

The UK productivity puzzle

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- Labour productivity growth in the United Kingdom has been particularly weak since the start of the crisis.
- The recent strength in hiring and modest pickup in productivity growth suggest that spare capacity within firms is unlikely to explain much of the current weakness.
- Factors related to the nature of the financial crisis are likely to be having a persistent impact on the level of productivity — but there remains considerable uncertainty around any interpretation of the puzzle.

Overview

Since the onset of the 2007–08 financial crisis, labour productivity in the United Kingdom has been exceptionally weak. Despite some modest improvements in 2013, whole-economy output per hour remains around 16% below the level implied by its pre-crisis trend. Even taking into account possible measurement issues and secular changes in some sectors, this shortfall is large — and often referred to as the 'productivity puzzle'.

Measures of productivity can be used to inform estimates of an economy's ability to grow without generating excessive inflationary pressure, which makes understanding recent movements important for the conduct of monetary policy. In this context a key challenge has been to understand better how much of the weakness in productivity has been due to (i) cyclical explanations related to demand conditions, compared to (ii) other more persistent causes related to the financial crisis. This article sets out some of the factors that might help to explain the UK productivity puzzle, grouped into these two categories. Based on recent research by Bank staff, the available evidence suggests that there is more likely to have been a range of factors at play rather than any one single explanation (see **summary table**).

During the initial phases of the recession, companies appear to have acted flexibly by holding on to labour and lowering levels of factor utilisation in response to weak demand conditions. Other cyclical explanations, such as having to work harder to win new business, are also likely to have played a role. But the protracted weakness in productivity and the strength in employment growth over the past two

years suggest that other factors are likely to be having a more persistent impact on the level of productivity. These factors are likely to have manifested themselves in reduced investment in both physical and intangible capital, such as innovation, and impaired resource allocation from low to high productive uses.

But there remains a large degree of uncertainty around any interpretation of the weakness in productivity. The explanations covered in this article are unlikely to be exhaustive and are unable to explain the full extent of the productivity shortfall.

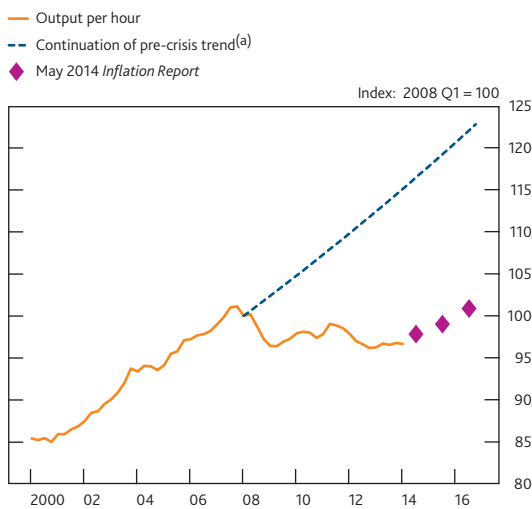
Summary table Factors contributing to the weakness in UK labour productivity by 2013 Q4

Shortfall in labour productivity relative to pre-crisis trend in 2013 Q4	16pp
Measurement issues Including: potential mismeasurement of output and changes to trend rates of growth in some sectors	Around 4pp
Actual shortfall to explain	12pp
Hypothesis I: cyclical explanations Including: measured spare capacity within firms, other cyclical factors reflecting changing demand conditions	Uncertain, but little evidence of spare capacity from business surveys and employment outturns
Hypothesis II: more persistent factors Including: reduced investment in physical and intangible capital, and impaired resource allocation and unusually high firm survival rates	Likely to be significant in recent years, contributing around 6 to 9pp
Total explained	Around 6 to 9pp

(1) The authors would like to thank Richard Galletly and Carleton Webb for their help in producing this article, and the ONS VML team for providing access to firm-level data.

Labour productivity is defined as the quantity of goods and services produced per unit of labour input. Since the onset of the 2007–08 financial crisis, labour productivity in the United Kingdom has been exceptionally weak. While labour productivity — measured by whole-economy output per hour worked — started to improve in 2013 alongside the recovery in output that was taking place at this time, it is still some 16% below the level implied by a simple continuation of its pre-crisis trend (Chart 1). This shortfall is sometimes referred to as the 'UK productivity puzzle', and has spurred a range of research both inside and outside the Bank of England in an effort to explain it.

Chart 1 Whole-economy labour productivity per hour



Sources: ONS and Bank calculations.

(a) Pre-crisis trend growth is calculated between 1997 and 2008 Q1, and is projected forward from 2008 Q1.

The level of labour productivity is an important macroeconomic indicator, as it measures the quantity of output that an economy is capable of producing with its existing resources. In the long run, technological progress, which leads to advances in measured productivity, is one of the main determinants of economic growth and improvements in standards of living. Measures of productivity are also important for the conduct of monetary policy, since they can be used to infer the economy's ability to grow without generating excessive inflationary pressure.

In the short to medium run, estimates of productivity can be affected by the intensity with which factors of production are utilised. Indeed, a key challenge in recent years has been to understand better how much of the weakness in productivity has been due to a temporary build-up of spare capacity in firms, compared to more persistent causes. As a result, productivity has been at the forefront of the discussions of the Monetary Policy Committee (MPC), and much attention has been devoted to discussing the various possible explanations for the productivity puzzle.⁽¹⁾ A key judgement in the May 2014 *Inflation Report* is for productivity growth to pick up

gradually as the recovery progresses (shown by the diamonds in Chart 1).

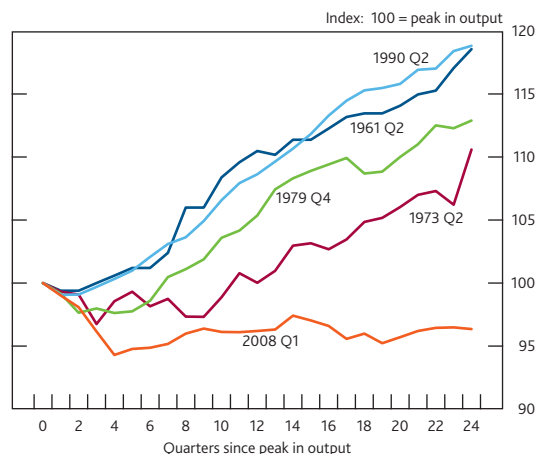
This article sets out some of the various factors that might be behind the UK productivity puzzle, based on results of recent Bank of England research.⁽²⁾ It builds on discussions in recent Bank of England *Inflation Reports*⁽³⁾ and a 2010 *Quarterly Bulletin* article, 'The impact of the financial crisis on supply'.

The first section of the article discusses the recent productivity experience in historical and international contexts, and introduces some possible explanations for the productivity puzzle. The two sections that follow discuss the available evidence under the two main hypotheses: that the weakness in productivity reflects cyclical explanations related to changing demand conditions, and that the weakness reflects more persistent factors. The penultimate section evaluates the relative importance of each of these explanations. The final section concludes.

The productivity puzzle: key facts and possible explanations

The fall in labour productivity during the recent recession has been larger than in any other post-war recession (Chart 2). And the recovery has been more protracted than previous experiences. Even six years after the initial downturn, the level of productivity lies around 4% below its pre-crisis peak, in contrast to the level of output, which has broadly recovered to its pre-crisis level.

Chart 2 Productivity after UK recessions



Sources: ONS and Bank calculations.

