

Productivity measures and analysis: ONS strategy and work programme

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This article presents development of the Office for National Statistics (ONS) strategy for productivity measurement to date and the new work programme for improving UK productivity measures and analysis. The key government objective of improving UK productivity has resulted in a continuing demand for comprehensive data to better understand the underlying features of the UK productivity gap with other major industrial countries.

ONS has long recognised the need for timely, detailed productivity statistics. This was reflected in the first productivity strategy and work programme, published in *Economic Trends* in April 2002, which was carried out between 2002 and 2005.

A second strategy and associated work programme aims to build on the successes of the first and address the additional and changing requirements of users. This article summarises the previous work and background, explains the strategy and details the planned work projects.

Introduction

Productivity for the whole economy, a region, industry or firm is defined as

Output
Input

Productivity is important to the understanding of economic growth. Change in economic output can be achieved by adding more inputs, or by changing the relationships between inputs and outputs. Productivity growth can occur either through improved efficiency (fewer inputs to produce the same outputs) or through inputs being used to produce outputs of greater value. Productivity analysis is not confined to macroeconomics. The concept originates with firms and other organisations which conduct sophisticated analysis on their own operations.

There are varied definitions of output and input resulting in different productivity measures for different uses. The main productivity measure published within ONS is labour productivity, measured as:

Gross value added
Employment

This particular form of productivity measurement allows for the analysis of industry contribution to economy-wide labour productivity and economic growth so that policy makers can better understand how the economy is working. Policy application at the macro level relates both to improving productivity and to increasing participation in the labour force. These in combination imply higher potential output and so measurement of this, in turn, needs to be linked to good labour market statistics estimates. There are also other forms of productivity such as capital productivity and capital labour multi-factor productivity (MFP) (see later for a fuller description of MFP). ONS does not publish either of these on a regular basis but is investigating MFP as part of the new work programme.

Improving UK productivity has been one of the Government's key policy objectives since 1997. HM Treasury (HMT) and the Department of Trade and Industry (DTI) share a joint Public Service Agreement target (DTI and HMT, 2004) to improve productivity in the UK relative to our key competitors, France, Germany and the United States. Accurate productivity measurement is also required by HMT and the Bank of England (BoE) for fiscal and monetary policy decisions as it is a key determinant of the non-inflationary trend growth of the economy.

This article begins with details of the productivity strategy constructed in 2002 and a summary of ONS work subsequently completed. It goes on to detail ONS projects and developments which form the background against which the new strategy is being developed and then gives a description of its elements. Following this is a detailed account of the proposed future productivity work, given in priority order.

The article concludes with a list of the planned productivity work projects.

Productivity strategy: aims

Productivity analysis is required to understand the underlying features of the productivity gap with other major industrial countries and help identify policies to improve UK productivity. ONS is required to produce accurate, comparable productivity estimates at as detailed a level as possible, and associated data to understand productivity drivers.

Consequently, ONS productivity strategy has been devised to meet three simple aims:

- to use the most appropriate productivity data sources
- to use the best comparable methodology
- to expand and maintain the range of productivity data available

By meeting these aims, ONS provides users with the productivity estimates and material for analyses that they require.

Productivity strategy: work programme, 2002–2005

In 2002 ONS reviewed the productivity work and publications already being carried out by the department and developed its productivity strategy to best meet these aims. The strategy was as follows:

- review the measurement of input growth and output growth – looking at the sources and methods of productivity estimation used in other countries and consider whether adopting approaches used elsewhere would be of benefit
- review and update the methodology being applied to these data – ensuring that methodology meets the needs of customers and follows international guidelines for calculating productivity (OECD, 2001)
- analyse new data sources – consider using the Annual Business Inquiry (ABI) and Index of Services (IoS) data for estimating productivity
- consider whether new outputs and measures could be produced – looking into the data series required to construct MFP measures as well as expanding the range of outputs to include more service sector productivity estimates

This strategy was converted into a work programme which was agreed with all key stakeholders. The outputs are summarised here and given in detail in the Appendix.

