individual statistical outputs is virtually non-existent: the “Pandora’s box” remains tightly shut. In its 2013 report, the Chartered Institute of Public Finance and Accountancy noted, “In terms of unit costs, activity costs, benchmarks and other financial performance ratios available being used to inform decisions to maintain or change current services we see significant difficulties at ONS.” While annual self-assessment by production teams using the Value Engineering Tool provides some information, it is unclear how this is then used to provide a meaningful input into prioritisation and resourcing decisions.

- 5.64** Priorities only tend to shift if an emerging issue is identified externally or through the formal mechanism of an NSQR. Even then, many staff believe the organisation is slow to respond and reallocate the necessary resources. The large majority of production staff spend around nine-tenths of their working time on standing responsibilities, so there is also little scope for shifting resources within teams. The lack of a central process for staff to feed in ideas and solutions to senior leadership was also frequently lamented.
- 5.65** **Focus.** Priorities are heavily influenced by the need to meet legislative requirements in order to avoid fines or else in response to statistical errors and the subsequent reputational damage. Given the lack of detailed management information, that is perhaps no surprise, with resource allocation set top-down based on headline issues, rather than built bottom-up based on a comprehensive understanding of business needs, costs and trade-offs. Some junior staff also complained that resource decisions were often determined by which Deputy Directors “shouted the loudest”.
- 5.66** **Project management.** Historically, an overly complex governance framework and a lack of sufficiently clear business case protocols have often led to failed or notoriously costly project delivery within ONS. While the Portfolio Committee has recently simplified governance arrangements and scrutiny processes in an attempt to improve the management of projects within ONS, there is a residual risk that a long-established tendency to make large resource commitments without sufficient testing and costing of different options could persist.
- 5.67** **Co-ordination across the statistical system.** The fact that UKSA is not always well-sighted on departmental statistical resourcing decisions and has no formal leverage to influence them, has led to a somewhat incoherent statistical landscape. Several HoPs and senior civil servants noted that improving the quality of statistics generally came at the bottom of their departments’ list of priorities. The 2013 PASC report also noted the lack of a strategy for the statistical system as a whole and recommended that UKSA “should coordinate data on resource requirements and plans for statistics across government departments, so that, where appropriate, resources can be pooled and the UK’s statistical needs met as efficiently as possible”.¹⁷
- 5.68** There is one noteworthy example of a departmental decision that illustrates the limitations of UKSA’s coordination powers. In April 2013, the Chair of UKSA publicly wrote to the Secretary of State for Communities and Local Government, highlighting concerns about a decision to cease the publication of regional statistics. UKSA suggested that the decision “might be seen to raise questions about whether the decision was based on statistical or political considerations” and asked that it be reviewed by the department.¹⁸ Despite this intervention, the statistical series was nevertheless stopped and UKSA had no formal powers to intervene beyond raising its concerns publicly.

17 PASC, (2013). Available [here](#).

18 UKSA, (2013). Letter from UKSA Chair to Secretary of State for Communities and Local Government, 23 April 2013. Available [here](#).

- 5.69** One particular issue flagged to the Review team was that there was insufficient clarity about statutory responsibilities. If there was a legal requirement for a new statistic, would it fall to the relevant departmental producer or ONS to ensure that it was produced? This lack of coordination reflects a fundamental weakness of the UK system compared to other countries.
- 5.70** **Transparency to users.** Several users complained that ONS’s prioritisation processes were opaque, and said they had little understanding of the rationale for the organisation’s decisions. This view was echoed in responses to the Review’s Call for Evidence. Professor Nick Oulton (LSE) asked, “How does the senior management of ONS decide which Eurostat requirements it will introduce and which it will seek to opt out from? What engagement with users does it undertake before coming to these decisions? This is clearly an important issue of ONS strategy.”
- 5.71** The periodic consultation on proposed changes to ONS products provides recipients with no information on the costs of different statistical outputs that might help to rationalise the changes. As users are consequently unable to take an informed view of the trade-offs, it is hardly surprising that the exercise is seen as being of only marginal benefit. However, the Review notes that there have been pockets of more transparent prioritisation in specific areas: for instance, for the first time the National Accounts published a workplan, setting out mid-term plans and priorities for the period 2015-2018, following consultation with users.¹⁹ While the work-plan contains no detail on costs, it sets out high priority areas and explains inter-linkages with UKSA’s wider strategy.

Box 5.B: Prioritisation in other NSIs

Efficient, flexible resource prioritisation in an NSI is no easy task on account of the multiplicity of demands typically placed on it, as several NSIs attested in providing evidence for this Review. This box explains what happens in Sweden and the Netherlands, though both are highly centralised systems, so their experience may not immediately carry across to the UK’s more fragmentary statistical system.

Statistics Sweden’s overall spending envelope is set each year in the Budget; the Ministry of Finance also provides a remit letter. Statistics Sweden then explains how it intends to deliver its objectives within budget, including which activities to increase, scale back or stop in order to meet user needs. It subsequently publishes a comprehensive annual report, setting out in detail its performance against those objectives. While individual statistical outputs are not costed, very granular information is provided, including an assessment on the timeliness of its statistical outputs, as well as analysis of the burdens of surveys on businesses over time.

19 ONS, (2015). ‘National Accounts Mid-Term Work Plan 2015-2018’. Available [here](#).

Statistics Netherlands' prioritisation across the whole statistical landscape is primarily driven by user needs. User views are gathered through annual public consultations, as well as external advisory groups and frequent bilateral discussions with key customers/stakeholders. Routine quality assessments are supplemented by a rigorous internal auditing function which audits key economic statistical outputs and reviews areas of concern. A research and innovation division of approximately 80 FTE staff is tasked with horizon-scanning to identify future statistical needs and also provides flexible resource and consultancy services. While Statistics Netherlands prides itself on having a responsive, informed and effective prioritisation process, it acknowledged that costing statistical outputs can be challenging, in particular as the same data sources are often used for multiple statistics.

- 5.72** The previous discussion suggests the need for improvements in the way ONS's activities are prioritised and resources allocated. The need for improvement is recognised by the current senior management team. A key deficiency is the lack of a good evidence base on the costs of delivering ONS's various statistical outputs and the gaps relative to user needs. Better information would allow a more strategic approach to the allocation of resources and reduce the tendency to focus the organisation's effort on just the most high-profile (but possibly ephemeral) issues.

Recommended Action 22: ONS should establish an effective and transparent process for prioritising and allocating resources, supported by better management information.

The role and effectiveness of the UKSA Board

- 5.73** UKSA has the statutory objective of "promoting and safeguarding the production and publication of official statistics that serve the public good". This role includes promoting and safeguarding "the quality of official statistics" including their "impartiality, accuracy and relevance" and "their coherence with other official statistics". It is also responsible for promoting and safeguarding, "good practice in relation to statistics" and "comprehensiveness of official statistics."²⁰ Section 30 of the Act identifies the National Statistician as the Board's principal adviser on: "a) the quality of official statistics, b) good practice in relation to official statistics, and c) the comprehensiveness of official statistics." In its consultation on 'Independence for Statistics', that led to the 2007 Act, the government of the day set out a vision for an independent board responsible for ensuring the quality of ONS's statistics and that they meet user needs.²¹

20 Statistics and Registration Service Act, (2007). Available [here](#).

21 HM Treasury, (2006). 'Independence for Statistics: a consultation document'. Available [here](#).

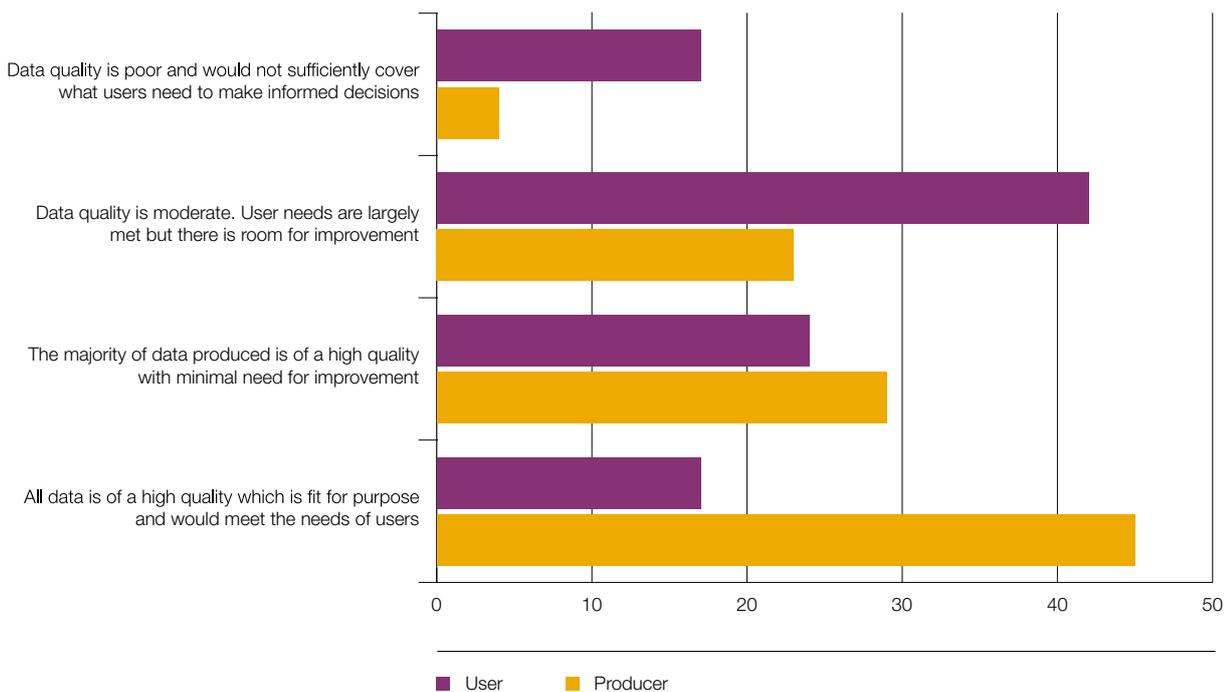
- 5.74 Responsibility for the oversight of ONS performance resides squarely with the UKSA Board. It is the Board's responsibility to ensure that ONS operates efficiently and produces high-quality statistics meeting user needs. And any failure by ONS to meet those standards also represents a failure of oversight by the Board. Ideally, these governance arrangements provide a mechanism through which performance issues are identified and corrected promptly without the need for external intervention.
- 5.75 Interviews with users and producers, together with inspection of material provided to the Board pointed to a number of issues warranting attention.
- 5.76 **Engagement with users.** Discussions with a wide range of users of economic statistics made it clear there was insufficient direct interaction between users and the non-executive members of UKSA. Better engagement with users of economic statistics would provide the Board with a fuller perspective on current and emerging statistical limitations and whether user needs are being met. In the absence of this, the Board has to rely on information mediated via ONS or else users' public comments.
- 5.77 The primary channel for users to provide feedback is the annual ONS customer satisfaction survey. ONS describes using this feedback to understand "how and why [its] statistics and analyses are used, and what [its] customers think about the quality of them and the statistics [ONS] provides."²² In its 2014-15 survey, ONS advised respondents for the first time that submissions would be published on the ONS website.
- 5.78 While publication is valuable for transparency, it does appear to inhibit the frankness of some users' responses. Certain key users (HM Treasury; Bank of England; Office for Budget Responsibility; Department for Business, Innovation and Skills), whilst acknowledging that ONS has made some progress in recent years, raised numerous concerns about the quality and relevance of numerous ONS statistical products with the Review team. Yet one would not guess this by looking at their responses to the survey. Looking specifically at the 2014-15 survey, for instance, reveals a marked reluctance to mark down ONS's performance. On the question of how they felt about the "quality of ONS statistics, analyses and advice", three users said they were satisfied, with only OBR saying they were neither satisfied nor dissatisfied. On the question of whether ONS was innovative, two agreed while two neither agreed nor disagreed. Of course, UKSA/ONS can hardly be criticised if respondents pull their punches, but it does suggest that key users do not find the survey a very effective route for expressing reservations about ONS performance.
- 5.79 As a result, ONS interpretation of the feedback was largely positive. Looking at feedback from government departments and other key stakeholders, 91% of respondents expressed satisfaction with ONS performance, whilst 82% of respondents were either satisfied or very satisfied with the quality of ONS's statistics, analyses and advice. In its public report on the results of the survey,

22 ONS, (2015), Customer Satisfaction Survey 2014-15. Available [here](#).

ONS identified three areas for improvement. These were the need to: improve ONS’s website and access to ONS outputs; be more consistent in the presentation of data in spreadsheets and ad hoc statistics; and improve communications with stakeholders. Commentary on de-designations or quality considerations was conspicuous by its absence. Only 59% of respondents thought ONS was innovative, but this was not identified as a priority area in the summary report.