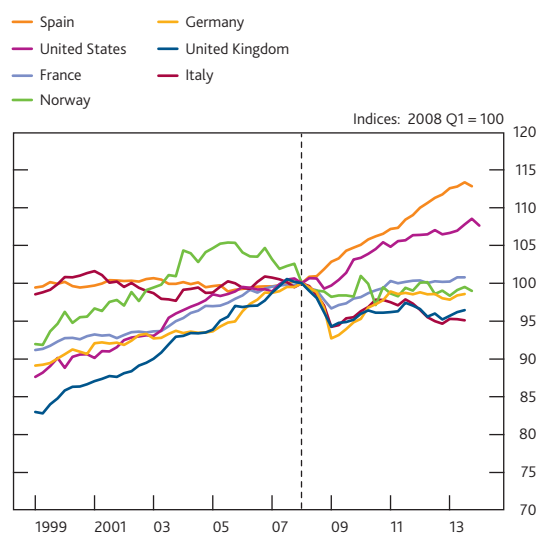
(1) For example, see the minutes of the Monetary Policy Committee meetings throughout 2013.
 (2) This work contains statistical data from the ONS, which is Crown Copyright. The use of the ONS statistical data in this work does not imply the endorsement of the ONS in relation to the interpretation or analysis of the statistical data. This work uses research data sets that may not exactly reproduce National Statistics aggregates.
 (3) See the November 2012 and May 2014 *Inflation Reports*.

The weakness in labour productivity is even more pronounced if one compares the current level with a simple continuation of its pre-crisis trend (**Chart 1**): this shortfall in productivity is currently 16%. And the shortfall is large whether one measures it as output per hour or output per worker, across the whole economy or only within the private sector.

But there are reasons why this comparison may overstate the size of the productivity puzzle. Output or labour inputs may be mismeasured, which in turn means that labour productivity may be mismeasured. In addition, trend productivity growth may also have slowed, for example due to the secular decline in North Sea oil output. This would result in a flatter profile for the dashed blue line in **Chart 1**.⁽¹⁾ These issues are discussed in more detail in the box on page 118. But, overall, although measurement issues may explain some part of the shortfall in productivity relative to a continuation of its pre-crisis trend, a large part still remains unexplained.

The United Kingdom's productivity weakness is also unusual in comparison with international experiences since the financial crisis. The United Kingdom's productivity performance, particularly relative to its pace of growth prior to the crisis, has been considerably weaker than that of most other advanced economies (**Chart 3**). While there may be important structural differences between the UK economy and other countries,⁽²⁾ these are unlikely to explain fully the United Kingdom's productivity underperformance.

Chart 3 Whole-economy labour productivity per head across countries



Sources: Eurostat, ONS, Thomson Reuters Datastream and Bank calculations.

Possible explanations

The unprecedented weakness in productivity has spurred a range of research efforts both inside and outside the Bank of England in order to explain it.

At a basic level, economists often think of labour productivity as being composed of three main factors: the amount of capital available per hour worked (or 'capital deepening'); the degree of technical efficiency with which labour and capital inputs are combined ('total factor productivity' or TFP); and the degree or intensity of utilisation of capital and labour within firms. The box on page 119 provides a more detailed description of these components.

Various explanations have been put forward to explain the productivity puzzle, and each of them is likely to have a different impact on the three components described above. These explanations can also be broadly characterised into two main hypotheses:

- (i) the weakness in productivity is cyclical, reflecting lower factor utilisation due to weak demand conditions, and is likely to be temporary in nature; and
- (ii) other factors are slowing growth in either the amount of capital per worker or TFP, leading to a more persistent effect on the level of productivity.

In assessing the outlook for inflation, the MPC needs to form a view on how much of the weakness of productivity reflects either of these two hypotheses. The relative weights the MPC puts on these two hypotheses are likely to influence its evaluation of the United Kingdom's productive capacity and hence the economy's ability to grow without generating excessive inflationary pressure.

The first hypothesis suggests that the weakness in productivity is more cyclical in nature and driven principally by weak demand conditions. The mechanism at work here is that firms are unable or unwilling to dispose of capital or lay off workers, either because of minimum staffing levels required to keep the business going, or because they believe the weakness in demand to be temporary.⁽³⁾ Holding on to resources in this way means that firms are able to maintain their capacity levels. In the meantime, these firms are not as productive as they might otherwise have been. The difference between this lower level of utilisation and more normal levels of capacity utilisation is what is sometimes called 'spare capacity within firms', an important element of spare capacity in the economy.⁽⁴⁾ Here, normal levels of spare capacity are taken to be those consistent with no significant pressure on inflation relative to the 2% inflation target.

(1) See in particular Patterson (2012).

(2) For example, the business services sector (which includes financial services) in the United Kingdom is larger than in many countries, rendering the UK economy more susceptible to financial shocks (Hughes and Saleheen (2012)).

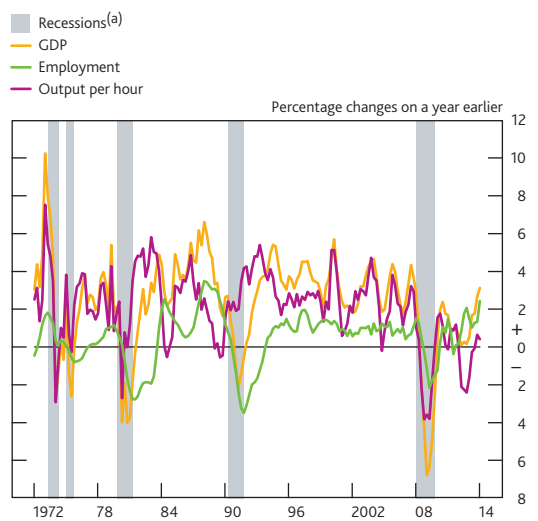
(3) Some studies, notably Blundell, Crawford and Jin (2013) and Grice (2012), also suggest that firms are better able to retain labour because of an increase in the flexibility of wages and increased labour supply.

(4) The other important element is spare capacity in the labour market — that is, the extra output that could be produced by those who are underemployed or out of work before the amount of slack stops pushing down on wage growth. See the box on page 29 of the May 2014 *Inflation Report* for further details.

It is plausible that there are other cyclical explanations for the weakness in productivity at work. The Bank's Agents have suggested that some firms diverted resources towards business development activities or generating custom which may not count as output, at least in the short term. Such firms may report that they have little spare capacity at present, but provided that there has been no deterioration in their ability to produce output, they should have scope to expand production should demand recover.

Labour productivity growth in the United Kingdom is strongly procyclical; as shown in **Chart 4**, periods of economic downturn are typically accompanied by a reduction in labour productivity, while periods of economic growth coincide with productivity improvements. However, since the onset of the recent financial crisis, productivity growth has been weaker than one would have expected given its normal cyclical relationship with GDP, particularly since 2010. Growth rates in output per hour (the magenta line in **Chart 4**) have been persistently weaker than GDP (the orange line), reflecting strong employment growth over the past few years. Therefore, cyclical factors alone are unlikely to explain the productivity puzzle fully.

Chart 4 GDP, productivity and employment



Sources: ONS and Bank calculations.