Outputs from the original work programme

These included:

- a pilot study using the ABI for productivity measures which published 4-digit information (Daffin and Lau, 2002)

- experimental series for service sector productivity published quarterly since 2002 in an experimental release
- a Volume Index of Capital Services (VICS) (Wallis, 2005)
- a pilot Quality-Adjusted Labour Input (QALI) measure (Holmwood, Lau, Richardson and Wallis, 2005)
- an international comparative study of methods of integrating the labour market employment figures with data from the National Accounts
- a major review and documentation of the ONS Perpetual Inventory Model (PIM) for estimating the capital stock
- the Inter-Departmental Business Register (IDBR)/ Labour Force Survey (LFS) linking project for improving coordination between the data collection areas

Additions to ONS work during the course of the work programme

These included:

- public sector productivity: the Atkinson Review (2005) resulted in publication of assessments of productivity in the NHS (Lee, 2004) and in education (UKCeMGA, 2006)
- a methodology review of productivity (Barnes and Williams, 2004) and documentation of productivity definitions which led to a new headline aggregate, output per worker
- the business data linking virtual lab which has contributed to understanding productivity drivers
- the New Economy work programme (detailed below)

New Economy work programme

Since the ONS ‘New Economy Measurement’ seminar in April 2002, there has been a significant amount of work to deliver on measurement objectives identified there. In particular:

- hedonic pricing and chain linking have been adopted to improve measurement of inputs, outputs and prices in areas of the economy where there is rapid technology change, or significant shift in the structure of output
- work on the productivity effects associated with Information and Communication Technology (ICT) investment and use at firm level was undertaken with the London School of Economics (LSE) and published in *Economic Trends* (Sadun, 2005 and Farooqui, 2005)
- associated work on IT investments has been published in *Economic Trends* (Chesson and Chamberlin, 2006) and the conclusions for purchased software and for own-account software will be incorporated in the National Accounts
- ONS has taken part, with OECD partners, in analysing the economic effects of ICT applications, and has published a number of articles (OECD, 2004)

This first strategy was mainly aimed at reviewing the methodology and data sources available and identifying and

creating new, useful outputs. Having completed the work programme drawn up, a second strategy is being developed to advance ONS productivity work still further. This strategy is taking into account the ONS projects and developments which have an impact on productivity statistics.

ONS projects and developments

There are five main streams of work within ONS which have implications for the productivity strategy. These are the implementation of the Atkinson Review, the Statistical Modernisation Programme which includes the National Accounts Re-Engineering Programme (NA REP), the Labour Market Statistics/National Accounts (LMS/NA) Consistency Project and the business micro-data lab.

Implementation of the Atkinson Review

The Atkinson Review was a year-long review, carried out across 2004, of the measurement of UK government output and productivity. Sir Tony Atkinson from Nuffield College, Oxford, led the review, supported by a team seconded from the ONS, HMT, BoE and Department of Health.

The Review's terms of reference were:

“To advance methodologies for the measurement of government output, productivity and associated price indices in the context of National Accounts, recognising:

- the full scope of government outputs
- the relationship between government outputs and social outcomes
- the need for comparability with measures of private sector services output and costs
- the existing work of ONS
- the appropriate measurement of inputs, including quality and the distinction between resources and capital, so that, together with the measurement of output, light can be thrown on developments in government productivity”

In addition to recommending a general framework and principles, the intention was to focus on practical solutions for measuring the key functional areas of health, education, public order and safety and social protection.

A final report was published in January 2005 detailing a principled framework for measuring government output in the National Accounts, within international guidelines, and setting out a number of recommendations on how these should be implemented. It reported on plans to further improve measurement of output in four spending areas: health; education; public order and safety, and social protection. The National Statistician welcomed the report and responded with the construction of a new centre within ONS designed to take forward the Atkinson report's agenda.