5.80 It appears, therefore, that the annual customer satisfaction survey does not provide ONS and UKSA board with an altogether reliable picture of the concerns of users and key stakeholders. A mismatch between the perception of producers and the experience of users also emerged in a small survey carried out by the Review team of over 70 users and producers. Users and producers were asked to evaluate the extent to which statistics met user needs. On average, producers estimated that 45% of their statistics were entirely fit for purpose and fully met user needs, while users put it almost a third of that, with only 17% of statistics fully meeting their needs. Moreover, producers estimated that only 4% of their data was of poor quality and did not support informed decision making, while amongst users this figure was over four times higher, at 17%. Moreover, these average responses conceal some even more contrasting individual results, with some producers believing that all their statistics fully met user needs, and some users feeling that almost all statistics required significant improvement!

Chart 5.B: Average user and producer responses (%)



Source: Review survey of users and producers.

- 5.81** Each month, the Board receives an update on ONS performance against the strategy laid out in ‘Better Statistics, Better Decisions’, covering achievement against key performance indicators, progress against planned activities and mitigation of strategic risks. In January 2016, as part of this report ONS reported generally positive feedback from key users, high levels of customer satisfaction with ONS performance and that work to ensure key statistics remained relevant was on track with sufficient mitigating actions in place. In effect, user views, ONS effectiveness and the quality of statistics were all rated as ‘green’ (though relationships with HM Treasury and the Bank of England were rated as ‘amber’). That was despite the challenges identified in the Interim Report. The minutes of the meeting do suggest, however, that the Board realised that there was a need for better engagement with stakeholders to understand their concerns.
- 5.82** The Board has recently instituted a series of seminars to improve engagement, holding sessions on the opportunities and challenges relating to increased use of government data, and on the ‘productivity puzzle’, as well as a joint session with the HMRC Board. The Review welcomes these efforts by the Board to become better informed about key measurement issues and emerging challenges. However, so far there has been less evidence of actions being stimulated by these seminars; it is obviously important that such sessions help to drive subsequent actions to improve statistics and do not just become a distraction.
- 5.83** In order to raise UKSA/ONS’s awareness of users’ concerns, as well as inform the prioritisation of resources between competing demands, the Review recommends establishing a high-level stakeholder group. This group would include senior representatives from HM Treasury and other interested departments, the Bank of England and OBR as well as the UKSA Chair, the National Statistician and the Director of the Independent Regulation and Evaluation Office (see Recommended Action 24 below). There are good grounds for also including some key private sector users, such as the Institute for Fiscal Studies. The group would meet (at least) annually and provide a space for frank discussions with the Board about ONS’s statistics and performance.

Recommended Action 23: A high-level group comprising representatives of HM Treasury, the Bank of England and other key stakeholders and users should be established to facilitate frank and open discussion with the UKSA Board.

- 5.84** **Monitoring quality and performance.** UKSA is charged with promoting and safeguarding “the quality of official statistics”. But its attention to the quality of the whole statistical estate and ONS performance appears to have been rather narrow, with the Board focussing on reliability, and the regulatory function concentrating on trustworthiness, rather than the broader issue of whether statistics adequately meet user needs and are fit for purpose. Moreover, attention to the issue often appears to have been reactive rather than proactive.

- 5.85** The Board has intervened when there have been important errors in published statistics. For instance, public concern about quality in the wake of the errors in the construction and GDP statistics in 2011 led the Board to make a strategic priority of “ensur(ing) that the macroeconomic statistics meet user need and best inform public debate and economic decision-making.” To achieve this, the Board committed to “independently reviewing the governance and future development of inflation statistics in 2013”, leading to the Johnson review of consumer price statistics. The Board also committed to review economic statistics to ensure that they “best meet user needs in the future”, leading to the restarting of the NSQR process, starting with the National Accounts.²³ This process has supported proactive identification of quality issues with particular economic statistics.
- 5.86** However, due to the in depth and resource intensive nature of NSQRs for both producers and the teams conducting the reviews, there is only one NSQR on an economic statistic a year. For meaningful routine exploration of quality issues, there is a need for more frequent monitoring of issues relating to the quality and coherence of statistics by the Board.
- 5.87** Since July 2015, there has been an increasing recognition of the need to focus on quality, particularly of economic statistics. There was an acknowledgement by the National Statistician in July 2015 that the “statistical system is skating on quite thin ice and there are significant vulnerabilities”, which required a balancing of everyday production tasks against “the imperative to prepare for the future.”²⁴ Similarly in October 2015, the Board considered “Challenges and opportunities in economic statistics”. The minuted discussion covered the increased use of administrative data, limited capacity to provide analysis and advice due to technological limitations, and challenging misuse of statistics publicly.²⁵ This shift is encouraging, and demonstrates that the National Statistician, his new leadership team and the Board are identifying and prioritising the quality of economic statistics.
- 5.88** On organisational performance, there are far fewer routine reporting mechanisms which support the identification and correction of capability issues within the ONS. It is commonplace for boards to rely on external assessment of performance to support scrutiny and the UKSA Board is no exception, having commissioned several reviews into aspects of ONS performance, such as those by CIPFA, Atkins and Thoughtworks. For this approach to work, the UKSA Board must be aware of organisational limitations, to commission reviews into them. The Review team found few effective self-assessment processes in ONS which could support proactive identification of organisational performance issues, limiting the UKSA Board’s ability to take early corrective action. Other independent organisations have had recourse to independent evaluation offices to address informational lacuna at Board level about organisational effectiveness.

23 UKSA, (2013). ‘Statement of Strategy’. Available [here](#).

24 UKSA Board Minutes, July 2015. Available [here](#).

25 UKSA Board Minutes, October 2015. Available [here](#).

- 5.89** In order to address this issue, the Review recommends a broadening and deepening of UKSA's regulatory function. This should include not only the assessment of the consistency of official statistics with the Code but also the execution of rigorous independent assessments of the accuracy, reliability and relevance of statistics, i.e. quality in the broadest sense, and of the organisation's ability to deliver them. Assessing both the statistical estate and ONS's effectiveness is likely to improve its ability to pre-emptively identify mistakes.
- 5.90** To reflect the expanded remit, the operation is referred in this Report as an 'Independent Regulation and Evaluation Office' (IREO). As well as providing the UKSA Board with digestible and relevant information, the IREO would be expected to publish an annual public report on the performance of ONS and provide an independent assessment of the quality of the whole statistical estate. This should also include the ability to recommend the creation of new statistics or modify existing ones to address lacunae and ensure greater coherence in the statistical estate. This report would also aid users, government and Parliament in holding UKSA/ONS to account for meeting its statutory responsibilities.

Recommended Action 24: The UKSA regulatory function should be subsumed within a new Independent Regulation and Evaluation Office (IREO) charged with assessing the trustworthiness and quality of official statistics as well as ONS's effectiveness; the head of the IREO would report to the UKSA Board and publish an annual assessment of ONS performance and the whole statistical estate.

- 5.91** In order to meet its expanded remit, the IREO would carry out reviews either on its own initiative or at the behest of the UKSA Board. It would clearly need to have sufficient resources at its disposal to do this, including statistical knowledge, and would be expected to draw on resources from within ONS or outside the organisation as appropriate, including commissioning reviews by external experts. As the Head of the IREO may sometimes need to tell uncomfortable truths to the UKSA Board, this person should be widely seen to be a strong and externally credible individual.
- 5.92** It is a moot point whether or not the IREO should be placed outside UKSA altogether. On the one hand, placing it outside bolsters independence and makes it less subject to the 'marking one's own homework' critique. On the other hand, leaving it inside facilitates scrutiny of ONS; it will be harder for a completely external organisation to understand what is going on in ONS than for a unit within UKSA/ONS. This is also the model chosen for both the IMF's and Bank of England's Independent Evaluation Offices. On balance, the Review favours the latter, at least in the first instance. But for it to be a success, it will need the UKSA Board and ONS staff to be open to criticism.
- 5.93** **Implementation.** Quality and performance issues need not only be identified but also addressed. Several individuals who spoke to the Review team expressed scepticism about the ability of the Board to effect change, citing only

partial implementation of the recommendations in past reviews. One former Board member said that, at least in the past, actions had sometimes been agreed at Board level but not followed through on. One factor appears to have been inadequate monitoring of progress in implementation.

- 5.94** After the discovery of the errors in the construction and GDP statistics in 2011, ONS conducted two internal reviews (Brand reviews one and two) to diagnose the causes. In July 2013, after errors were discovered in Business Investment Statistics and GDP, the ONS Board commissioned a third Brand review. This review found that recommendations made in the first two reviews, that might have prevented the latest errors, had not been implemented. The subsequent Board discussion noted that “under the present circumstances it would not be a surprise if further errors occurred”.²⁶ The ONS Board commissioned a response to the Brand review “as a matter of urgency”, stipulating that this must include deadlines by which all recommendations would be implemented. Clearly, failure to implement recommendations for two years is unsatisfactory, unless there were reasons why remedial action was impossible.
- 5.95** While NSQRs and RQRs may help to isolate weaknesses in statistical outputs and scope for quality improvements, the UKSA Board does not routinely see progress against any associated recommendations for action. Recommendations are placed on a central risk register that contains hundreds of other individual risks, but are only monitored by the central quality team and the production teams responsible for delivering the recommendations. So it is not surprising that implementation has yet to begin on several of the recommendations of the Barker-Ridgeway review. Of course, the Board should not be expected to track the implementation of every single recommendation. However, it is important the UKSA Board ensure the past failures of the former ONS Board, like in the example of the implementation of the Brand reviews, are not repeated.
- 5.96** **Strategy.** In 2015, the UKSA Board launched ‘Better Statistics, Better Decisions’, laying out an ambitious five-year strategy for UK statistics structured around five key qualities needed for a world-class NSI in the 21st century: “Helpful, Professional, Efficient, Capable and Innovative”. That strategy is consistent with the vision for the future provision of statistics that underlies this Report. The associated business plan would, though, benefit from a comprehensive corresponding set of SMART (specific, measurable, assignable, realistic, time-limited) objectives against which the Board can hold ONS and departmental producers to account. At present many of the objectives are somewhat nebulously defined, leaving room for debate over whether they have been achieved. In her response to the Call for Evidence, Professor Diane Coyle noted that “there is a big gap between UKSA’s: ‘Statistics need to keep pace with a fast changing world. We need to be constantly attuned to developments and respond rapidly when new issues arise where the evidence base is absent or contested,’ and the specific challenges of measuring the digital economy”.