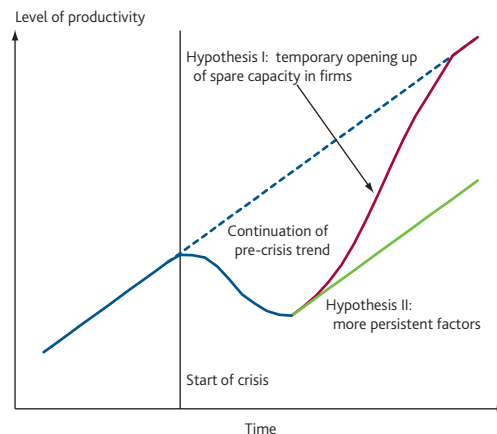
(a) Grey bars indicate recessions, defined as two consecutive quarters of falling GDP. The recessions are assumed to end once GDP begins to rise.

The second hypothesis suggests that the weakness in productivity is likely to persist for some time, as the underlying factors behind it may have disrupted the capacity of the economy to supply goods and services, through underinvestment or inefficient allocation of resources.⁽¹⁾ There are several mechanisms associated with the recent financial crisis that may have caused this to happen. Impaired access to finance for companies and heightened uncertainty with respect to the macroeconomic environment may have dissuaded firms wishing to invest in profitable projects from

doing so, impeding growth in the amount of capital per worker. Tight credit conditions may also have slowed the investment in, and introduction of, new innovations. Furthermore, the crisis may have led to impediments in the movement of capital and labour towards their most productive uses, again slowing growth in productivity.⁽²⁾

Figure 1 is a stylised diagram which compares how one might expect productivity to behave under the two hypotheses described above. Under the first hypothesis, productivity weakens following a crisis and the subsequent deterioration in demand conditions as firms reduce their levels of capacity utilisation. Productivity then recovers, as demand conditions pick up, and any spare capacity is used up. By contrast, under the second hypothesis, productivity weakens and stays persistently weaker. Productivity growth starts to recover only when these more persistent factors start to wane, and the level of productivity never recovers to where it might have been in the absence of the crisis.

Figure 1 Evolution of labour productivity under two stylised hypotheses



Of course, in reality, it could well be that the evolution of productivity in the United Kingdom reflects a combination of the two hypotheses considered above. Moreover, even the more persistent causes of productivity weakness could unwind — at least partially — over some time horizon, in contrast to the scenario depicted by the green line in **Figure 1**, where the productivity shortfall is assumed to persist indefinitely. For either of these reasons, the actual path for labour productivity could fall somewhere between the stylised scenarios shown on **Figure 1**.⁽³⁾

(1) Oulton and Sebastiá-Barriol (2013) suggest that financial crises have tended to reduce the long-run level of productivity permanently. They estimate that a banking crisis reduces the long-run level of productivity by around 0.8%–1%, on average, for each year that the crisis lasts.

(2) See Broadbent (2012, 2013) and Barnett *et al* (2014b).

(3) Under a more pessimistic scenario, a financial crisis would lead to a permanently lower growth rate of productivity. In this case, the gap between the subsequent path of productivity and the pre-crisis trend would continue to grow indefinitely.

How much of the productivity puzzle might be explained by measurement issues?

This box outlines several reasons why the reduction in measured labour productivity might overstate the true size of the productivity puzzle. Since labour productivity is measured as the amount of output per worker (or the amount of output per hour worked), if output turns out greater — or employment (or total hours worked) weaker — than initially estimated, this might reduce the size of the shortfall. Furthermore, since the shortfall in productivity is often estimated relative to the level implied by a pre-crisis trend, any changes to this trend will also affect the size of the shortfall.

Output

Initial estimates of GDP are revised as new information becomes available. As described in the May 2014 *Inflation Report*, Bank staff expect that the latest level of measured GDP will ultimately be revised upwards. This is based on past revisions to the data and other indicators of economic activity, such as the business surveys. The expected cumulative revision to the level of GDP between 2011 Q1 and 2013 Q4 is only small at around 0.7%. Patterson (2012) also considers that measurement errors in GDP estimates could in principle account for some of the productivity weakness but concludes that this is likely to be very small.

In addition, the National Accounts data do not currently capture investment in intangible assets such as research and development (R&D) expenditure. R&D is an input into the production process, but its output might not be evident immediately: for this reason, it is currently treated as intermediate consumption and not as a form of investment. Arithmetically, this will lead to an underestimation of GDP. In the forthcoming 2014 *Blue Book*, expenditure on R&D will be considered as an investment and will be included in gross fixed capital formation rather than intermediate consumption. This means that, for the first time, expenditure on R&D will directly contribute to GDP.⁽¹⁾ Estimates suggest that intangible investment held up better during the recession than the physical (or tangible) investment captured in the official GDP data. As argued in Goodridge, Haskel and Wallis (2013), if intangible spending had been included, it could have lifted the level of GDP relative to 2008 by around 1½ percentage points.

Employment and total hours

Headline data are unlikely to overestimate substantially the amount of total hours worked. Although the ONS Labour Force Survey measure of employment is uncertain due to sampling variation, an alternative measure based on ONS Workforce Jobs points to a broadly similar rise in total employment since 2010. Similarly, changes in the Labour Force Survey measure of average hours worked have been

corroborated by other indicators such as the Annual Survey of Hours and Earnings.

A notable feature of the rise in total employment has been the rise in self-employment. Since the trough in employment in 2010, self-employment has risen by more than 600,000 (just under half of the rise in total employment). However, even under the extreme assumption that none of the newly self-employed over this period has generated any output, this would only account for around 2 percentage points of the shortfall in the level of measured productivity.

Trend rates of growth

It may be that the trend rate of productivity growth started slowing prior to the onset of the crisis. For example, the growth of North Sea oil and gas extraction output has been in secular decline since around 2003 and this has slowed trend growth in labour productivity in this sector from a little under +1 percentage point to -2 percentage points per quarter. This would not affect the measurement of labour productivity *per se*, but would affect the trend rate of growth one would use to generate a counterfactual trend estimate. Multiplying the difference between these trends with the sector's share in output suggests it might account for around 1 percentage point of the current productivity shortfall. Similarly, it is also possible that productivity growth in the financial services sector will be persistently lower since the crisis, following its relatively rapid growth prior to 2007. It is difficult to quantify this effect, but a reasonable assumption could be that slower financial sector productivity growth could contribute a further 1 percentage point to the productivity shortfall.

Overall, although measurement issues and revisions to output may explain some of the shortfall in productivity — up to 4 percentage points — the rest remains unexplained.

(1) For more details see the recent ONS articles at: www.ons.gov.uk/ons/rel/naa1-rd/national-accounts-articles/impact-of-esa10-changes-on-current-price-gdp-estimates/art---impact-of-esa10-changes-on-current-price-gdp-estimates.html.

Accounting framework for labour productivity growth

Labour productivity growth is often decomposed into capacity utilisation, capital deepening and technological growth. This box briefly describes a way to account for these components, and relates these to the two hypotheses discussed in the rest of this article.

The framework is based on a simple set of assumptions about firms' production processes. Suppose that a firm produces output Y using capital K and labour L . Inputs are not always fully employed: capital is utilised only to a fraction W of its full potential and the labour force exerts a degree of effort E . Finally, A represents a measure of technological efficiency. The production of output can then be expressed as a function F of the inputs of production K and L , adjusted by their degree of utilisation W and E respectively, and augmented by technological efficiency:

$$Y = AF(WK, EL)$$

By rearranging the function above, **labour productivity**, defined as output per unit of employment (Y/L), can be expressed in terms of its three main components: the level of technological efficiency A , capital per hour worked or 'capital deepening' (K/L) and the degree of capacity utilisation ($Util$, which is a function of W and E):

$$\frac{Y}{L} = Af\left(\frac{K}{L}, Util\right)$$

Technological efficiency A , also called **total factor productivity (TFP)**, is sometimes used as an alternative measure of productivity, and reflects how efficiently labour and capital, as well as any other inputs, are combined to produce output. Technological progress and the associated improvements in TFP are key drivers of long-term economic growth. It is not directly observable and, therefore, is usually estimated as a residual by rearranging the equation above. A further challenge is that the degree of utilisation is also unobservable directly. In addition, there is currently a large degree of uncertainty around official estimates of the capital stock.

