

Article

Productivity measurement – how to understand the data around the UK’s biggest economic issue

First in a series of explainer articles from expert academics providing a view on the measurement of productivity in the UK and the productivity puzzle.

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1 . Introduction

In December 2019, the Royal Statistical Society announced that the [UK Statistics of the Decade](#) award had been awarded to the Office for National Statistics's (ONS's) labour productivity series. This series reveals that average annual growth in the decade after the 2008 economic downturn was only 0.3% a year, a period of weakness deeper and more prolonged than any seen in the UK since the 1890s. This weakness has implications for profits, wages, living standards, tax revenue and public services.

In response to the interest this has generated, the ONS is keen to contextualise its data and has commissioned a series of short "explainer" articles from expert academics, each providing a view on the measurement of productivity in the UK. These articles will explore where the data and methods are strong, where improvements are possible, and where the data support or do not support some of the main proposed explanations of the UK productivity puzzle.

Each article should provide a brief summary or assessment of a particular aspect relating to the measurement of productivity, drawing out where the available data provide evidence to discount or support the main arguments around the productivity puzzle or where data gaps exist. These articles, which will be published over the coming months, will provide an entry point for those looking to understand the main issues concerning the productivity puzzle.

We have planned a series of articles, including this one, on the following topics:

- Productivity measurement – how to understand the data around the UK's biggest economic issue
- Measurement of productivity statistics, by Nick Oulton
- Measurement of output data used in productivity statistics, by Martin Weale
- Measurement of capital data used in productivity statistics, by Jonathan Haskel
- Measurement of labour market data used in productivity statistics, by Richard Heys and Stuart Newman
- How the production boundary influences productivity measurement, by Diane Coyle
- How management and uncertainty issues influence productivity measurement, by Paul Mizen

These articles take the enhanced set of productivity statistics now being published by the ONS to evaluate some of the different theories around the UK's productivity puzzle, to provide clarity on the lessons emerging from these data.

2 . Productivity and the productivity puzzle

Productivity is the relationship between inputs and outputs in the economy: the fewer inputs used to produce the same quantity of outputs, the more productive we consider that process. Productivity is important because it is the main cause of economic growth and determines the long-term economic health of a nation. In turn, this increases salaries and profits, improves standards of living, and enables the tax revenue to grow, which allows the government to fund better public services.

Figure 1 shows that labour productivity has demonstrated weak growth since the 2008 economic downturn, whereas in the previous 10 years it was close to historical long-term average growth rates of 2.0% per year. This sustained period of minimal labour productivity growth has been labelled the UK's productivity puzzle and is arguably the defining economic question of our age.

Figure 1: Growth in output per hour has been weak over the last decade

Output per hour, UK, Quarter 2 (Apr to June) 1998 to Quarter 3 (July to Sept) 2019

Notes:

1. Percentiles are measurements that indicate the percentage of observations beneath a specified point. The 25th percentile is the value below which 25% of the observations reside.

Download this chart

[.xls](#)

This period of sustained weakness has resulted in a number of economic rationales being proposed as potential causes. [Recent surveys of leading economists](#) have tackled the question of which of these rationales are the most powerful, without drawing absolute agreement across the profession. This paper will outline the main candidates after outlining how we measure productivity.

3 . How we measure productivity

The Office for National Statistics (ONS) delivers one of the richest sets of [productivity data](#) in terms of range and granularity. The three main productivity measures include labour productivity, multi-factor productivity (MFP) and public service productivity.

Labour productivity

This is a [National Statistic](#), and it is therefore produced in full compliance with the [Code of Practice for Statistics](#) and reports how much output is produced per hour of work. Because capital is also used to produce output, this is a partial measure that will change as more or less capital is deployed, not just because hours of work have delivered more or less return. Other factors can also influence this measure such as management techniques or consumer sentiment.

Multi-factor productivity (MFP)

This is an [experimental statistic](#) that is under development to achieve National Statistics status. It measures how much output is produced per unit of input, including labour hours, the quality of labour and the impact of capital. The unexplained residual after the impact of these other factors is identified is also called MFP. It can be considered the "recipe" or the way in which the inputs are put together to make the output.