- 5.97** A comparison with Statistics Sweden is instructive. There, some objectives are set by ministries, such as reducing burdens to businesses, addressing declining response rates to household surveys and improved measurement of the impacts of globalisation and digitisation. In its annual report, Statistics Sweden describes progress against those specific objectives, together with a lot of information on what statistics are produced, their cost, staffing and user views.²⁷ UKSA should seek to emulate such a detailed description of its activities and the progress against its strategic objectives both for ONS and departmental producers.

A more effective UKSA Board

- 5.98** The most important ingredient in ensuring that the UKSA Board is effective is the quality of the people involved and their commitment to delivering a statistical system fit for a 21st Century economy. But the Board also needs to be supported by effective processes and here the Review believes there is scope for improvement. In particular, the information flows regarding the quality of statistics and their costs, user views and needs, and the implementation and monitoring of change all leave something to be desired.
- 5.99** Several of the recommendations in this Report seek to close this gap. These relate to identifying shortcomings in economic statistics across the whole statistical estate (Recommended Action 2) an effective and transparent prioritisation process (Recommended Action 22), the establishment of a high-level stakeholder group to improve awareness of user views (Recommended Action 23), the creation of an IREO to increase scrutiny of the quality of statistics and ONS performance (Recommended Action 24) and the technical analysis coming out of the Centre for Excellence in the Measurement of the Economy (Recommended Action 4). Together these should significantly expand the evidence base underpinning Board and senior management decisions.

Oversight of UKSA

- 5.100** The architecture enshrined in the Act was designed to prevent government interference in the production and publication of official statistics. Many respondents to the Call for Evidence reiterated the central importance of maintaining that independence. One respondent neatly captured the overall sentiment: “whatever changes are made to the governance arrangements, it is essential that the independence of the production of statistics continues to be guaranteed by statute and is seen to be free from political influence.”²⁸ The Review strongly endorses that sentiment.
- 5.101** Independence alone is, however, clearly insufficient to guarantee the provision of high-quality statistics that are fit for purpose. In response to the question “do you think the current governance arrangements for economic statistics support their effective production?” Professor Diane Coyle noted, “while the arrangements

27 Statistics Sweden (2015) Annual Report 2014. Available [here](#).

28 SP Energy Networks response to Call for Evidence.

broadly safeguard the independence of official economic statistics, the user dissatisfaction means the answer to this question has to be no. The statistics produced are not at present effective in answering the questions users want to address.” Much of this Report has been focussed on explaining why this is so and what can be done to improve matters.

- 5.102** In a democratic society, accountability should be the hand-maiden of independence. The UKSA Board is responsible for ensuring that ONS delivers statistics that meet user needs (though its ability to achieve that for the wider statistical system is rather more limited). So the Board should also be accountable – to government, Parliament, users and the public more generally – for achieving that objective. The 2007 Act sought to establish this accountability by making UKSA accountable to Parliament.
- 5.103** In most advanced economies, the Ministry of Finance is the ‘parent’ department of the NSI. This may seem a natural assignment, as the Ministry of Finance is invariably a major user of economic statistics, as well as holding the purse strings. One consequence of the Act was that residual ministerial responsibilities were given to the Cabinet Office. The thinking was that this would buttress independence precisely *because* of the Cabinet Office’s ‘lack of a particular subject interest’ in statistics. As a department which both produces and uses relatively few statistics, the Cabinet Office was seen as offering an impartial home. Moreover, its role as the co-ordinating department across Whitehall meant that it could support “effective planning of statistical work ... to meet future statistical requirements right across government”.²⁹ Alongside that shift in the identity of the parent department, responsibility for Parliamentary oversight of UKSA and ONS shifted from the Treasury Select Committee (TSC) to the then Public Administration Select Committee (PASC) – now Public Administration and Constitutional Affairs Committee (PACAC).
- 5.104** While it is primarily the responsibility of the UKSA Board to hold ONS to account for the delivery of high-quality statistics, both the parent department and the relevant select committees should be engaged in ensuring that happens. Several factors appear to have contributed to this engagement being less stringent than might have been expected in view of the number of recent errors and the extent of user concerns:
- As noted above, the information on ONS performance and user satisfaction, including on an internationally comparable basis, is not all it could be.
 - Reticence on the part of government and key stakeholders to voice their criticisms loudly in case it was seen as infringing UKSA’s independence.
 - The relative lack of interest within the Cabinet Office in statistics, with an insufficient amount of officials’ time allocated to the oversight of UKSA. Although there has been some extensive engagement on data access

29 TSC, (2006). Oral evidence from the Centre for Policy Studies. Available [here](#).

legislation, routine meetings with senior UKSA/ONS leadership instead focussed on how ONS could better support government implementation taskforces, rather than oversight of UKSA.

- While PASC/PACAC has been very active, viz. its wide ranging inquiry on statistics launched in 2012, its focus, not surprisingly, has been on issues where it has a comparative advantage, namely constitution and governance, rather than the quality and delivery of economic statistics themselves. Although recognising that there were some user concerns about data quality, its 2013 report on the Operation of the Act focussed on issues such as: the lack of clarity over UKSA's committee structure; the need to separate UKSA's production and regulatory functions; co-ordination across the statistical system; and confusion over the meaning of the 'National Statistics' badge.

- 5.105** Now it may seem that the obvious solution to this problem is just to transfer departmental responsibility back to HM Treasury (and prime responsibility for Parliamentary oversight to Treasury Select Committee). Certainly that would put a department in charge that has a high stake in ONS producing high-quality economic statistics. Moreover, the annual spending review process means that the Treasury should be well-sighted on UKSA/ONS's objectives and the resources needed to achieve them.
- 5.106** Such a re-assignment of responsibility would, however, also reintroduce the concerns about ensuring independence that the 2007 Act was supposed to solve. Moreover, while HM Treasury has a stake in the provision of high-quality economic statistics, it has less of a stake in other ONS statistical products, such as population, crime or health statistics. There is no perfect solution.
- 5.107** Accordingly the Review does not recommend changing the current assignment. Instead, the expectation is that other recommendations in the Report will mitigate some of the problems associated with the current arrangements, while allowing the benefits of the present arrangements in buttressing independence to be maintained. These include: establishing effective and transparent processes for prioritisation (Recommended Action 22); the high-level stakeholder group for economic statistics, acting as a conduit for key users to make their concerns felt (Recommended Action 23); and the role of the IREO in providing an additional and public evaluation of ONS performance (Recommended Action 24).

the fact that the *de novo* synthesis of cholesterol is inhibited by the presence of dietary cholesterol (10).

There is a growing body of evidence that the intake of dietary cholesterol is associated with the development of atherosclerosis (11).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of coronary artery disease (12).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of stroke (13).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of peripheral vascular disease (14).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of diabetes mellitus (15).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of hypertension (16).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of obesity (17).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of cancer (18).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of Alzheimer's disease (19).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of Parkinson's disease (20).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of multiple sclerosis (21).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of schizophrenia (22).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of bipolar disorder (23).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of depression (24).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of anxiety disorders (25).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of personality disorders (26).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of eating disorders (27).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of substance use disorders (28).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of self-harm (29).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of suicidal thoughts (30).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of suicidal behavior (31).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of suicide (32).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of suicide risk (33).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of suicide completion (34).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of suicide mortality (35).

There is also a growing body of evidence that the intake of dietary cholesterol is associated with the development of suicide risk factors (36).

Annex A: List of tables and charts

Tables

- Table 2.A Timing of preliminary quarterly GDP estimate (days after end of reference quarter)
- Table 2.B Examples of countries using different depreciation patterns for dwellings and other buildings and structures
- Table 3.A Classification of intangible capital
- Table 3.B Use of hedonic quality adjustment in the CPI and date introduced
- Table 4.A Timeline of significant reviews of ONS and predecessors
- Table 4.B ‘Official figures are generally accurate’, percentage of respondents
- Table 4.C List of de-designated national statistics produced by ONS
- Table 4.D Statisticians and economists, for ONS and Civil Service in 1996 and 2015
- Table 4.E Annual Business Survey 2014 sample size, by questionnaire type
- Table 4.F Comparison of microdata access using VML, HMRC Datalab and facilities in Canada and New Zealand

Charts

- Chart 2.A Availability of data for each GDP measure from the end of the reference quarter
- Chart 2.B Revisions to quarterly GDP growth five months after preliminary estimate, Q4 1994 to Q4 2013 (percentage points)
- Chart 2.C Revisions to quarterly GDP growth three years after preliminary estimate, Q4 1994 to Q4 2013 (percentage points)
- Chart 2.D Revisions to quarterly GDP growth, 2008 to 2012
- Chart 2.E Share of nominal gross value added
- Chart 2.F Role of services in gross value added and the Standard Industrial Classification (SIC)
- Chart 2.G Size of financial systems as a % of GDP
- Chart 2.H Examples of the functional form of depreciation
- Chart 3.A Global internet traffic trends

- Chart 3.B Share of the population undertaking internet-enabled activities
- Chart 3.C Internet use
- Chart 3.D Share of information and communication in gross value added
- Chart 3.E Relative price of communication and internet consumption traffic
- Chart 3.F Internet activity and economic activity: newspapers and periodicals
- Chart 3.G Internet activity and economic activity: communication services
- Chart 3.H Comparison of units and value of music sales
- Chart 3.I Digital disruption in the travel booking industry
- Chart 3.J Data storage capacity
- Chart 3.K Market capitalisation of Airbnb compared to major hotels, 2015 (£ billion)
- Chart 3.L UK business investment in tangible and intangible capital, 1970 to 2012 (% of adjusted GVA)
- Chart 3.M Business investment, 2010 (% of adjusted GVA)
- Chart 3.N Labour productivity growth before and after the contribution of intangible assets, 1995 to 2006
- Chart 3.O UK current account balance (% of nominal GDP)
- Chart 3.P Share of parent applications located outside the UK and separate from inventors (%)
- Chart 4.A Approximate deflated core ONS resources against real GDP
- Chart 4.B Staff working on core National Accounts tables by population, 2015
- Chart 4.C Staff working on core National Accounts tables 2015
- Chart 4.D Trust in National Statistical Institutes, % of respondents (excluding 'don't know')
- Chart 4.E Headcount at ONS sites, 2004 to 2015
- Chart 4.F Staff by salary relative to national annual average wage, ONS and Statistics Canada
- Chart 4.G Business survey costs (2007-08 to 2014-15) and response rates for five business survey (2005 to 2014)
- Chart 4.H Labour Force Survey response and contact rates, 1993 to 2015
- Chart 4.I Household expenditure survey response rate, 1969 to 2010
- Chart 5.A UK Statistical System Governance Map, November 2015
- Chart 5.B Average user and producer responses (%)