This article sets out various explanations that have been put forward to help explain the UK productivity puzzle. The evidence relating to each explanation is discussed in relation to two main hypotheses. First, that the weakness in productivity has been due to cyclical explanations, such as a temporary build-up of spare capacity in firms, and second, that the weakness has been driven by other more persistent causes. Whether an explanation falls under the first or second hypothesis depends on which component of labour productivity it is likely to affect. For example, lower levels of capacity or factor utilisation will directly affect the degree of utilisation $Util$ and are accordingly allocated under the first hypothesis. Factors affecting the level of capital per worker or TFP, on the other hand, are likely to have a more persistent effect on productivity and are categorised under the second hypothesis.

Hypothesis I: cyclical explanations

This section outlines the reasons why firms may have chosen to use their labour less intensively and therefore retain or 'hoard' labour. It then considers other cyclical factors which may have led productivity to respond to changes in demand conditions. Finally, it puts these pieces of evidence in context by considering the recent economic recovery.

Spare capacity within firms

Labour productivity often deteriorates in the initial stages of a recession, as the fall in output is not always accompanied by an immediate fall in employment. During the recent recession, employment has been more resilient than in the 1980s and 1990s downturns, despite the larger fall in output. This means that the drop in productivity has been more pronounced than in previous downturns.

Some companies may have been unable to cut employment below a minimum threshold. They may have required a certain amount of labour to keep the business going, so-called 'overhead labour'. An example could be the need to maintain

a building's security guards as long as the building is in use, or until it is sold or demolished. It is likely that, relative to previous recessions, this may have played a larger role as the service sector is now a larger part of the economy and overhead labour is, arguably, more important for the service sector than for other industries.

Alternatively, the resilience in employment could reflect firms making the active decision to retain staff, despite weak demand, in the expectation of a recovery in demand. Companies might wish to retain underutilised labour to avoid the cost of firing and subsequent re-hiring when the economy picks up. But they might only be able to do so to the extent that they are able to contain wage costs in the interim. The increased flexibility of real wages over the past few decades, partly due to the decline in labour unionisation, may therefore have helped firms to hold on to their employees.⁽¹⁾ Between

(1) Martin and Rowthorn (2012) suggest that lower real wages may have also encouraged firms to create low-productivity, low-paid jobs in private service activities. Pessoa and Van Reenen (2013) suggest that the large fall in real wages associated with an increase in the cost of capital has also caused a fall in the capital to labour ratio which they expect will reverse as demand for goods and services improves.

2008 Q1 and 2013 Q4 real product wages, a measure of firms' real labour costs per employee, fell by 5%.⁽¹⁾

Indeed, in the early stages of the recession, the Bank's Agents reported that business contacts had been wary of repeating their experiences of the 1980s and 1990s recessions. Having fired workers early on in the course of those downturns, companies then found it difficult to find workers with the appropriate, firm-specific skills when the economy recovered, and were thus less able to take advantage of improved demand conditions.

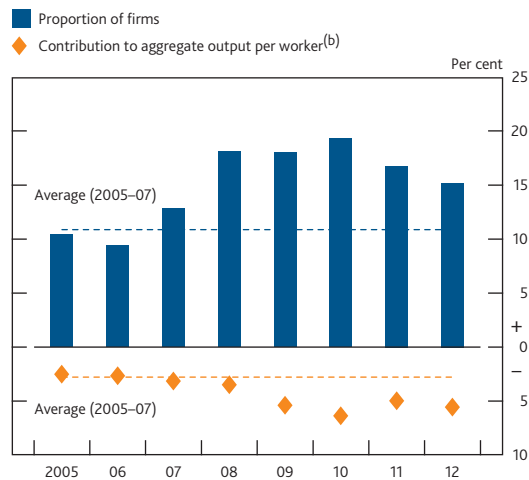
Barnett *et al* (2014a) also find some firm-level evidence of 'labour hoarding'. Using ONS firm-level data they show that aggregate movements in employment can be linked to individual firms' behaviour at different points in the cycle. As one might expect, before the crisis (2005 to 2007) hiring was concentrated among firms whose output was growing. Also somewhat predictably, during the trough of the recession (2008 to 2009), the proportion of firms with shrinking output and falling employment increased.

Beginning in 2008, a large proportion of firms with shrinking output began holding employment flat, rather than reducing it. **Chart 5** shows the proportion of businesses experiencing shrinking output but flat employment from 2005 to 2012 (the latest available data point). It rose from around 11% in 2005–07 to around 20% by 2010 and remained elevated even to 2012.⁽²⁾ This group of firms has also consistently made one of the largest downward contributions to productivity growth relative to the pre-crisis period (shown by the diamonds in **Chart 5**). This suggests that some companies did react flexibly by holding on to labour in response to weak demand conditions, and that this contributed to the fall in measured labour productivity — at least until 2012.

If companies had been operating with underutilised resources in this way, then one would have expected to see it reflected in business survey measures of spare capacity. Indeed, these surveys pointed to a significant degree of slack within companies in the earlier stages of the crisis: reported levels of capacity utilisation fell considerably in 2009 (**Chart 6**). This is likely to have reflected an opening up of a degree of spare capacity in firms that persisted into 2012 — at least in the services sector — in line with the firm-level evidence presented above.

However, operating with underutilised resources is unlikely to be sustainable for long. Over time, the idea that firms are continuing to hold on to an excessively large workforce becomes less plausible. The survey measures of capacity utilisation have now closed substantially, which suggests, on the face of it, that firms are now operating at or slightly above normal levels of capacity.⁽³⁾

Chart 5 Proportion of firms experiencing shrinking output but flat employment^(a)

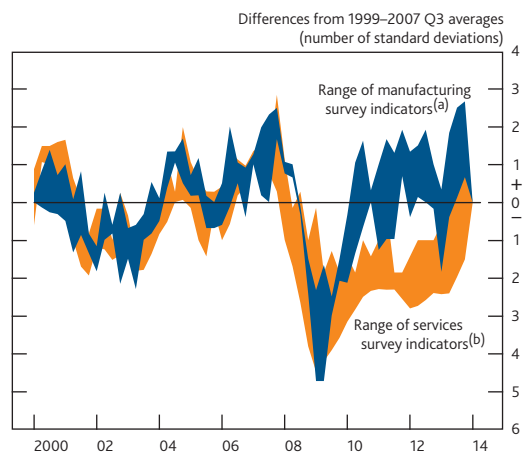


Sources: ONS research data sets and Bank calculations.

(a) Dashed lines represent the average between 2005 and 2007.

(b) Percentage point contribution to the annualised growth rate of output per worker.

Chart 6 Survey measures of capacity utilisation



Sources: Bank of England, BCC, CBI and ONS.

(a) Includes measures of manufacturing capacity utilisation from the Bank's Agents and CBI, and a measure of non-services capacity utilisation from BCC. The Agents' data are end-quarter observations. The BCC data are non seasonally adjusted.

