



BANK OF ENGLAND

Speech

The UK productivity puzzle: an international perspective

Speech given by

Martin Weale, External Member of the Monetary Policy Committee

Mile End Group, Queen Mary, University of London

8 December 2014

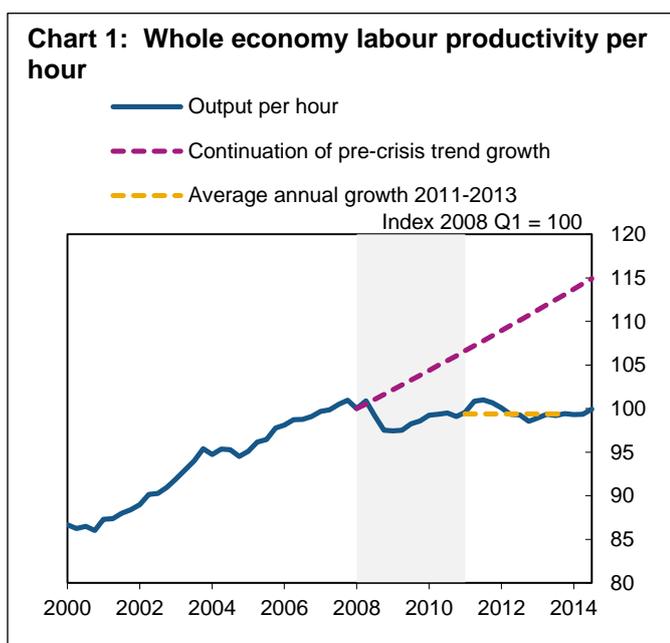
I would like to thank Charlotte Adams, Nicholas Fawcett and Tomas Key for their assistance in preparing this text. I am also grateful to Alina Barnett, Alan Castle, Michael Chin, Lai Co, Delma Essel, Kristin Forbes, Andrew Harvey, Nick McLaren, Marko Melolinna, Ivan Petrella, Emma Sinclair, and Greg Thwaites for their help, and to Patrice Ollivaud and David Turner for kindly sharing their data.

Thank you very much for inviting me here today. It is a great pleasure to be talking to the Mile End Group; since I am fortunate enough to spend one day a week at Queen Mary, I feel firmly on home territory.

Over the last few years much has been said about the United Kingdom's productivity puzzle; after a long spell in which people became increasingly productive, today output per hour worked is no higher than it was six years ago. Today I would like to look at that from an international perspective. Productivity measures how much output one person can produce, over a specified time – such as an hour, or a year. It lies at the heart of the long-run improvement in our standard of living. We benefit hugely, when it happens: one year's labour produces nearly five times as much in 2014 as it did in 1914. And we suffer, when it doesn't: its absence is one reason why living standards have stagnated. The outlook for productivity is an important influence on the Monetary Policy Committee's (MPC's) forecast of the economy, as recently published in the November *Inflation Report*.

The UK is not alone in having had weak productivity growth recently. So the first issue I would like to address is whether it has been affected more severely than other advanced economies. Secondly, I would like to explore how far we can identify factors which influence relative productivity performance. And thirdly I would like to offer some thoughts on the purely statistical evidence on the prospects for some sort of return to normality as far as productivity growth is concerned.

The financial crisis caused the level of productivity to fall in many countries, with the UK more severely affected than most. But given this initial shock, I am interested in how they have subsequently recovered. So I will focus on economic performance after 2010, in order to see what can be said about underlying productivity growth after the crisis.



Productivity in an international context

To set the scene, Chart 1 updates a rather well-worn comparison of what has actually happened to productivity, with what would have happened if the pre-crisis trend had continued. You can see from the chart that output per hour worked is now 15% per cent lower than it would have been if productivity had continued to grow at its average rate after 2007. Moreover productivity remained flat over the period 2010 to 2013, after growing 2.2 per cent per year from 2000 to 2007.¹ Encouragingly, performance has been better so far this year. I will return to this later.