Annex B: Acronyms

ABI	Annual Business Inquiry
ABS	Annual Business Survey
ACAS	Annual Acquisitions and Disposals of Capital Assets Survey
ADRN	Administrative Data Research Network
ARD	Annual Respondents Database
BED	Business Employment Dynamics
BIS	Department of Business, Innovation and Skills
BLS	Bureau of Labor Statistics
CBI	Confederation of British Industry
CDs	Compact Discs
CIPFA	Chartered Institute of Public Finance and Accountancy
CPI	Consumer Prices Index
CPIH	Consumer Prices Index including Owner-Occupiers' Housing Costs
CSO	Central Statistical Office
DEL	Departmental Expenditure Limit
ESA	European Systems of Accounts
ESRC	Economic and Social Research Council
EU	European Union
FCA	Financial Conduct Authority
FISIM	Financial Intermediation Services Indirectly Measured
FRED	Federal Reserve Economic Database
FTE	Full-time equivalent staff
GBps	Gigabytes per second
GDP	Gross Domestic Product
GDP(E)	Expenditure measure of GDP

GDP(I)	Income measure of GDP
GDP(O)	Output measure of GDP
GDS	Government Digital Service
GEP	General Expenditure Policy
GSS	Government Statistical Service
GVA	Gross Value Added
HMRC	HM Revenue and Customs
HoP	Heads of Profession
HSL	Health and Safety Laboratory
IDBR	Inter-Departmental Business Register
IEO	Independent Evaluation Office
IRO	Independent Regulation and Evaluation Office
IPS	International Passenger Survey
ISO	Information Sharing Order
IT	Information Technology
JOLTS	Job Openings and Labor Turnover Survey
LCF	Living Costs and Food Survey
LEP	Local Enterprise Partnership
LFS	Labour Force Survey
MNE	Multinational enterprise
NDP	National Population Database
NIESR	National Institute of Economic and Social Research
NSEG	National Statisticians Executive Group
NSI	National Statistical Institute
NSQR	National Statistics Quality Review
NUTS	Nomenclature of Units for Territorial Statistics
OBR	Office for Budget Responsibility
OECD	Organisation for Economic Co-operation and Development
ONS	Office for National Statistics
P2P	Peer-to-Peer
PASC	Public Administration Select Committee

PAYE	Pay As You Earn
PC	Portfolio Committee
PIM	Perpetual Inventory Method
PPM	Project and Programme Management
PRODCOM	Products of the European Community
QMI	Quality and Methodology Information
R&D	Research and Development
RDC	Research Data Centres
RES	Royal Economic Society
RPI	Retail Prices Index
RQR	Regular quality review
RSS	Royal Statistical Society
SCS	Senior Civil Service
SIC	Standard Industrial Classification
SNA	System of National Accounts
SR	Spending Review
SRSA	2007 Statistics and Registration Service Act
TSC	Treasury Select Committee
UK	United Kingdom
UKCeMGA	UK Centre for the Measurement of Government Activity
UKSA	UK Statistics Authority
VAT	Value Added Tax
VICS	Volume Index of Capital Services
VML	Virtual Microdata Laboratory
VOA	Valuation Office Agency
WTO	World Trade Organisation

Annex C: Terms of reference

- C.1** As announced in the Productivity Plan, with the support of the Chair of the UK Statistics Authority, the Chancellor of the Exchequer has commissioned Professor Sir Charles Bean to conduct an independent review of the quality, delivery and governance of UK economic statistics.
- C.2** The Terms of Reference of the Review are to:
- assess the UK's future statistics needs in particular relating to the challenges of measuring the modern economy;
 - assess the effectiveness of the ONS in delivering those statistics, including the extent to which the ONS makes use of relevant data and emerging data science techniques
 - while fully protecting the independence of the UK national statistics, consider whether the current governance framework best supports the production of world-class economic statistics.
 - The Review will make interim recommendations to the Chancellor of the Exchequer and the Minister for the Cabinet Office in the autumn, with a final report published by Budget 2016.

Annex D: Call for evidence

Scope of the review

- D.1** In line with the Terms of Reference this Review of economic statistics will assess the UK's future statistics needs, the capability of ONS in delivering those statistics and the most appropriate governance framework to support production of those statistics.
- D.2** ONS is the executive office of the UK Statistics Authority, an independent body with the statutory objective to promote and safeguard the production and publication of official statistics that serve the public good. Although other public bodies produce statistics in the UK, the Review will principally focus on the ONS, as the primary source of economic statistics.
- D.3** In assessing the needs of a modern economy, the Review will look at statistics that are used to inform economic decision-making. This includes ONS publications from national accounts to labour market statistics to family expenditure data, as well as the data sources from across the public and private sectors that are used as inputs. The Review will also consider any potential gaps in this range. Statistics not relevant to economic decision making fall outside the scope of the Review. To understand the statistics needed to measure the modern economy, the Review is seeking evidence from users of economic data.
- D.4** This Review follows a number of other reviews on specific areas of statistics, most recently the National Statistics Quality Review of the National Accounts and Balance of Payments, and the Review of UK Consumer Price Statistics. The Review will carefully consider these previous studies, and seek to build on their findings to identify the UK's future statistics needs and how best to meet them. The Review will also take note of the Authority's own assessment work.
- D.5** The Reviewer has been asked to make interim recommendations to the Chancellor of the Exchequer and the Minister for the Cabinet Office in the autumn, with a final report published by Budget 2016.

Call for evidence questions

- D.6** The key questions of this Call for Evidence are outlined below, together with accompanying background information to assist users and create a suitably focused response. Responses are invited to all questions, but partial responses are also welcome where users feel they have little to say on particular questions.

- D.7** The first part of the Terms of Reference of the Review is to assess *the UK's future statistics needs in particular relating to the challenges of measuring the modern economy*.
- D.8** There are a number of difficulties in measuring the modern economy, which represent significant challenges to all national statistics offices. These can range from specific issues related to the comprehensive measurement of a constantly evolving economy – for instance, capturing the benefits of technological change through quality improvements – to broader issues related to the provision of more granular information, for example more complete Flow of Funds data, or more detailed regional statistics. The questions below seek respondents' views on the nature of those challenges and appropriate future priorities.
1. From your perspective, what are the most significant outstanding challenges in measuring the modern economy?
 2. Are there features of the modern economy that you think are not well captured in the present range of UK economic statistics?
 3. What do you think should be the two or three top statistical priorities for measuring the modern economy?
- D.9** The second part of the Terms of Reference of the Review is to assess *the effectiveness of the ONS in delivering those statistics, including the extent to which the ONS makes use of relevant data and emerging data-science techniques*.
- D.10** The ONS is the primary source of economic statistics in the UK. Delivering the UK's future statistics needs will mean ensuring that the ONS has the capability to publish timely, accurate and high quality data. That capability could be enhanced by improvements to methods of data collection, analysis or dissemination. This may require using new sources of information, as well as employing new techniques and technologies to gather and exploit those data sources. The experience of other countries or other data providers may offer helpful examples. One example of the potential use of big data is the recent trial by ONS of 'web scraping' to collect a sample of price data online. The questions below seek respondents' views on whether the ONS is well placed to deliver timely, accurate and high quality statistics.
4. What are the strengths and weaknesses in ONS's current ability to deliver the existing range of economic statistics?
 5. What steps do you think are needed for ONS to have the capability to collect, analyse and disseminate the relevant data to meet future statistics needs?
 6. What scope is there for ONS to exploit emerging data-science techniques in meeting future statistics needs?

- D.11** The third part of the Terms of Reference of the Review is to, *while fully protecting the independence of the UK national statistics, consider whether the current governance framework best supports the production of world-class economic statistics.*
- D.12** For the interim recommendations to be published in the autumn, the immediate priority of the Review is to assess the statistics needed for a modern economy and the capability of the ONS to develop those statistics. The Review will subsequently consider what governance arrangements are most appropriate to support the development of those statistics and ensure the future needs for economic statistics are met.
- D.13** The Statistics and Registration Service Act 2007 established the UK Statistics Authority as an independent body operating at arm's length from government as a non-ministerial department, directly accountable to Parliament. The Minister for the Cabinet Office undertakes the government's residual responsibilities in relation to the UK Statistics Authority. Protection for the statutory independence for statistics is set out in the Terms of Reference of the Review.
7. Do you think the current governance arrangements for economic statistics support their effective production?
 8. Are there changes to those arrangements that you would advocate?
- D.14** To enable the Review to make the best use of your responses, respondents are asked to respond in the formats described below. In particular, respondents are asked to describe their use of economic data in order to enable the most useful analysis of responses.

Annex E: Call for evidence respondents

Organisations

Bank of England

BMLL Technologies Ltd.

British Chambers of Commerce

British Film Institute

Chartered Institute of Personnel and Development

Confederation of British Industry

Crafts Council

Datawatch

Department for Business, Innovation and Skills

Department for Communities and Local Government

Department for Culture, Media and Sport

Department for Environment, Food and Rural Affairs

Design Council

Eurostat

Exporting Education UK

Food Standards Agency

Full Fact

GFC Economics

Greater London Authority

HM Treasury

House of Commons Library

Huxtable Associates, Mineral Industry Services

Institute for Chartered Accountants in England and Wales

Kent County Council

Kern Consulting

Manufacturing Technologies Association

NESTA

New Economics Foundation

New Economy

Northern Ireland Statistics and Research Agency

Notayesmanseconomics

Office for Budget Responsibility

Oxford Economics

Royal Economic Society

Royal Statistical Society

Scienceogram

Scottish Enterprise

Scottish Government

SP Energy Networks

Spilsbury Research

Spotify Ltd.

Trades Union Congress

UK Music

VisitBritain

Welsh Government

Academics

Alex Adamou

Christopher Hood

Dame Kate Barker

David Blanchflower

David Heald

Diane Coyle

JP MacIntosh, Paul Ormerod and Bridget Rosewell

Ludi Simpson

Mike Holcombe

Nicholas Oulton

Paul Allin

Paul Smith

Sir John Kingman

Private individuals, including users and producers of economic statistics

Andrew Lydon

Bill Wells

John Hann

Reginald Cox

Simon Briscoe

Stuart Onyeche

2 anonymous responses

Responses to the Call for Evidence have been published online.

Annex F: Stakeholder Engagement

This list of stakeholders that Professor Bean and the Review team have engaged with, including meetings with experts undertaken in a personal capacity rather than as representatives of their organisations. Alongside this, correspondence has also been received from various individuals.

Government Departments, agencies and public bodies

Professor Bean and the Review team have had ongoing engagement with ONS and UKSA as the subject of the Review, and with HM Treasury and Cabinet Office as the commissioning departments.