The UK Centre for the Measurement of Government Activity (UKCeMGA) was launched on 19 July 2005 in order to take forward the recommendations from the Atkinson Review. Its aim is to strengthen the capability of ONS to publish

authoritative and coherent measures of the output and productivity of government-provided services in the UK National Accounts.

The key objectives of the work programme of UKCeMGA are:

- to ensure that the measures of key government services in the UK National Accounts are fit for purpose
- to develop, with other government departments, devolved administrations and other stakeholders, better measures progressively over time, where such improvements are needed
- to conduct rolling reviews of methods of measurement of different government services, to ensure methodology keeps pace with changing circumstances and modes of delivery
- to publish a regular series of authoritative productivity articles describing the output and productivity performance of the main government services, building on the first one, published for health in autumn 2004
- to develop and publish credible and coherent satellite accounts (for example, for education and health)

UKCeMGA has, since its launch, published productivity articles for education (2005), health (2006, as a follow up to the first article published during the Atkinson Review in 2004), and for adult social care (2006).

The Statistical Modernisation Programme

ONS has embarked on a major programme to modernise the whole of the statistical system used across all areas of the office. The objectives of this Statistical Modernisation Programme are to re-engineer key statistical systems, to move ONS surveys and other data onto a corporate database system (CORD), to introduce a set of standard tools and to standardise and systematise the processing and presentation of statistical outputs.

The office currently uses a wide range of databases and software, which is mainly a legacy from the days before ONS was created and the different areas of the office were situated in different government departments (Central Statistical Office, Office of Population Censuses and Surveys, Department of Employment). While ONS has some core databases and software, the aim of this programme is to ensure that this core is developed into a comprehensive system of data and packages that satisfy the needs of all areas.

National Accounts Re-Engineering Programme

The National Accounts Group (NAG) has taken the opportunity presented by the Statistical Modernisation Programme to update its methodology alongside modernisation of its statistical system. The improved power of the statistical system will mean that computational constraints imposed by the current systems will be greatly relaxed, opening up new possibilities to improve the methodology for the National Accounts system.

One of the early decisions was that the supply-use framework should remain the backbone of the National Accounts system (for details, see Aldin and Tuke, 2004).

A number of improvements to this framework have been proposed:

- the level of detail will be expanded from the existing 123 industries by 123 products on a quarterly, constant price basis
- the supply-use framework will be applied to quarterly balancing, so as to achieve better integration between annual and quarterly balancing processes
- balanced supply-use tables will be produced at both current and constant prices. This allows gross value added (GVA) to be derived from the double deflation method.¹ Double deflation is important for productivity analysis because the methodology works to ensure that the growth rate of output-side GDP (GDP(O)) is equal to the growth rate of expenditure-side GDP (GDP(E)). This helps to ensure consistency between GDP and industry output – so aiding industry level productivity analysis
- more diagnostics will be incorporated for quality assurance and to inform the balancing process. These will take the form of built-in data confrontation with a wide range of statistics and of derived diagnostic tools. Productivity estimates will be an important part of this process.

A range of productivity measures will be compiled as direct outputs from the National Accounts system after re-engineering, including industry-level labour productivity, and help improve the National Accounts balancing process.

The LMS/NA Consistency Project

Expenditure and output estimates for National Accounts are currently produced independently of labour market statistics. This means that the first time the two are effectively compared in the current system is in the production of productivity estimates. When the first ONS Productivity Strategy and Work Programme was formulated in consultation with key users, it was felt that the planned utilisation of LFS data in labour productivity analysis was hampered by its inconsistencies with the National Accounts. (Details of the known inconsistencies which surfaced from earlier analysis are shown in the *Employment and Jobs Review*, 2006.) A project was therefore drawn up to investigate further and tackle this issue.