(b) Includes measures of services capacity utilisation from the Bank's Agents, BCC and CBI. The Agents' data are end-quarter observations. The CBI measure weights together financial services, business/consumer services and distributive trades surveys using shares in nominal value added. The BCC data are non seasonally adjusted.

There are, however, reasons why one might not want to take these surveys at face value. First, most of the measures are qualitative, not quantitative, in nature; as such they only capture the average proportion of firms above or below capacity, and not the amount of spare capacity within individual firms.⁽⁴⁾ Second, they ask companies to compare their current level of capacity utilisation relative to 'normal'

(1) Unit wage costs, however, increased over this period, as the fall in productivity more than offset the fall in wages.

(2) A firm is considered to have flat employment or flat gross value added growth if its respective annual growth rates range from -5% to +5%. Note that relative to Barnett *et al* (2014a) **Chart 5** expands the sample to 2012 and includes revisions to the ONS employment data resulting in some quantitative changes to previous estimates.

(3) Note that this section relates to spare capacity within firms. There remains a greater degree of spare capacity in the labour market as explained in Section 5 and the box on page 27 of the May 2014 *Inflation Report*.

(4) See Relleen *et al* (2013) for further details.

levels. What constitutes ‘normal’ is subjective and may well have evolved over time, particularly after six years of weak demand conditions.⁽¹⁾

Other cyclical factors

There may be other reasons why productivity tracked demand conditions over the crisis, which are not captured by business survey measures of capacity utilisation.

One reason is that companies may have had to work harder during the economic downturn in order to win business or obtain work contracts — often termed ‘thin market externalities’. For example, the Bank’s Agents reported that some firms, particularly in the service sector, had diverted resources towards activities that might not immediately count as ‘output’ in the National Accounts. This may include working harder to drum up a given quantity of sales in a low-demand environment, or devoting time to less tangible ‘business development’ activities.⁽²⁾ A large part of the fall in aggregate productivity was in the business services sector, which would lend some support to these hypotheses.⁽³⁾

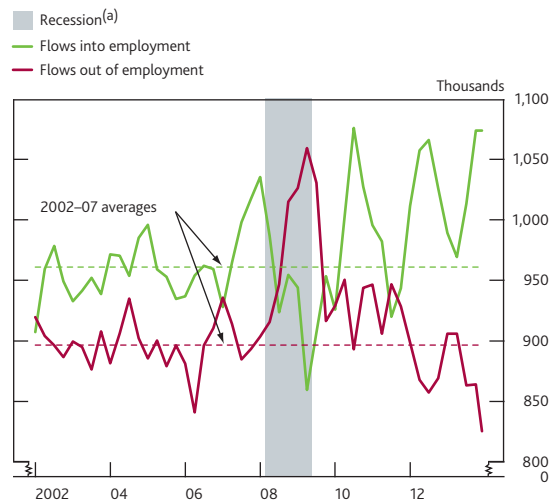
To the extent that these factors have been at play, firms would be unlikely to have reported significant quantities of truly ‘idle’ resources in business surveys. At face value, the survey results would thus understate firms’ ability to improve productivity by increasing measured output without additional hiring. Moreover, such a recovery in productivity could be relatively gradual, especially if shifting employees across jobs is costly (due, for example, to the need to re-train workers). But it is possible that, if demand were to continue to grow strongly, businesses may find they can meet the extra demand by working more intensively, and that they have more spare capacity than expected.

Recent aggregate employment growth

The arguments presented above — with respect to spare capacity and other cyclical factors — can help explain why firms may have held on to existing staff during the recession despite weak demand growth. Consistent with this, the number of people flowing out of employment to either unemployment or inactivity — despite rising sharply at the start of the recession — has remained below the pre-recession average since 2012 (red line in **Chart 7**). But these arguments are less convincing as explanations for why hiring remains high — at (or above) pre-recession averages — despite the backdrop of weak output growth (green line in **Chart 7**). In fact, net employment, which is a combination of flows both into and out of employment, has increased since 2010 as a result of both stronger hiring and fewer people leaving their jobs.

The strength of employment growth became particularly striking from 2012. **Chart 8** shows that, since 2012 Q1, total employment has increased by over a million, of which the number of employees has increased by around 700,000.⁽⁴⁾

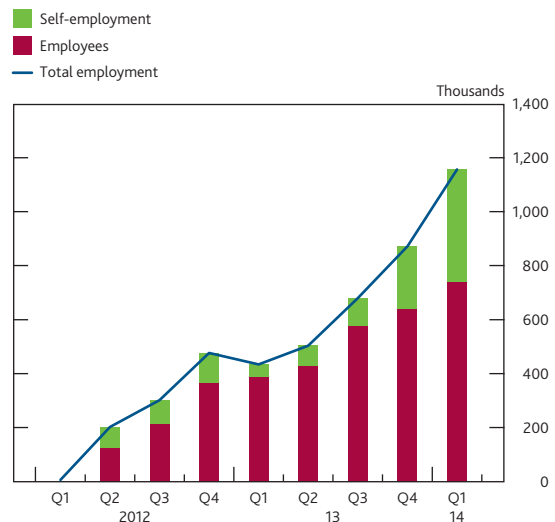
Chart 7 Employment flows



Sources: ONS and Bank calculations.

(a) Grey bar indicates recession, defined as two consecutive quarters of falling GDP. Recessions are assumed to end once GDP begins to rise.

Chart 8 Total employment change since 2012 Q1



Source: ONS Labour Force Statistics.

Although output growth began to gain momentum in 2013, this overwhelming strength in employment growth resulted in a dip in productivity which has only just started to recover: while output per hour grew by 0.2% a quarter on average during 2013, this was well below its pre-crisis average growth rate of around 0.6%.⁽⁵⁾ Even taking into account Bank staff estimates of future revisions to official estimates of GDP, the increase in productivity remains muted.⁽⁶⁾

(1) See Bush (2008).
 (2) See Miles (2012) and McCafferty (2013) for a further discussion.
 (3) See King and Millard (2014).
 (4) A discussion of self-employment over the crisis can be found in the May 2014 *Inflation Report*.
 (5) The pre-crisis average is calculated between 1997 Q1 and 2008 Q1.
 (6) See the box on page 118 as well as the discussion in the May 2014 *Inflation Report* and Bell *et al* (2014) for approaches taken by Bank staff to produce early estimates of GDP growth.

One possible rationalisation for the strength in aggregate employment is that it masks a range of different employment behaviours across firms. It may be that, although some firms have held on to labour despite falling output, other firms have been more successful in expanding both output and employment.

In addition, it may be that the financial crisis led to an increase in labour supply in the United Kingdom. The crisis is likely to have reduced both current real incomes and expected future labour incomes, which may have encouraged more people to seek work and participate in the labour market. Changes to the retirement age and benefit provision rules may also have affected incentives to participate.⁽¹⁾ These structural changes may have put downward pressure on wages and encouraged companies to both hold on to and hire additional staff, resulting in an increase in employment at the expense of measured labour productivity.⁽²⁾

Hypothesis II: more persistent factors

The strength in hiring over the past two years and the very persistent nature of the weakness in productivity suggest that cyclical factors alone are unlikely to explain the productivity puzzle fully. This section examines the evidence relating to the second hypothesis: that certain factors may have disrupted the capacity of the economy to supply goods and services, by causing an inefficient allocation of resources, and are having a more persistent impact on productivity growth. It begins by examining the role of lower levels of investment in different forms of capital, and then turns to the role of resource allocation.