¹ If the pattern of past data revisions continues, then Bank staff suggest that this will be revised up slightly.

It would be wrong to think that the economy will inevitably make up all of the lost ground from the crisis. People often like to think in terms of trends as guides to the future; believing in trends means that there are plenty of trends to see. An alternative view of the many series which economists study is that they are random walks. Bygones are bygones, so the best guide to the future is often provided by rolling forward some underlying growth rate starting from now. If this is really the case for labour productivity, the most we should hope for is that productivity should grow on a path parallel to, but below the dotted red line on the graph. It could be that a shock as large as the financial crisis is different, so that the productivity loss is likely to be made up. But recent evidence does not support this, and indeed could suggest that the underlying growth rate has also fallen.

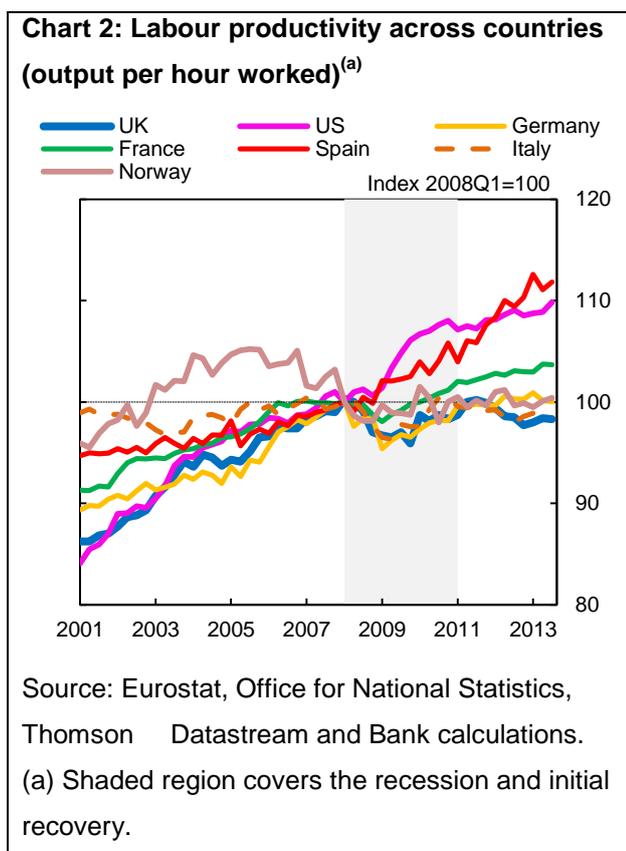


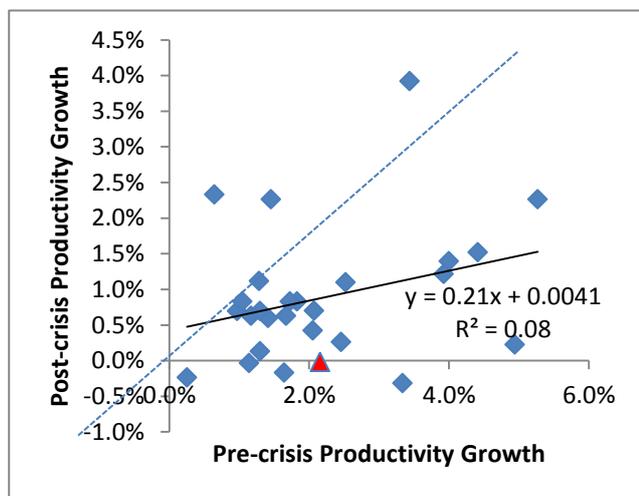
Chart 2 shows how productivity movements in Britain compare with those in other advanced economies.² I have shaded the period of recession and immediate recovery from 2008 to 2010. With the exception of Spain, productivity growth has been slower since 2010 than it was before the crisis.