The aim of this project is to recommend ways to improve the coherence of the employment and earnings statistics of different sources (that is, number of jobs, number of people in employment, total actual hours worked, and earnings) in relation to their output measures in National Accounts for productivity analysis. As such, this project goes through the following steps for each type of data:

- identify issues and the extent of data inconsistency
- identify the sources of these discrepancies

- identify how other countries handle the issues under concern
- consider alternative data sources
- set out proposals for how ONS might improve on the current situation

The first part of this project, looking at compensation of employees – the main labour market statistics data used in the National Accounts – is almost complete. The central recommendations are to use Pay As You Earn data from HM Revenue and Customs for the annual industry division breakdown and to use average weekly earnings for the quarterly series. Further details will be given in a future *Labour Market Trends* article (Lindsay, 2006).

The second part of this project is to consider employment (persons, jobs and hours). The analysis carried out for the Employment and Jobs Review is being used as a starting point as this previous investigation has effectively covered many of the early milestones already. The aim is to consider that work – which included recommending how and where each ONS data source should be used – along with an investigation into possible non-ONS sources to determine the most suitable data, or combination of data, for employment in the context of productivity estimates (and, thus for the NA REP).

The final part will focus on the self-employed and unpaid workers. The difficulty with these elements of the labour input is that they are covered by far fewer sources than paid employees. Therefore, while there is scope for a data confrontation exercise, it will be of a narrower range of sources (LFS, National Insurance data, tax returns data) than that used for the first two data series. The planned way forward is to use the framework for employees as the foundation block and make sure that statistics on other workers are added on in a consistent manner.

The business micro-data lab

The business micro-data lab was established in early 2003 and contains over 30 years of linked business surveys of manufacturing data, nine years for services, covering a number of variables (see Robjohns, 2006 for more details). The main role of ONS is to facilitate access to, and the use of, these data. The results from research carried out within the lab feed back into:

- policy on productivity (through government departments)
- survey design
- statistical measurement

HMT, BoE and DTI regard micro-data work as an important contributor to the understanding of productivity, and have sponsored over 40 projects to investigate specific issues. Business Data Linking development was originally funded by HMT, and DTI has funded at least 15 projects – led by academic researchers and/or ONS.

The value of micro-data work for policy users is that it:

- allows analysis of all five productivity drivers (investment, innovation, skills, enterprise and competition²) and their effects in greater depth than macro or industry data
- permits analysis of differences between successful and unsuccessful firms
- allows policy and programme evaluation, almost always assessed in terms of productivity
- gives DTI access to basic productivity data in greater industry and regional detail than ONS published statistics

ONS undertakes productivity analysis projects itself using micro-data when sponsored to do so, and where the work contributes to measurement improvement. This is to better understand productivity issues in general as well as improving the quality of estimates. Eurostat and OECD are now beginning to sponsor international work in this area.

Productivity strategy: the future

ONS strategy confirms the three basic aims previously identified:

- to use most appropriate productivity data sources
- to use the best accepted methodology, and
- to expand and maintain the range of productivity data available for policy users

The strategy is being updated to build on the work carried out since 2002 and to take into account other projects and developments within the department:

- update data sources for productivity so that consistent measures of input and output growth are used – ensuring that input and output data are consistent with each other as well as consistent with their uses elsewhere in ONS, using the results of the LMS/NA Consistency Project
- continue to identify and analyse new data sources – in particular, productivity data analysis carried out within the business micro-data lab aims to identify improvements in output and input measurement
- update methodology to incorporate changes to the System of National Accounts and also to meet the guidelines set out by the Atkinson Review – productivity estimation requires consistency with international National Accounts standards so that useful comparisons with other countries can be made. Changes to non-market sector methodology will be carried out by UKCeMGA using the guidelines given in the Atkinson Review (2005); consistency with market sector productivity will be considered where appropriate
- review and expand the use of productivity data series produced by the 2002 work programme – as new data sources are established, further use can be made of them; the range of productivity series produced from them can be expanded and their experimental status reviewed (for example, service sector productivity). In the case of

the VICS and QALI measure, these can now be used to produce MFP estimates (see below for an explanation of MFP)

- include data confrontation via productivity calculations within the re-engineered National Accounts system – this is being designed to produce productivity estimates as a standard output and will use them as a diagnostics tool for quality assuring the National Accounts

This updated strategy is emerging as a second work programme.