Tangible and intangible capital investment and working capital

As explained in the box on page 119, the size of the capital stock available to each unit of labour is an important determinant of labour productivity. Investment in the physical capital stock has been subdued in the aftermath of the crisis. This could be a consequence of increased uncertainty surrounding the economic outlook — making firms more cautious when investing or disinvesting — or unfavourable credit conditions, if firms cannot obtain finance (or can only do so at a higher cost).⁽³⁾ In addition, because real wages fell considerably whereas the cost of capital initially increased at the start of the crisis, the relative cost of labour to capital is likely to have fallen. This may have provided an incentive to businesses to use more labour-intensive forms of production.

Although the annual flow of business investment is small as a proportion of the total capital stock, protracted periods of weak investment could lead to a material deterioration in the capital stock per worker. As an illustration, if business investment had continued to grow at its pre-2007 average rate of around 1% per quarter, capital per worker would have

been around 8% higher than was estimated for 2013 Q4.⁽⁴⁾ The gap between the actual capital stock and this counterfactual level might account for around 2½ percentage points of the productivity shortfall.⁽⁵⁾

As well as physical capital, companies also invest in so-called 'intangible capital'. This might include knowledge-based capital like intellectual property rights, or sales-based capital like brand names. These types of investment are often complementary to physical (tangible) forms of capital. For instance, the implementation of innovative production processes might occur at the same time as the introduction of new plants and machinery.

Chart 9 shows that spending in Research and Development (R&D), a widely used measure of innovative activity, has been relatively stable during and after the crisis.⁽⁶⁾ But R&D expenditure is only a measure of innovation *input*. Measures of innovation *output* are, for example, the proportion of companies that have introduced new goods or services ('product innovation') or new productive processes ('process innovation'). Available data on innovation outputs from the UK Innovation Survey indicate that spending on R&D has resulted in fewer implemented innovations in the years following the onset of the Great Recession. This is shown by the blue and orange bars in **Chart 9**.⁽⁷⁾ And crucially, it is the *implementation* of innovation, not merely the investment in it, that matters for productivity.⁽⁸⁾

The UK Innovation Survey shows that the proportion of product innovators — defined as companies that have introduced a new or significantly improved product over the previous three years — has declined from 24% to 18% between 2008 and 2012. According to Bank analysis based on firm-level data from the same survey, product innovators were around 20% more productive over 2004 to 2010 than other companies.⁽⁹⁾ This would imply that the reduction in the number of product innovators could account for a little over

(1) See the box on page 27 in the May 2013 *Inflation Report*.

(2) The impact on productivity may be even more pronounced if the increase in labour supply was among lower-skilled occupations. However, according to the Labour Force Survey estimates, much of the increase in employment has been in higher-skilled occupations.

(3) See Bloom, Bond and Van Reenen (2007) or Haddow *et al* (2013) for a discussion of the mechanisms through which uncertainty can affect investment and supply.

(4) These estimates are very uncertain, since the ONS has not published capital stock data since 2011. For the purpose of this comparison we use the Bank of England's internal estimates.

(5) Pessoa and Van Reenen (2013) use a different method to compute the capital stock, based on total investment rather than business investment, and find a larger impact of the capital stock on productivity.

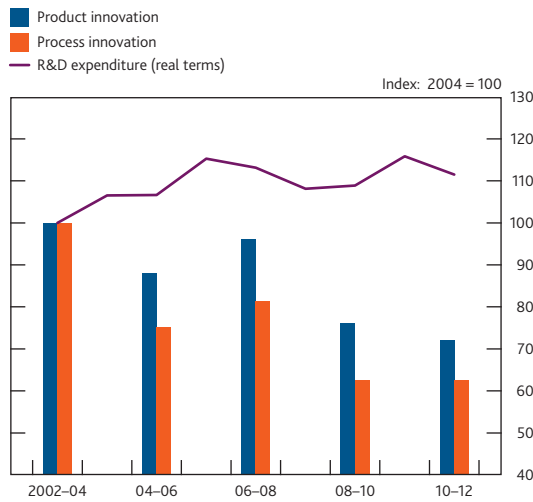
(6) This is unusual, since R&D expenditure usually falls in recessions, and could be due to a number of factors, including policy initiatives such as the R&D tax credits.

(7) The UK Innovation Survey is conducted by the Department for Business, Innovation and Skills (BIS), see: www.gov.uk/government/collections/community-innovation-survey.

(8) See Hall (2011) for a survey of the evidence on the impact of implemented innovation on productivity.

(9) This refers to the median productivity across the two groups. While these estimates are somewhat higher than previous UK studies such as Griffiths *et al* (2006) and Criscuolo and Haskel (2003), they are in the range of other studies reported in Hall (2011).

Chart 9 Innovation measures for the United Kingdom



Sources: BIS UK Innovation Survey and ONS Business Enterprise Research and Development.

1 percentage point of the productivity shortfall between 2008 and 2012.⁽¹⁾

It is possible, however, that as the recovery takes hold, companies might be able to bring to market a backlog of new goods and services resulting from their ongoing R&D efforts. While the timing of this is very uncertain, if new products are only introduced to the market when demand for them exists, then a strengthening of demand conditions could bring about a relatively prompt and significant improvement in productivity growth.

Another form of capital is 'working capital'. This is the net cash balance a company needs to hold in order to meet its day-to-day expenses. The contraction in the availability of credit during the financial crisis may have had a large negative effect on the working capital positions of UK firms, which would have forced companies to operate less efficient production processes, for example by restricting their holdings of inventory. This, in turn, may have affected measured labour productivity.⁽²⁾

Taken together, Bank staff estimates suggest that these capital channels might explain a significant proportion — 3 to 4 percentage points — of the productivity shortfall.

Impaired resource allocation

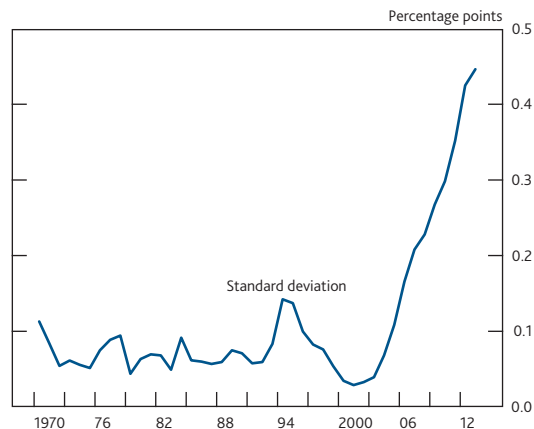
Another important explanation for the weakness in productivity is the slowdown in the reallocation of resources — capital and labour — to more efficient and productive uses. There are several reasons, discussed in this section, for why the process of reallocation could be impeded after a financial crisis.

Economic theory suggests that more efficient companies should be able to attract more inputs, be they capital or labour, relative to companies that are less efficient. Over

time, the less efficient companies are forced to become more efficient or go out of business. This process of 'creative destruction' drives a more efficient allocation of capital and labour across the economy and leads to higher productivity growth at the aggregate level.⁽³⁾ Several academic studies have shown that resource reallocation was indeed an important driver of UK productivity growth prior to the 2007–08 crisis.⁽⁴⁾ However, if there are impediments to the free movement of these factors of production, then it is possible that differences in the level of efficiency across companies may persist, leading to slower productivity growth at the aggregate level.