Comparing productivity growth rates from 2000 to 2007 with those from 2010 to 2013, Chart 3 shows how twenty-seven OECD countries have fared. The United Kingdom is represented by the red triangle. The forty-five degree line indicates the set of out-turns for which growth rates are the same in both periods. Above this line, productivity growth is faster in the second period than in the first, while below the line, it is slower. You can see that only three countries appear above the line; for the remaining twenty-four productivity growth has been slower in the aftermath of the crisis than it was beforehand. Although the UK's

fall has been one of the sharper ones, it is not on its own.

² Listed in Table 1.

Chart 3: Labour Productivity Growth in the OECD before and after the Crisis.



Source: Bank Calculations from OECD data. UK data point is highlighted in red.

That itself is something of a surprise. The late phases of previous UK recessions have been associated with rapid productivity growth (see Chart 10). If, for example, the crisis and recession had led to labour hoarding, then one might have expected a period of relatively rapid productivity growth later on. This might happen either because demand started to rise and hoarded labour could become fully employed, or because it did not and businesses eventually decided that they could not afford to pay any longer for labour which was not being fully utilised.

Equally, if there had been some other disruption to the productivity process, for example, if in the period before the crisis capital had been misallocated, then as time went by a period of above-normal productivity growth would have been

expected. Profits would be relatively high in the capital scarce industries and low in the capital-surplus industries, so the capital scarce industries would be able to afford more investment even if bank finance were not available. And this would have a disproportionate effect on labour productivity; the increases in the industries which were building up their capital stocks would more than offset the declines in the industries where capital stocks were falling.

The fact that the United Kingdom is in a club with twenty-three other countries suggests that our experience is far from unique, although it is also the case that the United Kingdom is one of the weaker performers over the three years considered.

Separately there is something striking about the three countries above the line. Two of them, Australia and Poland, are the two advanced economies which did not experience recessions in 2008 and 2009. The third is Spain; some other explanation is needed to account for its membership of this select group. Bryson, Forth and Askenazy (2014) suggest that it is a consequence of a decline in the share of output devoted to construction, a low productivity sector, and also a decline in the use of temporary contracts.

Finally a further point emerges; productivity growth rates in period from 2010 to 2013 are at best only very weakly correlated with those in the period before the crisis. The regression line shown on the diagram is close to horizontal and the slope of it is not statistically significant. Pritchett and Summers (2014) suggest, comparing GDP growth rates in one decade with those of the previous decade that there is almost no

correlation.³ They approach the issue with particular reference to growth in China and other “emerging” economies. GDP growth rates are the sum of growth rates of hours worked and growth rates of labour productivity appropriately compounded. Unless there were some strange inverse relationship between growth in hours worked and growth of labour productivity, it would be strange to find a strong correlation in productivity but none in GDP. Thus, while a question about productivity is different from a question about GDP, it would nevertheless be strange to find strong persistence in GDP growth but none in productivity growth.

Chart 3 compares productivity growth rates before and after the crisis. Obviously it is of interest to explore whether and how far these differences can be explained by countries’ circumstances.

A Regression Analysis

Regression analysis provides a means of exploring the influences of circumstances and history on productivity after the crisis. I present the results of a number of regression equations in Table 1. This exercise is closely related to that of Ollivaud and Turner (2014).⁴ They try to explain the shortfall in output in 2014 as compared to what it would have been had pre-crisis growth rates continued. Here I have, in the first three regression equations tried to explain productivity growth from 2010 to 2013 in terms only of pre-crisis variables. The logic of this is that, if successful, such an exercise would allow us to explain today’s circumstances without taking the recession explicitly into account.

In the first equation I include productivity growth over 2000-07, the (log) level of productivity in 2007, the current account balance (as a proportion of GDP) and measures of financial and trade openness. The current account balance is often seen as a predictor of banking crises while financial openness indicates the degree of exposure to an international financial crisis and trade openness exposure to an international down-turn. I have also included a dummy variable for Spain, given the anomalous position identified above, together with a second dummy for countries in the euro area.