Annabel Burns, Department for Education

Ben Broadbent and other officials, Bank of England

David Blunt and Bernard Silverman, Home Office

David Sterling and other officials, Department of Finance and Personnel for Northern Ireland

Derek Jones and Jonathan Price, Welsh Government

Edward Zamboni, Sean Whellams and other officials, HM Revenue and Customs

Gary Gillespie and other officials, Scottish Government

Helen Balmforth, Maria Ottati and other officials, Health and Safety Executive

Jenny Bates, Siobhan Carey and other officials, Department of Business, Innovation and Skills

Neil McIvor and Adrian Richards, Department for Work and Pensions

Officials at the Land Registry

Officials at the Valuation Office Agency

Paul Crawford and other officials, Department for Culture, Media and Sport

Phil Evans and Charlie Ewen, Met Office

Robert Chote and other officials, Office for Budget Responsibility

Stephen Aldridge, David Fry and other officials, Department for Communities and Local Government

National Statistical Institutes

Alfredo Cristobal, National Statistical Institute of Spain

Ingegerd Jansson, Magnus Häll, Stefan Lundgren, Oskar Nyqvist and Dan Wu, Statistics Sweden

Jennifer Banim and Pádraig Dalton, Central Statistical Office of Ireland

Jorgen Elmestov, Statistics Denmark

Raoul Depoutot, National Institute of Statistics and Economic Studies, France

Teresa Dickinson, Gary Dunnet, Vince Galvin, Frances Krsinich, Rachael Milicich, Anna McDowell, Stephen Oakley and Brenda Peryer, Statistics New Zealand

Tjark Tjin-A-Tsoi and Barteld Braaksma, Statistics Netherlands

Wayne Smith, James Tebrake and other colleagues, Statistics Canada

Others

Adam Cohen and Hal Varian, Google

Anajali Samani, The ASI

Ben Jones, Confederation of British Industry

Bill Schomberg, Reuters

Carol Dezateux, University College London

Chris Giles, The Financial Times

Chris Skinner, London School of Economics

Constantin Cotzias, Fergal O'Brien, Jillian Ward, Bloomberg L.P

David Caplan, Belmana Research

David Firth, University of Warwick

David Groom, Vocalink

David Hand, Imperial College London

David Smith, The Sunday Times

David Spiegelhalter, University of Cambridge

Deborah Davies, Michael Flood and Iain Sterland, members of the Demographics User Group

Diane Coyle, University of Manchester

Geoff Tily, Trades Union Congress

George Buckley, Deutsche Bank

Giles Pavey, Dunnhumby

Hasan Bakhshi, John Davies, Juan Mateos-Garcia and Cath Sleeman, Nesta

Henry Overman, London School of Economics

Hetan Shah and other colleagues, Royal Statistical Society

Howard Archer, IHS Economics

Jane Elliot, Economic and Social Research Council

Jason Douglas, Wall Street Journal

João Cadete de Matos and others, Banco de Portugal

John Aston, University of Cambridge

Jonathan Haskel, Royal Economic Society

Kevin Daly, Goldman Sachs

Laura Gardiner and Matt Whittaker, Resolution Foundation

Li-Chun Zhang, University of Southampton and Statistics Norway

Ian Keyte, Louise Pakseresht and Laurie Smith, Royal Society

Mark Birkin, University of Leeds

Martin Burrow, China-Britain Business Council

Matthew Waite, Milja Keijonen and Gordon Douglass, Greater London Authority

Melanie Baker, Morgan Stanley

Michael Mandel, Progressive Policy Institute

Michael Osborne, University of Oxford

Michael Saunders, Citi Research Economics

Mike Heiser, Local Government Association

Nadim Ahmad, Chiara Criscuolo and Paul Schreyer, Organisation for Economic Co-operation and Development

Neville Hill, Credit Suisse

Nicholas Oulton, London School of Economics

Paul Cheshire, London School of Economics

Paul Johnson, Helen Miller and Luke Sibieta, Institute for Fiscal Studies

Peter Elias, University of Warwick

Peter Spence, The Telegraph

Petros Dellaportas, University College London

Philip Aldrick, the Times

Philip Rush, Nomura

Richard Alldritt, Consultant

Ross Campbell, Robert Hodgkinson and Zohir Uddin, Institute of Chartered Accountants in England and Wales

Simon Briscoe, Consultant

Simon Kirby, National Institute of Economic and Social Research

Suren Thiru, British Chambers of Commerce

Timothy Lane and other colleagues, Bank of Canada

Tom Gatten, Growth Intelligence

Tony Clayton, Imperial College London

Walter Radermacher, Eurostat

Will Page, Spotify Ltd.

Conferences Attended

TechUK event, 11 September 2015

Eurostat conference, 22 September 2015

Open meeting hosted by Royal Statistical Society, 28 September 2015

IP Expo Europe, 7-8 October 2015

BIS and ONS joint conference: How e-commerce is changing the shape of business, 8 October 2015

Government Economic Service Mini-Conference, 6 November 2015

University College London, Theory of Big Data Conference, 7 January 2016

ONS Economic Forum, 19 January 2016 and 15 October 2015

Annex G: Bibliography

- Abbott, O., (2014), 'ONS Methodology Working Paper Series 1: ONS Innovation Laboratories'. Available [here](#).
- Abowd, J. M., and Zellner, A., (1985). 'Estimating Gross Labor Force Flows,' Journal of Business and Economic Statistics.
- Abramovsky, L., and Griffith, R., (2006). 'Outsourcing and Offshoring of Business Services: How Important is ICT?' Journal of the European Economic Association, MIT Press, vol. 4(2-3), p.594-601, 04-05
- Acemoglu, D. Ozdaglar, A., and Tahbaz-Salehi, A., (2015). 'Networks, Shocks, and Systemic Risk,' NBER Working Papers 20931, National Bureau of Economic Research
- Acemoglu, D., Carvalho, V., Ozdaglar, A., and Tahbaz-Salehi, A., (2012). 'The Network Origins of Aggregate Fluctuations,' Econometrica, vol. 80(5), p. 1977-2016, 09
- Adrian, T., and Shin, H. (2010). 'The Changing Nature of Financial Intermediation and the Financial Crisis of 2007–2009,' Annual Review of Economics, vol. 2(1), p. 603-618, 09
- Aghion, P., Besley, T., Browne, J., Caselli, F., Lambert, R., Lomax, R., Pissarides, C., Stern, N., and Van Reenen, J., (2013). 'Investing for Prosperity: Skills, Infrastructure and Innovation – Report of the LSE Growth Commission'. Available [here](#).
- Agnew, H., (2016). 'PwC seeks more data analysts to analyse deals', Financial Times. Available [here](#).
- Aguiar, M., Hurst, E., and Karabarbounis, L., (2012). 'Recent developments in the economics of time use,' Annual Review of Economics 4, pp.373-397
- Akritidis, L., (2007). 'Improving the measurement of banking services in the UK National Accounts,' ONS Economic & Labour Market Review, Vol 1, No 5. Available [here](#).
- Allsopp, C., (2004). 'Review of Statistics for Economic Policymaking: Final Report'. Available [here](#).
- Anderson, C., (2006). The Long Tail: Why the Future of Business Is Selling Less of More. Hyperion
- Approval is subject to the 'Commissioners for Revenues and Customs Act 2005' which also defines a HMRC function. Available [here](#).
- Atkinson, T., (2005). 'Atkinson Review: Final Report – Measurement of Government Output and Productivity for the National Accounts,' Palgrave MacMillan. Available [here](#).

- Bailey, R., Rofique, J. and Humphrey, A., (2010). 'Public Confidence in Official Statistics 2009', Natcen Social Research. Available [here](#).
- Bakhshi, H., Mateos-Garcia, J. and Whitby, A., (2014). 'Model Workers – How leading companies are recruiting and managing data talent'. Available [here](#).
- Bank of England, (2004). 'Inflation Report – May (2004)'. Available [here](#).
- Bank of England, (2015). Response to ONS customer satisfaction survey 2014-15. Available [here](#).
- Bank of Portugal, (2013). 'A flexible approach to credit statistics: The use of the Portuguese Central Credit Register for statistical compilation'. Available [here](#).
- Barker, K. and Ridgeway, A., (2014). 'National Statistics Quality Review: National Accounts and Balance of Payments.' Available [here](#).
- Barker, K., (2004). 'Barker Review of Housing Supply'. Available [here](#).
- Barrett, G., Levell, P. and Milligan, K., (2012). 'A comparison of micro and macro expenditure measures across countries using differing survey methods'. Paper prepared for "*Conference on Improving the Measurement of Consumer Expenditures*". Available [here](#).
- Basu, S., Inklaar, R., and Wang, J. C. (2011). 'The Value of Risk: Measuring the Service Income of U.S. Commercial Banks,' *Economic Inquiry*, vol. 49(1), p. 226-245
- Battiston, S., Delli Gatti, D., Gallegati, M., Greenwald, B., and Stiglitz, J., (2012). 'Liaisons dangereuses: Increasing connectivity, risk sharing, and systemic risk,' *Journal of Economic Dynamics and Control*, vol. 36(8), p. 1121-1141
- BBC News Magazine, (2014). 'The lost era of the A-Z map?'. Available [here](#).
- Bê Duc, L., and Le Breton, G. (2009). 'Flow-of-funds analysis at the ECB Framework and applications,' *European Central Bank Occasional Paper Series No 105*. Available [here](#).
- Bebusiness.com, 'The History of VoIP'. Available [here](#).
- Becker, G., (1965). 'A Theory of the Allocation of Time'. *The Economic Journal*, Vol. 75, No 299
- BIS, (2015). 'Independent review of the sharing economy – Government response'. Available [here](#).
- BIS, (2015). 'Small Business Survey 2014: SME employers,' *BIS research paper number 214*. Available [here](#).
- Blanchflower, D., (2014). 'Yet more evidence that pay is going nowhere fast,' *The Independent*. Available [here](#).
- Bloom, N., Genakos, C., Sadun, R., and Van Reenen, J., (2012). 'Management Practices Across Firms and Countries,' *NBER Working Papers*, no.17850. Available [here](#).
- BLS, (2004). 'Effects of Job Changing on Payroll Survey Employment Trends'. Available [here](#).