In practice, differentials in productivity levels across markets and sectors are likely to exist even in normal times.⁽⁵⁾ Some sectors are, by their nature, less labour intensive (hence more productive), and a healthy, dynamic economy requires such firms to coexist with others that may be more labour intensive, as both perform important economic functions. But if resource allocation is restricted, one would expect to see increased *differences* in productivity, prices and rates of return across firms and sectors relative to their levels before the crisis. **Chart 10** shows that, since 2007 and up to 2013, the difference between trend and actual productivity across UK industry sectors has been significantly more dispersed than during the pre-crisis period, indicative of little reallocation having taken place since that time.

Chart 10 Productivity dispersions across industries^(a)



Sources: EUKlems, ONS and Bank calculations.

(a) The chart shows the standard deviation of productivity shortfalls (relative to a trend calculated between 1970 and 2006) across 1-digit Standard Industrial Classification (SIC) sectors.

(1) These are broadly consistent with other studies. For example, Goodridge, Haskel and Wallis (2013) find that the slowdown in intangible investment (of which innovation is a large part) before and during the crisis accounts for around 3½ percentage points of the UK productivity shortfall.

(2) See Fernandez-Corugedo *et al* (2011).

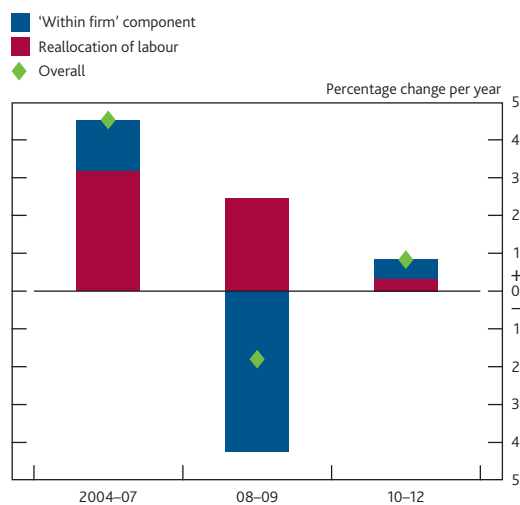
(3) See, for example, Caballero and Hammour (2000).

(4) For example, Disney, Haskel and Heden (2003) find that the formation of new production units, the failure of other units and changing market share could explain around 50% of UK labour productivity growth within the manufacturing sector between 1980 and 1992.

(5) See, for example, Bernard and Jones (1996) and Bernard *et al* (2002).

It is possible to examine the role of reallocation in more detail using ONS firm-level data from the Annual Business Survey. **Chart 11** decomposes private sector productivity growth into growth that can be attributed to changes in productivity within individual firms (the blue bars), and changes stemming from the reallocation of labour from less productive to more productive firms (the red bars). The reallocation of labour here includes the decisions by existing firms to expand or reduce their headcounts, hiring decisions associated with the creation of new firms, as well as the laying off of employees by failing companies.⁽¹⁾

Chart 11 Decomposition of labour productivity^(a)



Sources: ONS research data sets and Bank calculations.

(a) The chart includes UK private non-financial corporations, excluding those in the agriculture, mining and utilities sectors. Further details are provided in Barnett *et al.* (2014a).

While the 'within firm' component accounts for the vast majority of the fall in productivity in 2008–09, the changes in the component that captures the reallocation of labour across UK firms are also striking. This component could explain more than half of labour productivity growth in the four years prior to the recession. At the beginning of the recession in 2008 and 2009, the contribution from reallocation fell slightly, rather than increasing significantly as a result of higher insolvencies or firing behaviour, as one might have expected.⁽²⁾ Following this, the contribution from reallocation declined even further, becoming negligible between 2010 and 2012. This result is in line with Weale (2012), who finds evidence of reduced labour movement through fewer job changes.⁽³⁾

There are a number of possible reasons why the resource allocation process may have been impaired since the financial crisis. Increased uncertainty about the economic environment may have made firms more cautious when investing, and delayed capital and labour reallocation. In addition, a dysfunctional financial system is likely to have impaired the effective movement of resources across the economy.⁽⁴⁾ Two mechanisms which may have slowed the movement of resources around the economy are:

- **impaired capital allocation** following large, asymmetric shocks to specific sectors or industries; and
- **higher firm survival** due to forbearance and other forms of public policy support.

These are discussed in turn below.

Impaired capital allocation

Broadbent (2012, 2013) considers the role of capital allocation across both firms and sectors for productivity growth. He finds that despite significant changes in sectoral rates of return on capital since the crisis, these have not been accompanied by subsequent movements of capital stocks across sectors. This is in contrary to what one would expect in an efficient economy, where capital responds by flowing towards sectors with the highest rates of return. More recently, Barnett *et al.* (2014b) employ a highly stylised model of the economy, with multiple firms and sectors, to show that increased price dispersion can be a consequence of frictions to efficient capital allocation. And the size of this price dispersion since the crisis can be used to infer the size of the associated output and productivity loss. The authors find that this mechanism might explain around 3 to 4 percentage points of the weakness in aggregate productivity.

This study also directly examines whether the relationship between rates of return and subsequent capital movements has changed since the financial crisis, again using ONS firm-level data from the Annual Business Survey. The authors find that the positive correlation between profitability and investment weakened significantly after the financial crisis, which further supports the notion that capital allocation has become less efficient.

Higher firm survival

Since the start of the recession in 2008 Q2, the level of company liquidations has remained low, while the proportion of loss-making firms has increased significantly (**Chart 12**).⁽⁵⁾ A lower rate of business failure, and the accompanying lower rate of unemployment, is likely to have meant that the loss to GDP and general welfare loss associated with the financial crisis was smaller than it otherwise would have been, but this may have pulled down on measured aggregate productivity growth.

(1) This chart is an updated version of the analysis presented in Barnett *et al.* (2014a) and includes data for 2012, the latest year available in the Annual Business Survey micro data set provided to the Bank by the ONS. The calculations are based on changes in firms' labour shares, which can be interpreted as capturing movements in capital as well.

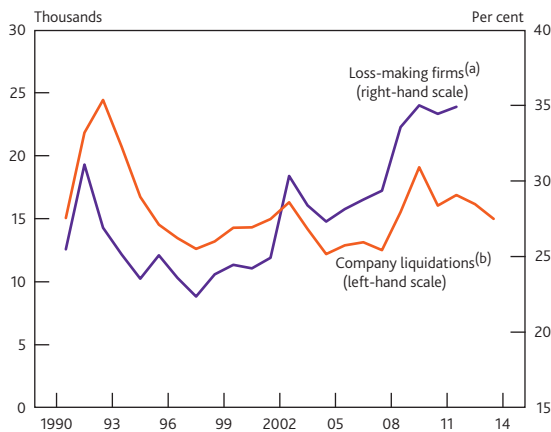
(2) These results are broadly in line with Riley, Rosazza Bondibene and Young (2014).

(3) Specifically, he finds that an apparent change in the workings of the labour market has resulted in there being fewer opportunities for career advancement through changing occupation or industry of employment than there were in the few years before the crisis, and that this could explain about 0.3 percentage points per annum of the fall in labour productivity.

(4) See Stiglitz (1989) for a discussion about the role of financial markets in allocating capital across firms.

(5) See also the Bank of England's August 2013 *Inflation Report*.

Chart 12 Company liquidations and loss-making firms



Sources: Bureau van Dijk, The Insolvency Service and Bank calculations.