You can see that I do not have a great deal of success. Paring the explanatory variables down in columns 2 and 3, a high level of productivity before the crisis seems to depress productivity after the crisis. The Spanish dummy is not quite significant at a five per cent level, and there is no statistically significant evidence that membership of the euro was a handicap. A dummy for the euro area allows me to test whether continuing problems there might be related to weaker productivity growth.

³ Although, in the period before the crisis, I find a stronger degree of persistence in developed countries than Pritchett and Summers suggest for the world as a whole.

⁴ Who kindly provided their data.

Table 1: Variables Explaining Productivity Growth 2010-2013 in Twenty-seven OECD Countries

Dependent Variable is Productivity Growth from 2010 to 2013								
	1	2	3	4	5	6	7	8
Prod. Growth 2000-07	0.062 (0.29)	0.126 (0.79)		0.027 (0.15)	0.092 (0.72)			
Log Productivity 2007	-0.005 (0.65)	-0.008 (1.27)	-0.011 (2.24)*	-0.002 (0.25)	-0.003 (0.68)	-0.006 (1.36)	-0.005 (1.36)	
Current Account 2007				-0.000 (0.32)				
Financial 2007				-0.000 (0.86)				
Trade 2007				0.000 (0.54)				
Spain	0.018 (1.80)	0.020 (2.24)*	0.018 (2.13)*	0.013 (1.59)	0.015 (2.00)	0.013 (1.90)	0.013 (1.91)	0.012 (1.80)
Euro Member	-0.005 (1.34)	-0.005 (1.54)	-0.005 (1.69)	-0.001 (0.35)	-0.001 (0.23)	-0.001 (0.32)		
GDP growth 2007-2009				0.103 (2.11)*	0.115 (2.61)*	0.113 (2.62)*	0.118 (2.98)**	0.128 (3.24)**
Prod. Growth 2007-2010				0.249 (1.88)	0.221 (1.83)	0.233 (1.97)	0.237 (2.07)	0.262 (2.27)*
Constant	0.026 (0.89)	0.036 (1.46)	0.050 (2.86)**	0.014 (0.60)	0.021 (1.03)	0.031 (2.06)	0.030 (2.08)*	0.010 (5.41)**
R^2	0.37	0.34	0.33	0.64	0.62	0.61	0.61	0.57
N	27	27	27	27	27	27	27	27

* $p < 0.05$; ** $p < 0.01$

The following countries were studied: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Irish Republic, Italy, Japan, South Korea, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom and United States

The variables are

Datum	Definition	Source
Prod. Growth 2010-13	Growth in labour productivity, 2010-2013	OECD database
Prod. Growth 2000-07	Growth in labour productivity, 2000-2007	OECD data base
Log Productivity 2007	Log Labour productivity at 2005 purchasing power parity	Penn World Tables 8.0
Current Account 2007	Current balance of payments as % of GDP, 2007	Ollivaud and Turner, 2014
Financial 2007	OECD Measure of Financial Openness, 2007	Ollivaud and Turner, 2014
Trade 2007	OECD Measure of Trade Openness, 2007	Ollivaud and Turner, 2014
Spain	Dummy =1 for Spain	
Euro	Dummy=1 if euro area member in 2010	
Growth 2007-09	Growth of GDP 2007-2009	OECD database
Prod. Growth 2007-2010	Growth in labour productivity, 2007-2010	OECD database

In columns 4 to 8 I try to explain productivity growth from 2010 to 2013 also taking account of recent experience. I include two variables in addition to the earlier group. The first additional variable is the depth of the recession, measured by the change in output from 2007 to 2009 and the second is productivity growth during the period of recession and immediate recovery from 2007 to 2010. You can see that the clearest

indicator of productivity growth from 2010 to 2013 is the depth of the earlier recession. The euro area dummy fades into insignificance and if I remove the level of productivity in 2007 I also find a significant role for productivity growth in the period from 2007 to 2010. Thus the exercise suggests that the depth of the recession and productivity performance from 2007 to 2010 are still casting a shadow over the OECD economies, but beyond that I have not been able to identify factors explaining weak productivity growth.