- BLS, (2015). 'Comparison of U.S. and international labor turnover statistics'. Available [here](#).
- Boettcher, I., (2015). 'Automated data collection on the Internet (webscraping)', Statistics Austria. Available [here](#).
- Boskin, M., Dulberger, E., Gordon, R., Griliches, Z., and Jorgenson, D., (1996). 'Toward a More Accurate Measure of the Cost of Living,' Final Report to the Senate Finance Committee. Available [here](#).
- Bostic Jr, W., Jarmin, R. and Moyer, B., (2014). 'Modernizing Federal Economic Statistics', US Census Bureau and Bureau of Economic Analysis'. Available [here](#).
- Botsman, R., (2010). What's mine is yours: The rise of collaborative consumption. HarperCollins Publishers.
- Branchi, M., Dieden, H., Haine, W., Horvath, A., Kanutin, A., and Kezber L., (2007). 'Analysis of revisions to general economic statistics,' European Central Bank Occasional Paper Series, No 74. Available [here](#).
- Bresnahan, T., Brynjolfsson, E., and Hitt, L., (2002). 'Information Technology, Workplace Organization, And The Demand For Skilled Labor: Firm-Level Evidence,' The Quarterly Journal of Economics, vol. 117(1), p.339-376, February. Available [here](#).
- British Quality Foundation, (2014). '2014 Awards'. Available [here](#).
- Broadbent, B. (2015). 'Compositional shifts in the labour market'. Available [here](#).
- Broadbent, B., (2012). 'Productivity and the allocation of resources'. Available [here](#).
- Brunnermeier, M. K. (2009). 'Deciphering the Liquidity and Credit Crunch 2007-2008,' Journal of Economic Perspectives, vol. 23(1), p. 77-100, Winter
- Brynjolfsson, E., and McAfee, A., (2014). 'The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies,' W. W. Norton & Company
- Brynjolfsson, E., and Oh, J., (2012). 'The Attention Economy: Measuring the Value of Free Digital Services on the Internet,' AIS Electronic Library
- Buckley, G., (2016). 'UK Economic Topic – UK: Beware the first estimate of GDP'. Deutsche Bank Research
- Burrows, O., Low, K., and Cumming, F. (2015). 'Mapping the UK financial system,' Bank of England Quarterly Bulletin, vol. 55(2), p. 114-129. Available [here](#).
- Byrne, D., Fernald, J., and Reinsdorf, M., (2016). 'Does the United States have a Productivity Slowdown or a Measurement Problem?,' Federal Reserve Bank of San Francisco, Working Paper 2016-03. Available [here](#).
- Byrne, D., Oliner, S., and Sichel, D., (2015). 'How fast are semiconductor prices falling?,' AEI Economic Policy Working Paper 2014-06. Available [here](#).
- Caballero, R. J., Hoshi, T. and Kashyap, A., (2008). 'Zombie Lending and Depressed Restructuring in Japan,' American Economic Review, vol. 98(5), p. 1943-77, December

- Cabinet Office, (2010). 'The Coalition: Our Programme for Government'. Available [here](#).
- Cabinet Office, (2015). 'Civil Service People Survey: 2015 results'. Available [here](#).
- Cabinet Office, (2016). 'Better use of data in government: consultation paper'. Available [here](#).
- Campbell, R., (2014). 'CPIH Announcement 14 August 2014 – Explanatory Note', ONS. Available [here](#).
- Carney, M., (2015). 'Remarks at the Economic Policy Symposium hosted by the Federal Reserve Bank of Kansas City', Jackson Hole, Wyoming. Available [here](#).
- Carney, M., (2015). 'The European Union, monetary and financial stability, and the Bank of England'. Available [here](#).
- Cassing, S., (1996). 'Correctly Measuring Real Value Added,' Review of Income and Wealth, Series 42, Number 2, June
- Cheng, Y., (2012). 'Overview of Current Population Survey Methodology,' Proceedings of the Joint Statistical Meetings – American Statistical Association. Available [here](#).
- Cheshire, P., (2013). 'Land Prices: the dog that's lost its bark'. Available [here](#).
- Cisco Systems, (2014). 'Cisco Global Cloud Index: Forecast and Methodology, 2013-2018'. Available [here](#).
- Cisco Systems, (2015). 'The Zettabyte Era – Trends and Analysis'. Available [here](#).
- Colangelo, A., and Inklaar, R., (2010). 'Banking sector output measurement in the euro area – a modified approach,' Working Paper Series 1204, European Central Bank
- Corrado, C., and Hulten, C., (2010). 'How Do You Measure a "Technological Revolution"?' American Economic Review, vol. 100(2), p. 99-104, May. Available [here](#).
- Corrado, C., Haskel, J., Jona-Lasinio, C., and Iommi, M., (2014). 'Internationally comparable macro-estimates of investment in intangible assets at the industry level: INTAN – Invest
- Corrado, C., Hulten, C., and Sichel, D., (2005). 'Measuring Capital and Technology: An Expanded Framework,' in Corrado, C., Haltiwanger, J., and Sichel, D. (eds.), Measuring Capital in the New Economy, National Bureau of Economic Research and University of Chicago Press. Available [here](#).
- Council of Economic Advisers, (2015). 'A Better Measure of Economic Growth: Gross Domestic Output (GDO),' Council of Economic Advisers Issue Brief, July. Available [here](#).
- Council of Economic Advisors, (2012). 'Economic Report of the President'. Available [here](#).
- Coyle, D., (1997). The Weightless World: Strategies for Managing the Digital Economy. Massachusetts Institute of Technology Press
- Coyle, D., (2014). GDP: A Brief but Affectionate History, Princeton, NJ: Princeton University Press

- Coyle, D., (2015). 'Modernising Economic Statistics: Why It Matters,' National Institute Economic Review No. 234
- Coyle, D., (2016). 'The Sharing Economy in the UK'. Available [here](#).
- Cremeans, J., (1980). 'Consumer Services Provided by Business through Advertising-Supported Media in the United States,' *Review of Income and Wealth* 26, pages 151-174
- Cunningham, A., and Jeffery, C., (2007). 'Extracting a better signal from uncertain data,' *Bank of England Quarterly Bulletin* 2007 Q3. Available [here](#).
- Davidson, L., (2015). 'Airbnb boss calls the UK the "centre of the sharing economy",' *The Telegraph*. Available [here](#).
- Davidson, L., (2015). 'Mapped: how the sharing economy is sweeping the world,' *The Telegraph*. Available [here](#).
- Davidson, L., (2015). 'Since Uber launched, there are 26pc more cabs in London,' *The Telegraph*. Available [here](#).
- DCLG, (2015). 'Land value estimates for policy appraisal 2014'. Available [here](#).
- DCLG, (2016). 'Permanent dwellings completed, by tenure and country'. Available [here](#).
- De Haan, J., (2015). 'A Framework for Large Scale Use of Scanner Data in the Dutch CPI', *Statistics Netherlands*
- de Leeuw, E., and de Heer, W., (2002). 'Trends in Household Survey Nonresponse: A Longitudinal and International Comparison,' in Groves, R. et al. (eds.). *Survey Nonresponse*
- DeGusta, M. (2011). 'The real death of the music industry,' *Business Insider*. Available [here](#).
- Deloitte, (2015). 'The internet of Things really is things, not people'. Available [here](#).
- Denman, J., and P. McDonald, (1996). 'Unemployment statistics from 1881 to the present day.' *Labour Market Trends* 104, no. 1: 5-18. Available [here](#).
- DfT, (2015). 'Taxis, private hire vehicles and their drivers'. Available [here](#).
- Diewert, W., (1974). 'Intertemporal Consumer Theory and the Demand for Durables,' *Econometrica* 42, May, p. 497–516
- Edens, B., van den Bergen, D., van Rossum, M., Hoekstra, R., and Rensman, M., (2015). 'The SNA: Facing a Choice Between Measurability and Relevance'. Available [here](#).
- Einav, L., and Levin, J., (2013). 'The data revolution and economic analysis'. NBER working paper 19035
- Eurostat, (2010). 'European system of accounts – ESA 2010 – Transmission programme of data'. Available [here](#).
- Eurostat, (2015). 'E-commerce statistics for individuals'. Available [here](#).

Eurostat, (2015). 'Quality Assurance Framework of the European Statistical system'. Available [here](#).

Eurostat, (2016). 'Handbook on prices and volume measures in national accounts'. Available [here](#).

Eurostat. 'Building the System of National Accounts – volume measures'. Available [here](#).

Fallick, B., and Fleischmann, C., 'Employer-to-Employer Flows in the U.S. Labor Market: The Complete Picture of Gross Worker Flows,' Federal Reserve FEDS Working Paper 2004-34

Feldstein, M., (2015). 'The U.S. Underestimates Growth,' Wall Street Journal. Available [here](#).

Fitzgerald, J., (2013). 'The effect of re-domiciled Plcs on Irish output measures and the balance of payments,' ESRI QEC Research. Available [here](#).

Franklin, M., and Murphy, J., (2014). 'Labour Productivity Measures from the ABS, 2008-2012,' ONS. Available [here](#).

Frazis, H. J., Robison, E., Evans, T., and Duff, M., (2005). 'Estimating gross flows consistent with stocks in the CPS'. Available [here](#).

Friedman, T. (2007). *The world is flat, 3.0: a brief history of the twenty-first century*. Picador, London

Gardiner, L., (2015). 'The 'gig economy' – revolutionising the world of work, or the latest storm in a teacup'. Available [here](#).

Gartner, (2015). 'Gartner Says 6.4 Billion Connected "Things" Will Be in Use in 2016, Up from 30 Percent in 2015'. Available [here](#).

Goldfarb, A., and Prince, J., (2008). 'Internet Adoption and Usage Patterns are Different: Implications for the Digital Divide,' *Information Economics and Policy* (20), pp.2-15

Goldman Sachs (2015). 'The Future of Finance (part 1): The rise of the new Shadow Bank'. Goldman Sachs Equity Research

Goolsbee, A., and Klenow, P.J., (2006). 'Valuing Consumer Products by the Time Spent Using Them: An Application to the Internet,' *American Economic Review* (96:2), pp.108-113

Government Digital Service, (2015). 'Office for National Statistics Website – Self Certification'. Available [here](#).

Griffith, R., Miller, H., and O'Connell, M., (2014). 'Ownership of intellectual property and corporate taxation'. Available [here](#).

Gulati, R., Nohria, N., and Wohlgezoge, F., (2010). 'Roaring Out of Recession,' *Harvard Business Review*, March. Available [here](#).

Hall, J., and Krueger, A., (2015). 'An Analysis of the Labor Market for Uber's Driver-Partners in the United States'. Available [here](#).

Harford, T., (2013). 'A statistical needle in a bureaucratic haystack', Financial Times. Available [here](#).

Harris, R., and Drinkwater, S., (2000). 'UK Plant and Machinery Capital Stocks and Plant Closures,' Oxford Bulletin of Economics and Statistics, 62: 243–265. Available [here](#).

Haskel, J., Goodridge, P., and Wallis, G., (2015). 'Accounting for the UK productivity puzzle: a decomposition and predictions,' Discussion Paper 2015/02, Imperial College Business School. Available [here](#).

Hatzius, J., and Dawsey, K., (2015). 'Doing the Sums on Productivity Paradox v2.0,' Goldman Sachs US Economics Analyst, No. 15/30

Henshall, D., (2015). 'Labour Market Flows, November 2015 (Experimental Statistics)'. Available [here](#).

Hilbert, M., and López, P., (2011). 'The world's technological capacity to store, communicate, and compute information,' Science, Vol. 332, Issue 6025, pp. 60-65

Hill, S., Thomas, R. and N. Dimsdale (2015), 'Three Centuries of Data – Version 2.2', Bank of England

Hills, B., and Thomas, R., (2005). 'The impact of government spending on demand pressure,' Bank of England Quarterly Bulletin 2005 Q1. Available [here](#).

HM Treasury, (1999). 'Building trust in statistics'. Available [here](#).

HM Treasury, (2006). 'Independence for Statistics: a consultation document'. Available [here](#).

HM Treasury, (2010). Correspondence from the Chancellor of the Exchequer to the Governor of the Bank of England on 'CPI Inflation'. Available [here](#).

HM Treasury, (2015). 'Spending Review and Autumn Statement 2015'. Available [here](#).

HM Treasury, (2015). Correspondence from Chancellor of the Exchequer to Governor of the Bank of England on remit of the Financial Policy Committee, 8 July 2015. Available [here](#).

HM Treasury, (2015). Response to ONS customer satisfaction survey 2014-15. Available [here](#).

Hoekstra, R., Ten Bosch, O. and Harteveld, F. (2010). 'Automated Data Collection from Web Sources for Official Statistics: First Experiences', Statistics Netherland. Available [here](#).

Hoekstra, R., Ten Bosch, O. and Harteveld, F., (2010). 'Automated Data Collection from Web Sources for Official Statistics: First Experiences', Statistics Netherlands. Available [here](#).