- (a) The number of companies that reported negative pre-tax profits in each year as a percentage of the total number of private non-financial corporations in the Bureau van Dijk data set that report data on pre-tax profits. Companies in the mining and quarrying, electricity and gas supply, and water supply sectors and extra-territorial organisations are excluded from the calculations. Data are to 2011.
- (b) Changes to legislation, data sources and methods of compilation mean the statistics should not be treated as a continuous and consistent time series. Since the Enterprise Act 2002, a number of administrations have subsequently converted to creditors' voluntary liquidations. These liquidations are excluded from the headline figures published by The Insolvency Service shown in this chart.

There are several factors that may have helped companies survive the protracted period of weak demand. For instance, Arrowsmith *et al* (2013) examine the prevalence of bank forbearance across the small to medium-sized enterprises (SME) sector. Forbearance is the practice of providing measures of support to a customer or business struggling to meet its debt obligations.⁽¹⁾ The authors find that, although productivity is estimated to be 40% lower in SMEs in receipt of forbearance, only around 6% of SMEs were found to be in receipt of forbearance. This result would suggest that the direct impact on private sector productivity is likely to have been relatively small at around 1 percentage point.⁽²⁾ However, the overall impact is likely to have been greater than this estimate to the extent that forbearance has been more widespread than occurring in just the SME sector.

Support by Her Majesty's Revenue and Customs (HMRC) in the form of its 'Time-to-Pay' scheme, whereby companies are granted extensions to pay their tax obligations, was also likely to have been a significant factor assisting firms over the recession. HMRC Time-to-Pay VAT approvals peaked at 118,000 in 2009, representing around 5% of the tax-registered business population. This fell to 20,700 in the first half of 2011.

In addition, the low level of Bank Rate has helped to keep borrowing costs for firms relatively low. This is in stark contrast to the 1990s recession, during which period Bank Rate was much higher. In fact, Arrowsmith *et al* (2013) note that commercial banks pointed to the low interest rate environment as a more significant factor in accounting for the low rate of company failure than loan forbearance *per se*.

Overall, there is likely to have been a variety of factors that have helped more companies survive the recent recession than the 1990s' experience, given the larger fall in output. To try and illustrate how significant the impact on productivity the higher rate of survival might have been, Barnett *et al* (2014a) consider a scenario in which firm deaths following the 2008 recession increased to a level more consistent with the 1990s recession. They find that the unusually low level of business failure is likely to have materially lowered measured labour productivity by up to around 5 percentage points. As mentioned above, however, there are important benefits associated with lower company failures. Unemployment is likely to have been lower, helping to prevent further erosion of the United Kingdom's supply capacity, and the loss to GDP, and general welfare, is also likely to have been smaller than it otherwise would have been.

Assessing the importance of the different explanations

Table A summarises estimates of the contribution from each of the possible explanations for the UK productivity puzzle, grouped into the two main hypotheses. It compares these to an estimate of the shortfall in productivity relative to a continuation of its pre-crisis trend (also shown in Chart 1). This 'shortfall' approach is useful to give a broad benchmark with which to assess the relative importance of each explanation. There may be, however, a number of reasons why such a benchmark may overstate or understate the true size of the shortfall.

Table A Factors contributing to the weakness in UK labour productivity by 2013 Q4

Shortfall in labour productivity relative to pre-crisis trend in 2013 Q4	16pp
Measurement issues, including:	≈ 4pp
<i>Mismeasurement of output</i>	≈ 2pp
<i>Lower trend productivity in the mining and extraction and finance sectors</i>	≈ 2pp
Actual shortfall to explain	≈ 12pp
Hypothesis I: cyclical explanations, including:	Uncertain
<i>Lower levels of measured capacity or factor utilisation</i>	≈ 0pp
<i>Other cyclical factors reflecting changing demand conditions</i>	Uncertain
Hypothesis II: more persistent factors, including:	Likely to be significant in recent years
<i>Reduced investment in physical and intangible capital</i>	≈ 3 to 4pp
<i>Impaired resource allocation and unusually high firm survival rates</i>	≈ 3 to 5pp
Total explained	≈ 6 to 9pp

- (1) For banks, this may range from ignoring a breach of a loan covenant, to giving the borrower more time to meet its loan obligations, to providing some form of active payment relief.
- (2) Arrowsmith *et al* (2013) builds on the discussion and findings from the Japanese experience of the 1990s documented in Caballero, Hoshi and Kashyap (2008). See also Nelson and Tanaka (2014).

None of the individual explanations covered in this article are able to fully explain the extent of the productivity puzzle. Rather, it seems likely that all of them, alongside the potential for data mismeasurement and changes to longer-term trends in mining and extraction output, have had a role to play.

Although the different explanations account for a large part of the measured shortfall, there is a wide margin of uncertainty surrounding each of these factors — and a significant proportion of the puzzle remains unexplained. Moreover, there are a number of caveats that are important to highlight. For instance, while the analysis examines each cause independently, it is possible that some of them overlap, resulting in some degree of double counting. Moreover, the list is unlikely to be exhaustive and ongoing research both inside and outside the Bank may yield further insights into the underlying drivers of the United Kingdom's productivity performance.⁽¹⁾

Conclusion

The sharp fall in labour productivity experienced in the initial phases of the recession is likely to have reflected a cyclical reduction in the intensity of factor utilisation and an opening up of spare capacity within firms. More recently, while business surveys indicate that the levels of capacity utilisation within firms have returned to more normal levels, there is evidence to suggest that firms have shifted staff from revenue generating to business development activities. This leaves open the possibility that firms would be able to improve productivity by meeting any recovery in demand without additional hiring.

However, the protracted weakness of labour productivity — still 4% below its pre-crisis peak six years after the onset of recession — and the recent strength in employment growth suggest that cyclical factors alone are unlikely to fully explain the productivity puzzle.

There may be several factors associated with the financial crisis that may have led to the more persistent weakness in

productivity, such as lower investment in both physical and intangible capital. Barriers or impediments to the efficient allocation of both capital and labour towards their more productive uses are also likely to have played a role. And it is possible that a number of factors have helped less productive firms survive the recession. All of these factors are likely to have dampened aggregate productivity growth in recent years.

The extent to which productivity growth picks up in the short to medium term very much depends on the nature of the shocks that have hit the economy. As the recovery strengthens, productivity may start to recover endogenously as demand conditions improve, for example if companies switch staff from generating business to producing output. In addition, companies might be able to bring to market the new goods and services that result from their R&D efforts, thus bringing about relatively rapid improvements in their measured productivity. And productivity growth could also pick up if barriers to the reallocation of labour and capital start to wane, for example due to a reduction in macroeconomic uncertainty or an improvement in credit conditions. Indeed, these are good reasons to be optimistic about the outlook for UK productivity growth.⁽²⁾

A key judgement in the May 2014 *Inflation Report* is for productivity growth to pick up gradually as the recovery progresses. This implies that although the productivity growth rate is expected to reach its historical average rate by the end of the forecast period, the level of productivity is assumed to remain well below a continuation of its pre-crisis trend (the diamonds in **Chart 1**). But there remains considerable uncertainty around the timing and extent of any strengthening. In setting out its monetary policy guidance framework, first in August 2013 and then in February 2014, the MPC has noted both the central role of an assessment of productivity in guiding the appropriate policy actions, and the great uncertainty about how productivity might evolve looking ahead. Indeed, the aim of the MPC's guidance was not to predict what might happen to productivity, but rather, to describe the framework that will guide its response to economic developments as they unfold.

(1) One such factor, for example, could be 'learning by doing', whereby increases in productivity are achieved through practice in using existing equipment and through incremental improvements to current productive processes.

(2) See Carney (2013) for further discussion.

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