This analysis could hardly be regarded as the last word. Ollivaud and Turner explored a range of variables wider than that I have discussed here and it is possible that eventually we will be able to provide a fuller account of the factors which have limited productivity growth since 2010. I would, however, caution against one route. Since I have suggested that the depth of the recession is an influence on subsequent productivity growth you might think that if I can explain the depth of the recession, that would offer a route to understanding the underlying causes behind weak productivity growth. The trouble with this avenue is that, while I can find factors which explain the depth of the recession, they do not do so with sufficient precision to make this approach possible, at least with the data with which I have been working.⁵

The results so far suggest that, weak productivity growth is one of the consequences of the recession. There is no doubt that the recession was, in turn, a consequence of the financial crisis which began in the summer of 2007. What do studies of the links between financial crises and the economy as a whole tell us?

Oulton and Sebastiá-Barriel (2013) show that banking crises tend to have a permanent effect on levels of productivity and GDP, although their work assumes that they have only a temporary effect on the growth rates. In developed countries they find that a crisis depresses the growth rate on average by 0.5 (-0.1 to 1.1) per cent,⁶ but that the long-run effect is to raise the level of output by 0.4 (-0.2 to 0.9) per cent for each year the crisis lasts as the dynamics play out. In developing countries growth rate is depressed by 0.8 (0.2 to 1.4) per cent and there is a permanent impact on output of 1.2 (0.2 to 2.2) per cent. In the OECD economies, if I look only at those which counted as advanced in 1971⁷ productivity growth has fallen by just over 1 per cent since the start of the crisis. This is compatible with what Oulton and Sebastiá-Barriel find for developing countries only provided one assumes that the crisis has continued from 2008 to 2013. Thus, even if one assumes that differences between developed and developing countries found in their work arise because of the differing intensity of the crises over the period since 1950, recent experience can be explained only if one assumes that the crisis has, for practical purposes continued unabated for six years. Alternatively the crisis has had a durable effect on productivity growth, which for me feels more plausible.

Nevertheless the mechanism remains very unclear. Riley, Rosazza-Bondibene and Young (2014) find that the crisis affected the supply of credit to businesses. But they do not find the sort of heterogeneity between

⁵ In statistical terms the problem is one of weak instruments.

⁶ 95 per cent confidence interval

⁷ I have included Spain and Italy but excluded Korea, Greece, Portugal and the former communist countries.

different types of businesses which would have been expected if there were a direct link between credit supply and productivity.

The Role of Investment

Up to now, I have focussed on how much output can be supplied by an hour of labour input. But of course labour needs capital to produce anything, so you might also wonder about the role of investment. Although there are good reasons for expecting investment to influence productivity growth, it is also likely to be the case that investment depends on growth. Pessoa and van Reenen (2014) assume a relatively high depreciation rate of capital, and argue that capital per worker fell by 9% over the crisis. If true, this would explain a substantial part of the fall in both real wages and labour productivity. But the data for the United Kingdom published in 2011 and 2012 suggested that net investment had remained positive, so, unless there was very considerable scrapping, it seems likely that the capital stock continued to rise. Oulton (2013) estimates that this was the case, although the capital stock grew less rapidly than before the crisis.

Some care is needed in exploring the relationship between investment and growth of labour productivity. National accounts were designed in 1940 as a tool for war-time management and in those circumstances it made sense to focus on gross capital formation and gross domestic product. If we want to know whether the capital stock is growing or not, however, we need to focus on capital formation net of depreciation. This makes a material difference. The OECD national accounts show net disinvestment between 2010 and 2013 in a number of countries including Greece, Italy and Japan, but not the United Kingdom. Secondly, if hours worked are growing rapidly then substantial capital investment is needed merely for the amount of capital to grow in line with labour; some adjustment is needed to take account of that⁸. I work with growth in labour productivity adjusted for this capital dilution effect and compare this with the share of net capital formation in GDP.