Hood, K. (2013), 'Measuring the Services of Commercial Banks in the National Income and Product Accounts: Changes in Concepts and Methods in the 2013 Comprehensive Revision,' Survey of Current Business, 93, No. 2 (February), p. 8-19

Hulten, C., and Wykoff, F., (1981). 'The Measurement of Economic Depreciation,' in Hulten, C. (ed.), *Depreciation, Inflation and the Taxation of Income from Capital*, Washington DC, The Urban Institute Press. Available [here](#).

IBM. 'Demystifying Big Data: Decoding: The Big Data Commission Report'. Available [here](#).

IFS, (2015). 'Green Budget'. Available [here](#).

International Monetary Fund 'Overview of the Monetary and Financial Statistics Framework'. Available [here](#).

International Telecommunication Union, (2015). 'Measuring the Information Society Report'. Available [here](#).

Jenkinson, G. and Brand, M., (2000). 'A decade of improvements to economic statistics', *Economic Trends*

Jeskanen-Sundstrom, H., (2008). 'Overview and challenges in the use of administrative data in official statistics'. Available [here](#).

Johnson, P., (2015). 'UK Consumer Price Statistics: A Review'. Available [here](#).

Jonas, A., Shanker, R., Liu, J., Jain, P., and Mehta, N., (2015). 'Shared Autonomy: Put This Chart on Your Wall, It's My Sad Life,' Morgan Stanley Research. Available [here](#).

JPMorgan Chase Institute, (2016). 'Paychecks, Paydays, and the Online Platform Economy'. Available [here](#).

Krsinich, F., (July 2015). 'Implementation of consumer electronics scanner data in the New Zealand CPI', *Statistics New Zealand*. Available [here](#).

Lambrecht, A., Goldfarb, A., Bonatti, A., Ghose, A., Goldstein, D., Lewis, R., Rao, A., Sahni, N., and Yao, S., (2014). 'How do firms make money selling digital goods online?,' *Marketing Letters*, Springer, vol. 25(3), p331-341, September. Available [here](#).

Landefeld, J., Seskin, E., and Fraumeni, B., (2008). 'Taking the Pulse of the Economy: Measuring GDP,' *Journal of Economic Perspectives*, vol. 22(2), p. 193-216, Spring

Landefeld, S. J., Fraumeni, B. M., and Wojtech, C., (2005). 'Accounting for Nonmarket Production: A Prototype Satellite Account Using the American Time Use Survey'. Available [here](#).

Lane, P., (2015). 'A financial perspective on the UK current account deficit,' *National Institute Economic Review*, No.234, November. Available [here](#).

Lanier, B., and Bajarib, P., (2005). 'Hedonic Price Indexes With Unobserved Product Characteristics, and Application to Personal Computers,' *Journal of Business & Economic Statistics*, Volume 23, Issue 1. Available [here](#).

Lanteri, A., (2014). 'The Market for Use Capital: Endogenous Irreversibility and Reallocation over the Business Cycle'. Available [here](#).

Leitch Review, (2006). 'Leitch Review of Skills, Prosperity for all in the global economy – world class skills'. Available [here](#).

Lequiller, F., Ahmad, N., Varjonen, S., Cave, W., and Ahn, K., (2003). 'Report of the OECD Task Force on Software Measurement in the National Accounts,' OECD Statistics Working Papers No. 2003/01. Available [here](#).

Lev-Ram, M., (2014). 'What's the next big thing in big data? Bigger data,' Fortune 500. Available [here](#).

LFS Longitudinal User Guide, Vol 11. Available [here](#).

Litan, R. E., Wyckoff, A., and Husbands Fealing, K., Editors (2014). 'Panel on Developing Science, Technology, and Innovation Indicators for the Future'. Committee on National Statistics, Division of Behavioral and Social Sciences and Education. Board on Science, Technology, and Economic Policy. Policy and Global Affairs; National Research Council. Available [here](#).

Lord Sainsbury of Turville, (2007). *The Race to the Top: a review of Government's science and innovation policies*. The Stationery Office: London.

Mandel, M., (2012). 'Beyond Goods and Services: The (Unmeasured) Rise of the Data-Driven Economy,' Policy Memo, Progressive Policy Institute. Available [here](#).

Mandel, M., and Scherer, J., (2012). 'The Geography of the App Economy,' South Mountain Economics Research Paper. Available [here](#).

Mandel, M., and Scherer, J., (2015). 'A Low-Cost and Flexible Approach for Tracking Jobs and Economic Activity Related to Innovative Technologies,' NESTA Working Paper No. 15/11. Available [here](#).

Manski, C., (2014). 'Communicating Uncertainty in Official Economic Statistics,' NBER Working Papers, No. 20098

Mateos Garcia, J. and Bakhshi, H., (2014). 'Using big data to map the UK video games industry'. Available [here](#).

McAfee, A., and Brynjolfsson, E., (2012). 'Big Data: The Management Revolution,' Harvard Business Review. Available [here](#).

McKinsey Global Institute, (2011). 'Big data: The next frontier for innovation, competition, and productivity'. Available [here](#).

McKinsey Global Institute, (2014). 'Global flows in a digital age: How trade, finance, people, and data connect the world economy'. Available [here](#).

McLaren, C.H., (2012). 'Synthesis of the results of the survey on Intellectual Property Products,' Working Party on National Accounts, OECD, Paris. Available [here](#).

Munday, T., and Daly, K., (2015). 'Tech mis-measurement – Likely a bigger problem when estimating US GDP than European GDP,' Goldman Sachs Economics Research, November

- Nakamura, L., and Soloveichik, R., (2015). 'Valuing "free" media across countries in GDP,' Working Papers 15-25, Federal Reserve Bank of Philadelphia
- Nathan, M., Rosso, A., and Bouet, F., (2014). 'Mapping information economy businesses with big data – findings for the UK'. Available [here](#).
- Naylor, J., Swier, N., Williams S., Gask K.; and Berton, R., (2015). 'ONS Big Data Project Q1 Report'. Available [here](#).
- NESTA, (2014). 'Understanding Alternative Finance: The UK Alternative Finance Industry Report 2014'. Available [here](#).
- New Economics Foundation, (2015). 'Five headline indicators of national success: A clearer picture of how the UK is performing'. Available [here](#).
- O'Connor, S., (2015). 'Workers moving from large to smaller companies,' Financial Times. Available [here](#).
- Oates, B., (2016). 'Surveying the Data Science Skills Landscape in UK Government'. Available [here](#).
- Observations for the other countries are not marked, as not all participating NSIs gave consent for their returns to be published
- OECD and World Trade Organisation, Measuring Trade in Value Added. Available [here](#).
- OECD, (2001). 'Measuring Productivity – OECD Manual'. Available [here](#).
- OECD, (2009). 'Measuring Capital – OECD Manual'. Available [here](#).
- OECD, (2010). 'Handbook on Deriving Capital Measures of Intellectual Property Products'. Available [here](#).
- OECD, (2010). 'Measuring Innovation: A New Perspective'
- OECD, (2013). 'Measuring the Internet Economy'. Available [here](#).
- OECD, (2013). 'Supporting Investment in Knowledge Capital, Growth and Innovation,' OECD Publishing. Available [here](#).
- OECD, (2015). 'Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development,' The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris. Available [here](#).
- OECD, (2015). 'OECD/G20 Base Erosion and Profit Shifting Project: Measuring and Monitoring BEPS'. Available [here](#).
- Ofcom, (2015). 'Adults' media use and attitudes'. Available [here](#).
- Ofcom, (2015). 'Communications Market Report'. Available [here](#).
- ONS (2015), Response to UK Peer Review recommendations. Available [here](#).
- ONS Digital Blog, (2014). 'Now Generation website – presentation to staff'. Available [here](#).

- ONS Digital Blog, (2015). 'Result of service assessment'. Available [here](#).
- ONS, (2008). 'Brief guide to the new Statistics and Registration Service Act 2007'. Available [here](#).
- ONS, (2009). 'Feasibility Study – Into the Development of Regional Short-Term Indicators'. Available [here](#).
- ONS, (2011). 'UK Relative Regional Consumer Price levels for Goods and Services for 2010'. Available [here](#).
- ONS, (2013). 'Non-response Weights for the UK Labour Force Survey? Results from the Census Non-response Link Study'. Available [here](#).
- ONS, (2014). 'Household Satellite Accounts'. Available [here](#).
- ONS, (2014). 'Review of the Labour Force Survey', p.8. Available [here](#).
- ONS, (2014). 'Understanding average earnings for the continuously employed: Using the Annual Survey of Hours and Earnings 2014'. Available [here](#).
- ONS, (2014). 'Trends in United Kingdom Housing Market, 2014.' Available [here](#).
- ONS, (2015), Customer Satisfaction Survey 2014-15. Available [here](#).
- ONS, (2015), Response to UK Peer Review recommendations. Available [here](#).
- ONS, (2015). 'Annual Report on Government Statistical Surveys for Official Statistics of Businesses and Local Authorities 2013/14'. Available [here](#).
- ONS, (2015). 'Consultation on Changes to ONS Products 2015'. Available [here](#).
- ONS, (2015). 'Consultation on the Approved Researcher scheme'. Available [here](#).
- ONS, (2015). 'Consumer Price Indices, Research indices using web scraped price data'. Available [here](#).
- ONS, (2015). 'Economic Well-being, Quarter 2 Apr to June 2015'. Available [here](#).
- ONS, (2015). 'Feasibility study into the use of HMRC turnover data within Short-term Output Indicators and National Accounts'. Available [here](#).
- ONS, (2015). 'Improving quality through regular reviews'. Available [here](#).
- ONS, (2015). 'Labour Force Survey'. Available [here](#).
- ONS, (2015). 'Labour Productivity: Q3 2015'. Available [here](#).
- ONS, (2015). 'National Accounts Mid-Term Work Plan 2015-2018'. Available [here](#).
- ONS, (2015). 'Natural capital accounting 2020 roadmap – Interim review and forward look.' Available [here](#).
- ONS, (2015). 'The UK Flow of Funds Project: Comprehensive review of the UK Financial Accounts'. Available [here](#).

ONS, (2015). 'The UK Flow of Funds Project: introduction, progress and future work'. Available [here](#).

ONS, (2015). 'Public Service Productivity Estimates: Total Public Services, 2012'. Available [here](#).

ONS, (2015). Correction note to 'Research indices using web scraped data'. Available [here](#).

ONS, (2016). 'An analysis of Foreign Direct Investment, the main driver of the recent deterioration in the UK's Current Account: January 2016'. Available [here](#).

ONS, (2016). 'Corrections to data'. Available [here](#).

ONS, (2016). 'Economic Review: March 2016'. Available [here](#).

ONS, (2016). 'First ONS Fellows announced'

ONS, (2016). 'House price index, December 2015'. Available [here](#).

ONS, (2016). 'Improving the coverage of the standard business survey population'. Available [here](#).

ONS, (2016). 'UK GDP(O) low level aggregates'. Available [here](#).

ONS, (2016). 'Public Service Productivity Estimates: Total Public Service, 2013'. Available [here](#).

ONS, 'A guide to the supply and use process'. Available [here](#).