Public service productivity

This is a National Statistic that measures how much output the public services produce per unit of input, after taking account of the materials consumed (for example, medicines in the health service) and the impact of the outputs on outcomes. This is to account for the fact that there are rarely observed prices. Imagine an operation gives people health improvements such that they would be willing to pay £1,000 if there was a market price.

Now imagine the same operation changes and the next year, everyone who receives the operation receives no benefit. As operations have no intrinsic "enjoyment value", we can assume everyone would pay zero for this operation. While there may be the same number of outputs, in this case operations, we need to take account of the change in quality to gauge true productivity, as noted in [The hardest part of productivity measurement](#) blog.

4 . The productivity puzzle

The productivity puzzle is now a firmly established part of the UK macroeconomic landscape. For five decades before the 2008 economic downturn, the average output each UK worker produced in an hour of work increased steadily by around 2% a year. In contrast, the productivity record since the economic downturn has been historically weak, enduring its slowest recovery from an economic downturn since the Second World War. While other countries have seen similar slowdowns, the UK's productivity puzzle is deeper and more persistent than elsewhere.

The fall in productivity growth is even more perplexing because it comes at a time of apparently rampant technological innovation and the strongest labour market performance since the 1970s, with high levels of employment and low unemployment. At the Office for National Statistics (ONS), our role is to provide the best possible estimates of productivity growth to understand what is going on and perhaps assist policymakers in finding solutions. As productivity has become a bigger issue, we have invested more time and effort into detailed productivity statistics than ever before. We have established a new research centre, the Economic Statistics Centre of Excellence (ESCoE) in collaboration with the National Institute for Economic and Social Research (NIESR) and a network of universities to improve our methods and data, alongside investigating further the detailed, firm-level data that we collect in our surveys and from administrative sources.

5 . Causes of the productivity puzzle

This section lists the most common theories to explain the productivity puzzle. The articles will use the data available to evaluate them. For a theory to be considered to be potentially valid as a single root cause of the puzzle, it needs to be able to meet two criteria. First, the productivity puzzle is seen as having commenced following the 2008 economic downturn. While there is some slowing of productivity growth pre-2008, it is clear the majority of the impact impacted in the years following 2008. Theories need to demonstrate why we observe this clear step-change in the pattern. Secondly, with productivity running significantly below the long-term trend, theories need to cumulatively demonstrate sufficient scale of impact.

We will next outline the considered theories.

Structural arguments

North Sea oil and gas

This argument says that there are long-term or "structural" trends in our economy that have made an erosion of productivity growth inevitable. In the UK context, the most obvious potential example is the draining of oil and gas reserves in the North Sea. Oil and gas is one of the industries that have the highest levels of labour productivity, with output per hour around 10 times higher than the UK average. The relative decline of this industry as a share of gross domestic product (GDP) could be expected to lead to a secular fall in the level of productivity, in the same way that if one removes the tallest player from a football team, the average height gets shorter.

Changes in financial regulation

We can look also at the finance sector, which shared similar characteristics to oil and gas before 2008. Both were very high productivity industries that showed high rates of growth before the crisis, which after the crisis have been shrinking in productivity. They are also shrinking in size but still high in absolute terms. Therefore, even though workers in finance demonstrated lower output per hour in 2015 than in 2008, these workers are moving from finance to even lower productivity industries: the question is whether this is significant enough to potentially be classed as a cause.

Loss of economies of scale from a fall in international trade

There is an argument that after 2008, changes in international trade patterns have reduced the demand for goods and services, leading to firms needing to change their production model and experience a step-change in productivity.

Labour and managerial arguments

Weak UK management practices

Working closely with Nick Bloom, John van Reenan and the Economic Statistics Centre of Excellence (ESCoE), we have published a series of articles investigating the relationship between measures of the use of formal management practices, including [Management practices and productivity among manufacturing businesses in Great Britain: Experimental estimates for 2015](#) and [Management practices and productivity in British production and services industries - initial results from the Management and Expectations Survey: 2016](#). These formal management practices are strongly correlated with levels of productivity at the firm level, but we need to investigate whether management has got "worse" since 2008 to cause the change in behaviour.