⁸ Growth accounting (Solow, 1957) suggests that the growth in GDP ($\Delta Y/Y$) should be accounted for by the sum of the growth in hours worked ($\Delta L/L$) multiplied by the share of employment income in domestic income, α , and the growth in the capital stock ($\Delta K/K$) multiplied by the share of gross operating surplus in domestic income, $1 - \alpha$, together with a residual. Making the simplifying assumption that indirect taxes fall similarly on capital and on output, the share of gross surplus is equal to the gross rate of return, $r + \delta$, multiplied by the ratio of capital to output

$$\begin{aligned} \frac{\Delta Y}{Y} &= \alpha \frac{\Delta L}{L} + (1 - \alpha) \frac{\Delta K}{K} + \text{residual} \\ &= \alpha \frac{\Delta L}{L} + (r + \delta) \left(\frac{K}{Y}\right) \left(\frac{\Delta K}{K}\right) + \text{residual} \\ &= \alpha \frac{\Delta L}{L} + (r + \delta) \left(\frac{\Delta K}{Y}\right) + \text{residual} \end{aligned}$$

The growth rate of labour productivity is

$$\frac{\Delta Q}{Q} = \frac{\Delta Y}{Y} - \frac{\Delta L}{L}$$

giving

$$\frac{\Delta Q}{Q} + (1 - \alpha) \frac{\Delta L}{L} = (r + \delta) \left(\frac{\Delta K}{Y}\right) + \text{residual}.$$

Thus we add to the growth of labour productivity the growth in hours worked multiplied by the share of capital to give a figure of labour productivity adjusted for capital dilution effects. This is compared with the share of net investment in GDP, $\frac{\Delta K}{Y}$.

Data are not available for Ireland or New Zealand and I also leave Greece out of the analysis because it is a clear outlier. Looking at the remaining twenty-four countries, there is a significant correlation between the change in capital formation and the change in adjusted labour productivity, in both cases comparing growth between 2010 and 2013 with growth from 2000 to 2007. The regression coefficient is 0.15 (0.02 to 0.28); I am hesitant to put much weight on this because, as I mentioned, there is a question whether investment is a response to, as well as a driver of productivity growth. Nevertheless such a figure is not much above what might be expected for a reasonable rate of return gross of depreciation. Net capital formation in the United Kingdom as a share of GDP was 1.6 percentage points lower after 2010 than it had been before the crisis. Using the coefficient of 0.15 which, as I have suggested, is probably on the high side, this points to only a small part of the UK's decline (0.23/2.2) in labour productivity being accounted for by weaker capital formation.

An alternative way of looking at the story is to study residual productivity growth, usually called total factor productivity growth, that is the component of productivity growth which is not accounted for by capital formation. The European Commission provides estimates of this and the picture they give is broadly consistent with that shown for labour productivity; growth rates of total factor productivity are faster from 2010 than in 2001-2007 for only three countries, Australia, New Zealand and Spain, while there is no obvious relationship between total factor productivity growth rates in the two periods. Thus we can safely conclude that, while reduced investment may play a role, it is probably not the dominant factor behind slower labour productivity growth.

Secular Stagnation and Productivity Growth

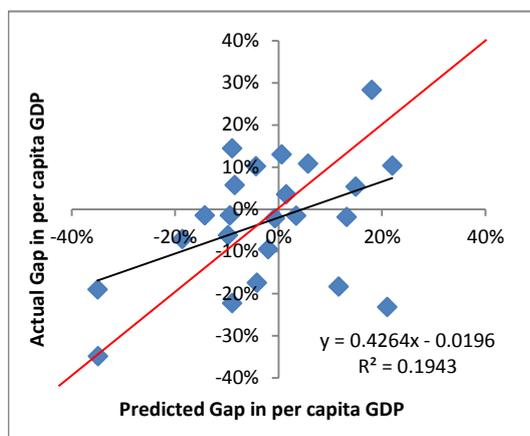
The failure of the major economies, and in particular those on the continent, to recover the spring they had before the crisis has led to concerns that the world is now facing a long period of economic stagnation. There has recently been a lively international discussion on the prospects for productivity growth. Gordon (2014) focuses on the United States. He points out that, with the exception of the "new economy" period from 1996 to 2014 underlying (total factor) productivity growth after allowing for the effects of rising educational attainment in the United States has been appreciably weaker since 1972 than it was in the previous eighty years; the overall productivity growth rate has, however, been sustained by improving educational attainment of the labour force. He argues that educational attainment is now stagnating. In the absence of some other new source of growth, overall productivity growth is therefore likely to stagnate. Even if one argues that new economy episodes are likely to occur with the same frequency as over the last forty years, the conclusions are not greatly affected.