New productivity work programme

This section outlines the work programme developing into a second strategy. This programme has been divided into sections based on seven work projects. The pace at which the programme develops will depend on the availability of resources.

Creating a structure for long-term productivity analysis within the National Accounts Re-engineering Programme

In order to take full advantage of the current redevelopment within the National Accounts systems, a structure for long-term productivity analysis will be included in the NA REP. This structure will be composed of National Accounts data sources along with checks and calculations to automatically produce productivity estimates at a detailed level which are consistent with National Accounts.

This structure will incorporate:

- improved public sector outputs developed by UKCeMGA
- recommendations from the LMS/NA Consistency Project
- constant price input-output (KPIO) tables. These are required for the construction of multi-factor productivity estimates because of the need for information on the flow of intermediate inputs
- double deflation. This is needed, along with KPIO, to ensure that the intermediate inputs and outputs are correctly deflated, ensuring that there is consistency between GDP and industry output when calculating productivity

Additionally, this structure should ensure that productivity is fully exploited as an analytical tool for diagnostic purposes. This will be linked to the development of a growth accounting framework.

Developing further the ability to use the growth accounting framework to analyse productivity and test consistency and coherence of the National Accounts.

The growth accounting framework allows the contribution of each industry to the national economy to be measured and assessed. Implementing this framework will allow more tests to be imposed on the consistency and coherence of the

National Accounts than is currently possible. Therefore the development of this framework will be incorporated into the re-engineered National Accounts and KPIO will be key to this.

MFP analysis apportions growth in output to growth in the factor inputs, capital and labour, and a growth in the residual which is generally assumed to mainly represent technical change. Estimates of MFP are interesting in their own right as they provide more detail for productivity analysis; however, they are also useful in considering the relationship between the data sources used and therefore act as a useful check in the National Accounts system.

Having developed and improved both the VICS (Wallis, 2005) and the QALI measure (Holmwood, Lau, Richardson and Wallis, 2005 and Goodridge, 2006), ONS has the potential to further develop the growth accounting framework and start to test for consistency of National Accounts output data and National Accounts consistent input data. These two series will be updated and improved as data become available and also used as inputs to produce an MFP series.

Further improvements to the two input series, VICS and QALI, may become more evident when initial MFP estimates are produced, as this will bring together, for the first time, consistent input measures and National Accounts output measures.

Continuing the project for improving the consistency between National Accounts and labour market statistics (LMS)

The aim is to continue and complete the project on the consistency of National Accounts and LMS. Priority objectives are to:

- deliver and implement the recommendations for compensation of employees
- carry out a similar analysis for employment
- ensure that the self-employed and unpaid elements are included in a consistent manner.

The results from this project will be used for productivity estimation and will feed into the NA REP.

Improved measurement in the following areas to improve productivity analysis

- capitalisation of Research and Development (R&D) – this is currently treated as intermediate consumption instead of a form of investment. The SNA 2007 discussion group has recommended that the 1993 SNA should be changed to recognise the outputs of R&D as assets. A project is under way, funded by Eurostat, to assess the practical and methodological issues involved in capitalising R&D
- inclusion of the ICT investment revision – revisions to software investment, which indicate that this is a greater proportion of GDP than previously estimated were published in *Economic Trends* (Chesson and Chamberlin, 2006). These results will be included in the revisions procedure for National Accounts

There is also a case for considering an ONS price index for software. There has been recent work on software investment, but there is currently no bespoke index for deflating software. Own-account software investment is deflated by an index based on earnings of occupations identified as being involved in the production of own-account software, while pre-packaged purchased software is deflated by one based on the US deflator for pre-packaged software adjusted for relative prices. Therefore, a bespoke index would be an improvement, but is likely to require substantial resources.