Labour hoarding

A classic hypothesis for the productivity slowdown is that during the 2008 recession, many firms did not immediately release their staff because they had invested in skills and other job-specific training and the costs of retraining and disruption exceed the savings from releasing staff, particularly after redundancy costs are taken into account. This phenomenon is generally observed after recessions, and it is seen in a short-term drop in productivity, from which the economy normally goes on to recover. After 2008, the argument that firms were holding onto workers in anticipation of a future recovery appeared valid for a period of time, but we need to investigate whether this is plausible more than a decade after the start of the downturn, particularly in light of historically strong levels of employment.

Labour misallocation

There is an alternative viewpoint we can review. While simple hoarding as an argument appears unlikely, this does not imply the economy is allocating labour inputs efficiently. Overall productivity can grow either because the individual sectors of the economy improve (changes within industries) or because workers move from a lower productivity sector to a higher productivity sector (changes between industries). This latter element is generally called the allocation effect, and in the UK this has been negative for much of the last few years. This suggests labour is moving from high to low productivity industries. Any explanation of the productivity puzzle also needs to be able to tackle this.

Measurement arguments

Mismeasurement of products already captured by GDP

One hypothesis put forward is that the wave of rapid digital innovation is not being captured in the data. Changes in the quality or composition of services – such as the avalanche of free apps we all use via our mobile phones – pose challenges for economic measurement, but this has always been the case. The main question is whether this period is observing more rapid change than previous periods.

Mismeasurement caused by services moving outside the GDP boundary

A further hypothesis (for example, see [Do-it-yourself digital: the production boundary and the productivity puzzle \(PDF, 377KB\)](#)) is that some activity that used to be counted towards GDP now falls outside the "productive boundary" and has moved to the household sector. The classic example here, as deployed in the [Bean Review](#), was holiday booking: holidays once booked in high street shops are today booked via a mobile device, with little or no in-person engagement with a travel agent. Yet this might be captured as a decrease in productivity due to the difficulties in measuring the modern methods of booking holidays.

Capital arguments

Duplication of channels

Productivity is the ratio of outputs and inputs, and it can improve either by increasing outputs or decreasing inputs. Over the last 30 years, as the internet has become established, almost all firms have launched a digital presence, which either creates synergies with their existing capital stock or potentially acts as a new channel duplicating this existing capital stock – in effect, an extra input. An example might be retailers using online shops alongside traditional "bricks and mortar" shops. We need to investigate whether it is possible that the current slowdown is a transitory effect as firms struggle to migrate towards using their new technology while resizing their traditional practices.

Bank forbearance

A classic hypothesis that was frequently put forward in the early 2010s was that government policy in relation to supporting banks had resulted in firms that in normal circumstances would have closed being sustained by bank "tolerance" or "forbearance". These firms survived despite having lower, or negative, productivity.

Banks' inability to lend against intangible assets

An argument put forward is that rather than forbearance on bad debts, it is the failure of Europe's more traditional money market to adapt to new conditions that is causing firms to be unable to invest. Banks, it is argued, prefer to lend against tangible assets, which can be sold if the firm fails, while venture capitalists are more willing to lend to firms that rely on new intangible technologies and assets. Given the growth of intangibles as a share of the capital stock, this suggests innovative new European firms are at a disadvantage compared with their American peers.

Impact of pensions causes firms to delay capital investment

One financial impact that might be observable is in relation to the availability of funds to undertake investment, and this is the change in the scale of pension deficits. The core of this argument is that sustained low interest rates, compounded through time, have significantly reduced the return on assets held in pension funds compared with expected returns before 2008. The end result has been that pension funds have fallen into deficit, requiring firms to divert discretionary resources from other purposes into topping up pension funds. The result could be lower spend on capital. Proponents of this argument suggest higher interest rates would partially rectify pension deficits by increasing future returns, releasing discretionary cash within firms to invest, causing investment to rise.