As Crafts (2014) points out, concerns about stagnation were also widespread in the 1930s, despite the fact that the Great Depression did not lead to the general loss of productivity and productivity growth which has followed from our more recent crisis.⁹

Weak productivity growth, if it persists is bound to be associated with slow overall economic growth and is one of the factors behind fears about secular stagnation¹⁰. Crafts argues that in many countries supply-side reforms can improve productivity performance and thus facilitate renewed economic growth.

How far can one hope that policy changes will remedy the productivity problem? Barnes, Bouis, Briard Dougherty and Eris (2013) bring together the results of a number of studies that the OECD has carried out to try and understand the possible impact of economic reforms. They set out their analysis in terms of GDP per head rather than per hour worked. The relative patterns of the two differ, first because different countries have different proportions of the population which work and secondly because working years are of very different duration in different countries. Labour market policies are likely to have an important impact on these two factors but relatively little impact on labour productivity. However, their analysis also includes things which are likely to influence productivity, e.g. product market regulation, openness, R & D incentives and educational attainment and quality. Tax structures can affect both labour supply and capital intensity. These two influences are, however, combined in the OECD study.

Chart 4: Explained and Actual GDP Gaps (2009)



Source: Barnes *et al.* (2013)

Adding up the influences of the different factors, they compute how far they would expect GDP per head in the OECD countries to deviate from the average. They compare this with the actual deviations in 2009.

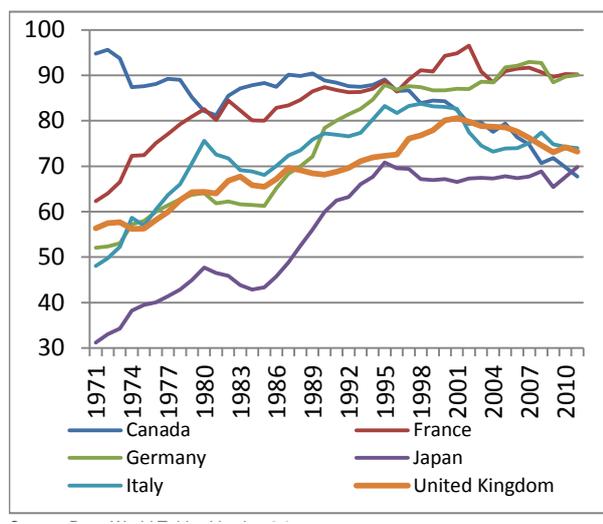
The results of this are shown in Chart 4 where I plot the fitted deviation against the actual deviation. If the different factors had an important role in explaining gaps in GDP, we would expect the points to be distributed around the red forty-five degree line – the predictions and outturns would roughly match up. But in reality, the factors only explain 20% of the actual variation in GDP per head. This is shown by the line of best fit in black,

which is much shallower than the red line.¹¹

⁹ The data are more patchy, but it is noteworthy that, while Germany and the United States experienced similar economic contractions between 1928 and 1932, productivity was unchanged in the former and fell sharply in the latter. In the United Kingdom, which, compared to Germany and the United States, was almost a bystander of the Great Depression, productivity rose between 1928 and 1932 (Solomou and Weale, 2010).