Continued development of micro-data resources for use in productivity analysis

ONS will continue to support and develop the business micro-data lab. Productivity analysis projects using micro-data will continue to be taken on in-house or in partnership when ONS is sponsored to do so and/or where the work contributes to measurement improvements. Work to establish the characteristics of assets, especially intangibles such as software, R&D, and skills, will be most important to the productivity agenda.

Developing new productivity measures to meet users' needs

- public sector productivity estimates – UKCeMGA is producing more detailed figures for output and productivity for the public sector. This is focused in four main areas:
 - health
 - education
 - public order and safety
 - social protection
- market sector productivity estimates – ONS currently does not produce labour productivity estimates for just the market sector. However, these are in the process of being developed on a per worker and a per hour worked basis. Combined with the work on public sector productivity, this means that there will be more detailed figures for both the public and private areas of the economy
- service sector productivity estimates – ONS currently produces some service sector productivity estimates on an experimental basis for distribution, hotels and catering and also agriculture, forestry and fishery as well as total services estimates. To produce additional service sector productivity estimates, suitable output indices and associated deflators are required:
 - Index of Services (IoS) – a review of the IoS (Drew and Morgan, 2005) is currently being carried out with the aim of the whole of the IoS becoming a National Statistic by early 2007. From November 2005, additional industry detail was included; indices are now published for 22 service sector industries. An article outlining these improvements has been published (Tily, 2006)

- development of Corporate Services Price Indices (CSPI) – the CSPI development schedule currently covers eight industries with the aim of meeting specified European sector coverage by mid-2008 (under the Eurostat STS Amendment Regulation). In terms of weighting the index, ultimately the CSPI will require a sales survey for weighting to achieve National Statistic status; however a new weighting methodology is being developed that is more accurate than previous methods
- International Comparisons of Productivity (ICP) – comparisons of GDP per worker and per hour worked are currently produced comparing the UK with key competitors from the G7 countries; for a technical note on the methodology see Lau and Wallis (2005). Until recently, the GDP per hour worked was an experimental index; however, in February 2006 it became a National Statistic due to improvements made to the OECD methodology. Given the changing world economy, other countries may be added to this comparison in future. Additionally, the possibility of producing constant purchasing power parities should be considered, drawing on international sources, so that GVA (a better measure for productivity purposes) could be used instead of GDP

Publish a comprehensive guide for ONS estimates of productivity

ONS's range of productivity statistics has increased over recent years, particularly with the creation of UKCeMGA. Therefore a new publication, effectively a complete guide to UK productivity data, will be produced to detail all ONS's work, explain the methodology and describe the various productivity data series. This manual will cover every aspect from theory to practice and from UK regional data sources to international comparisons.

Projects and outputs: 2006–2008

The work programme identified above is relatively ambitious, and will need review in the light of resources. Projects and outputs are to:

- ensure productivity is included within the NA REP, both as an output and as an analytical tool
- construct constant price input-output tables within the NA REP
- calculate real GVA using the double deflation method within the NA REP
- develop the growth accounting framework within the NA REP
- update and improve the VICS
- update and improve the QALI measure
- produce MFP estimates
- implement the recommendations for compensation of employees
- carry out an analysis to determine which employment data to use for productivity figures
- carry out an analysis to determine how the self-employed and unpaid elements should be included within productivity estimates
- include the ICT revision in the National Accounts
- investigate capitalisation of R&D
- continue development of micro-data
- develop measures of market sector productivity
- develop measures of service sector productivity
- continue to publish appropriate ICP
- produce the framework and guide for users of ONS productivity statistics

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Notes

1. Double deflation is a method to estimate real GVA by deflating output and intermediate inputs separately before subtracting the latter from the former. This is in contrast to the single deflation method whereby the subtraction is done at current prices and the difference – GVA at current prices – is deflated using an output deflator to arrive at real GVA estimates. This means that an industry's gross output is deflated by the price of its output, while each input is deflated by its own price index.
2. These productivity drivers are identified by HMT and DTI and used as an intellectual framework for analysing the underlying factors that are driving productivity performance and organising policies designed to improve productivity (HMT and DTI, 2004).

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