Oulton, N., (2004). 'A statistical framework for the analysis of productivity and sustainable development'. Paper prepared for the Allsopp Review of Statistics for Economic Policymaking. Available [here](#).

Page, W., and Carey, C., (2011). 'Adding up the UK music industry 2010', PRS for Music, Economic Insight Issue 23. Available [here](#).

PASC, (2013). 'A review of the operation and of the Statistics and Registration Service Act 2007'. Available [here](#).

PASC, (2013). 'Communicating and publishing statistics'. Available [here](#).

PASC, (2013). 'Communicating and Publishing Statistics: Written evidence submitted by Full Fact'. Available [here](#).

Patterson, P., (2012). 'The Productivity Conundrum, Explanations and Preliminary Analysis,' ONS. Available [here](#).

Penneck, S., (2009). 'The Office for National Statistics Statistical Modernisation Programme: What went right? What went wrong?' ONS.

Pickford S., (1989). 'Government Economic Statistics – A Scrutiny Report'

Pike, T., 'The impact of e-commerce on the consumer sector – view from a Bank of England Agent'. Available [here](#).

Poterba, J. M., and Summers, L., (1986). 'Reporting Errors and Labor Market Dynamics.' *Econometrica*.

Priceonomics, (2013). 'Airbnb vs Hotels: A Price Comparison'. Available [here](#).

PricewaterhouseCoopers, (2014). 'Five key sharing economy sectors could generate £9 billion of UK revenues by 2025'. Available [here](#).

Publishing Statistics: Written evidence submitted by Full Fact'. Available [here](#).

Rayner, D., (1980). 'Review of Government Statistical Services'

Richardson, C., (2005). 'Using the value of time for quality adjustment – testing the concept for rail fares,' *Economic Trends* 621. Available [here](#).

Robbins, C., Howells, T., and Li, W., (2010). 'Experimental Quarterly U.S. Gross Domestic Product by Industry Statistics,' BEA Briefing. Available [here](#).

Saunders, M., Fordham, T., and O'Kelly, A., (2015). 'UK Economics Weekly: Balancing Economic and Political Uncertainties,' Citi Research

Science and Technology Committee, (2015). 'The big data dilemma'. Available [here](#).

Science Daily, (2013). 'Big Data, for better or worse: 90% of world's data generated over last two years'. Available [here](#).

Shapiro, C., and Varian, H., (1998). 'Information Rules: A Strategic Guide to the Network Economy,' Harvard Business School Press.

Shapiro, M., and Wilcox, D., (1996). 'Mismeasurement in the Consumer Price Index: An Evaluation,' NBER Working Paper No. 5590. Available [here](#).

Shaw, J., (2014). 'Why "Big Data" Is a Big Deal,' *Harvard Magazine*, March-April. Available [here](#).

Simpson I., Beninger K. and Ormston R., Natcen Social Research, (2015). 'Public Confidence in Official Statistics'. Available [here](#).

Snorrason H., Byfuglien J. and Vihavainen H., (2015). 'Peer Review Report on compliance with the Code of Practice and the coordination role of the National Statistical Institute: United Kingdom'. Available [here](#).

Stapenhurst, C., and McLaren, C., (2015). 'Presenting a Generalised Perpetual Inventory Method', United Kingdom Government Statistical Service Methodology Symposium. Available [here](#).

Statistics and Registration Service Act, (2007). Available [here](#).

Statistics Canada, (2006). 'The Integrated Approach to Economic Surveys in Canada'. Available [here](#).

Statistics Canada, (2015). 'Review of the July 2014 Labour force Survey release'. Available [here](#).

Statistics Netherlands, (2015). 'Annual Report for 2014'. Available [here](#).

Statistics New Zealand, (2010). 'Measuring government sector productivity in New Zealand: a feasibility study'. Available [here](#).

Statistics New Zealand, 'Microdata access protocols'. Available [here](#).

Statistics New Zealand. 'Microdata research'. Available [here](#).

Statistics Sweden (2015) Annual Report 2014. Available [here](#).

Stewart, J., Costa, V., Page, M. and Chen, C., (2012). 'Maximising the Use of Administrative Data in Sub-Annual Business Collections'. Available [here](#).

Stiglitz, J., Sen, A., and Fitoussi, J., (2015). 'Report by the Commission on the Measurement of Economic Performance and Social Progress'. Available [here](#).

Stokes, K., Clarence, E., Anderson, L., and Rinne, A., (2014). 'Making sense of the UK collaborative economy,' NESTA. Available [here](#).

Stoneman, P., and Francis, N., (1994). 'Double Deflation and the Measurement of Output and Productivity in UK Manufacturing 1979-89,' International Journal of the Economics of Business, vol. 1(3), p. 423-437

Struijs, P., Braaksma, B. and Daas, P. (2014). 'Official Statistics and Big Data', *Big Data and Society*'. Available [here](#).

Syverson, C., (2016). 'Challenges to mismeasurement explanations for the U.S. productivity slowdown,' National Bureau of Economic Research Working Paper 21974. Available [here](#).

Taylor, C., and Wales, P., (2014). 'Economic Review, August 2014'. Available [here](#).

Ten Bosch, O. and Windmeijer, D., (2014). 'On the use of internet robots for official statistics', Statistics Netherlands Working Paper. Available [here](#).

The full list of data available for access is available [here](#).

The New York Times Magazine, (2012). 'On YouTube, Amateur Is the New Pro'. Available [here](#).

The Royal Society, (2014). 'Hidden Wealth: the contribution of science to service sector innovation'. Available [here](#).

Town & Country Planning, (2013). 'New estimates of housing demand and need in England, 2011 to 2031,' Tomorrow Series Paper 16. Available [here](#).

Toyota, (2015). 'February Price List 2016'. Available [here](#).

TSC Chair letter to the Reviewer, 26th February 2016. Available [here](#).

TSC, (2006). 'Independence for statistics: Tenth Report of Session 2005-06'. Available [here](#).

TSC, (2013). 'Oral evidence: Bank of England November 2013 Inflation Report'. Available [here](#).

- TUC, (2014). 'Earnings and Settlements'. Available [here](#).
- UK Trade Statistics, Assessment report, February 2011. Available [here](#).
- UKSA Board Minutes, July 2015. Available [here](#).
- UKSA Board Minutes, October 2015. Available [here](#).
- UKSA, (2009). 'Code of Practice'. Available [here](#)
- UKSA, (2010). Statistics on overseas Travel and Tourism, Assessment report, May 2010. Available [here](#).
- UKSA, (2010). 'Strengthening User Engagement'. p.2. Available [here](#).
- UKSA, (2010). 'Strengthening User Engagement' p.10. Available [here](#).
- UKSA, (2010). Letter from UKSA Chair to the Prime Minister, 12 May 2010. Available [here](#).
- UKSA, (2011). 'Annual Report 2010/11'. Available [here](#).
- UKSA, (2011). 'Use of Administrative or Management Information'. Available [here](#).
- UKSA, (2011). 'Statement on the release of Output in Construction estimates'. Available [here](#).
- UKSA, (2013). CPIH statistic, Assessment report, July 2013. Available [here](#).
- UKSA, (2013). Letter from UKSA Chair to Secretary of State for Communities and Local Government. Available [here](#).
- UKSA, (2013). 'Statement of Strategy'. Available [here](#).
- UKSA, (2013). 'Statistics on Consumer Price Inflation' Assessment Report 257. Available [here](#).
- UKSA, (2014). Statistics on Construction, assessment report, April 2014. Available [here](#).
- UKSA, (2014). 'The Use of Official Statistics by the Financial Services Industry'. Monitoring Review. Available [here](#).
- UKSA, (2014). Correspondence from Sir Andrew Dilnot to John Pullinger on 'Consumer Price Indices including Housing Costs (CPIH) Indicator'. Available [here](#).
- UKSA, (2014). 'Papers from UK Statistics Authority meeting on 01 May 2014'. Available [here](#).
- UKSA, (2015). 'Assessment of Compliance with the Code of Practice for Official Statistics – the UK Annual and Quarterly National Accounts,' assessment report 299. Available [here](#).
- UKSA, (2015). Assessment of House Price Index, July 2015. Available [here](#).
- UKSA, (2015). Assessment of National Accounts, February 2015. Available [here](#).
- UKSA, (2015). Assessment of Public Sector Finances, October 2015. Available [here](#).

- UKSA, (2015). Assessment of Statistics on UK Trade, May 2015. Available [here](#).
- UKSA, (2015). Assessment of Supply and Use Tables, February 2015. Available [here](#).
- UKSA, (2015). 'Coherence and Accessibility of Official Statistics on Income and Earnings'. Available [here](#).
- UKSA, (2015). 'Quality Assurance of Administrative Data: Setting the Standard' p.4. Available [here](#).
- UKSA, (2015). 'Statistics on UK Trade (Office for National Statistics)'. Assessment Report 304. p.2. Available [here](#).
- UKSA, (2016). 'Coherence and Accessibility of Official Income and Earnings Statistics'. Available [here](#).
- UKSA, (2016). Re-assessment of CPIH, March 2016. Available [here](#).
- UKSA, (2016). 'Statement on Stocktake of Code of Practice'. Available [here](#).
- UKSA, Letter to Department for Communities and Local Government Secretary of State, 23 April 2013. Available [here](#).
- UN Statistical Commission and Economic Commission for Europe, (2009). 'The shoe problem – and what we are doing to prevent it'. Available [here](#).
- UN Statistical Commission and Economic Commission for Europe, (2010). 'Corrections at Statistics Sweden'. Available [here](#).
- UN Statistics Division, (2014). 'Microdata dissemination best practises'. Available [here](#).
- United Nations Statistical Commission and Economic Commission for Europe, (2009). 'The shoe problem – and what we are doing to prevent it'. Available [here](#).
- US Census Bureau, (2013). 'Management and Organizational Practices Survey'. Available [here](#).
- van Ark, B., Hao, J., Corrado, C., and Hulten, C., (2009). 'Measuring Intangible Capital and Its Contribution to Economic Growth in Europe,' European Investment Bank Papers. Available [here](#).
- Varian, H. (2009). 'How the Web challenges managers', Mc Kinsey & Company Quarterly. Available [here](#).
- Varian, H., (2006). 'The Economics of Internet Search,' Technical Report, Google, Inc. Available [here](#).
- Wallgren, A., and., Wallgren, B., (2011). 'To understand the Possibilities of Administrative Data you must change your Statistical Paradigm!'. Section on Survey Research Methods, American Statistical Association. Available [here](#).
- Walton, A., (2016). 'Revisions to GDP and components in Blue Book 2014 and 2015'. Available [here](#).

Weitzman, M. L., (1998). 'Recombinant Growth,' *The Quarterly Journal of Economics* 113 (2): 331-360

Wells, J., and Restieaux, A., (2014). 'Review of Hedonic Quality Adjustment in UK Consumer Price Statistics and Internationally'

Wile, R., (2015). 'There are probably way more people in the 'gig economy' than we realize'. Available [here](#).

Woskow, D., (2014). 'Unlocking the sharing economy – An independent review'. Available [here](#).

Yossi, A., (2015). 'What Happens in an Internet Minute? How to Capitalize on the Big Data Explosion'. Available [here](#).

Zwijnenburg, J., (2015). 'Revisions of quarterly GDP in selected OECD countries,' *OECD Statistics Brief*, No. 22. Available [here](#).