Innovation arguments

Best practice within firms tends to move over time from those companies at the frontier to those further back

A breakdown in this dispersion of best practice is another possible reason for the productivity puzzle. Looking at individual firms, analysis from the Office for National Statistics (ONS) into ["laggards"](#) and analysis from the OECD on [Frontier firms, technology diffusion and public policy](#) has focused on a phenomenon that can be observed within many industries. In particular, we observe a phenomenon among the technology sectors where frontier firms accelerate away from the pack while firms at the bottom of the productivity league exhibit a worrying trend towards containing a larger share of increasingly older and larger firms, which employ more people. This is a strong indicator that the most advanced firms around the world have not slowed their rate of productivity growth while productivity in lagging firms has stagnated, or that even if the frontier firms are not growing at the same pace as before (Schneider 2018), laggard firms still form a "long tail" of under-performance. The question, therefore, is whether this has markedly changed since 2008.

A slowdown in the flow of ideas or new technologies

Some argue that the productivity slowdown observed worldwide is because the flow or value of "new ideas" and "new technologies" is in some way diminished from those achieved in the past (for example, Gordon 2016). The essential argument is that today's innovation in communications or digital data pale in comparison with the effect of the steam engine, the internal combustion engine, clean water, the impact on female labour market participation of home washing machines and other household appliances, electricity and nuclear power, the invention of the computer, radio, or television. Nevertheless, the argument deployed earlier about diffusion can also be applied here. If current new ideas are not as impactful across multiple firms as previous generations of new ideas, this would be a universal effect covering all countries, so we need to determine why the UK would have a worse experience than its developed peers.

Uncertainty arguments

Whether UK firms systemically changed the balance between capital and labour inputs

Rapid employment growth, as discussed earlier in regards to labour hoarding, in a world where many firms are lagging behind the frontier, is an interesting combination worth reviewing. In particular, why firms have made the choice to hire and grow employment, particularly when capital investment is not keeping pace. In our statistics, we can observe that capital and labour ratios have not grown as before 2008. Using the insights from [Technology-specific production functions](#), presented at the 2018 ESCoE Conference, we can consider this in terms of whether firms that have not kept pace with the frontier firms have instead selected a "sub-optimal" technology model (combination of labour and capital) as either a self-imposed limit on their ambition or a constraint imposed on firms that cannot afford or access certain types of skills in their workforce. If this is happening, the main question becomes whether these firms are pushing out these technology frontiers at a rate comparable with that before 2008, or instead whether "older" technology functions display slower growth generally. We need to determine whether the movement out of one technology frontier causes growth, or whether the jump from one technology to the next is what delivers productivity growth.

Uncertainty caused by rapid technology change causing firms to delay capital investment

It is clear from our multi-factor productivity (MFP) analysis that the growth of capital services has slowed since 2008, particularly in terms of capital services per unit of labour. Given historically low interest rates, when one might otherwise presume that capital investment would have accelerated, has the change in the macroeconomic environment post 2008, where uncertainty caused by financial instability or other factors may have a compounding effect? This is illustrated by a paper from the Bank of England which showed that 'heightened economic uncertainty lowered investment even after controlling for investment opportunities, sales growth, and the firm's own stock volatility'. This calculation on whether to invest would normally be based on some assessment of the probability that at any point in time, a rival technology may come onto the market that reduces the future benefits. There has always been some probability of this event, but this historically was low. The main lessons of the digital age are the ability of new entrants to remove even the largest incumbent from the market (for example, digital cameras and Kodak) and that the emergence of new entrants is uncertain and now global – a new competitor on the far side of the world can remove a domestic incumbent, whereas historically it may have taken them decades to penetrate other territories. As such, firm-level uncertainty may cause firms to be pessimistic and delay their investment decision, possibly recruiting labour to see them through.

6 . Conclusions

The productivity puzzle is accurately named. This article has listed the leading hypotheses, and this series of articles will test whether our published measures give any insights into these. Given the complex interaction between a number of these theories, and the way they all impact on the UK economy to some degree, it is likely that the productivity puzzle is at least partly caused by all the things discussed here. The UK's unique characteristics as a relatively open, developed, digitally advanced economy with large oil and gas and financial sectors leaves it in a position where some of the theories here could relate more to the UK than other countries, which might go some way towards explaining why the UK has faced a deeper and more prolonged downturn than many of its peers. We do not know all the answers yet, but the aim of this series of articles will be to give users information to help us better understand how well the UK's productivity statistics can help us get to the answer.