¹⁰ A separate concern is that, perhaps as a result of both slow productivity growth and reduced growth in populations of working age, investment demand in advanced economies is likely to be weaker than in the past. Without a rise in consumption demand to offset this, the advanced economies risk a sustained period of demand deficiency. Proponents of this view of secular stagnation point out that it may not be possible to reduce interest rates low enough to offset this.

Chart 5: Output per Hour in the G7 Countries (US=100)



So this exercise underscores the difficulty in identifying clear supply-side policies which are bound to address either labour supply problems or problems associated with productivity and its growth rate.

Limits to Catch-up

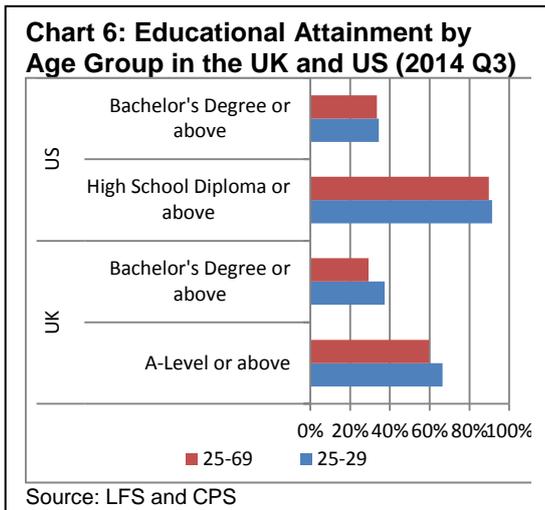
My analysis thus far has argued that the productivity puzzle is an OECD and not a UK issue. Are there nevertheless grounds for thinking that productivity in the UK can be driven by an element of catch-up, not with an extrapolation of the position before 2008 but with the actual level of productivity in the United

States? The suggestion that catch-up enhances productivity growth was explored, for example, by Marris (1982) and, in the 1990s underpinned a voluminous literature on economic growth. Perhaps the most recent issue raised by this more recent literature was whether productivity would converge with that of the United States or perhaps to a level lower than that of technically most advanced country (see Islam (1995) and Lee, Pesaran and Smith (1997)). Chart 5 shows the productivity levels of the G7 economies measured relative to the United States. The profile is not exactly the same as that for output per hour in Chart 2 both because productivity is measured relative to the United States and also because output is valued at international prices, not national market prices, in order to facilitate the cross-country comparison.

Five of the six present a picture of convergence followed by stasis or modest decline, while Canada shows a stable or weakening position for the forty years considered. A graph cannot predict the future. It is perfectly possible that the catch-up process will resume tomorrow. Nevertheless, it should caution us against assuming that the UK is better at catching up with the United States than are the other large economies. In particular it is noteworthy that the United Kingdom's peak level of productivity relative to the United States was reached in 2001 rather than immediately ahead of the crisis.

On the other hand, there are also grounds for optimism about the United Kingdom's position relative to the United States, if not its absolute rate of productivity growth. Improving educational attainment is generally thought to be a factor behind rising labour productivity. Well-educated people are paid more than poorly educated people and, if relative pay measures their productivity, the latter should be higher. Over the last twenty years the educational attainment of young people has risen very sharply. During the thirty or forty years after the Second World War the United States had a clear lead in rising educational attainment but, that is no longer the case. Chart 6 shows the educational attainment of i) the whole population aged

¹¹ It is possible that the slope of this line of best fit is dampened by errors in the measurement of the different factors. But only an implausibly large degree of measurement uncertainty would be able to explain the results presented here.



twenty-five to sixty-nine and ii) that subgroup aged twenty-five to twenty-nine. You can see that there is very little difference between the two in the United States. As Gordon (2014) has observed, the educational attainment of the labour force is no longer rising. In the United Kingdom by contrast the educational attainment of young people is appreciably higher than that of the population aged twenty-five to sixty-nine. Assuming that attainment rates of young people are maintained, the consequence will be rising overall educational attainment and thus, it should be expected, a source of rising productivity absent in the United States.

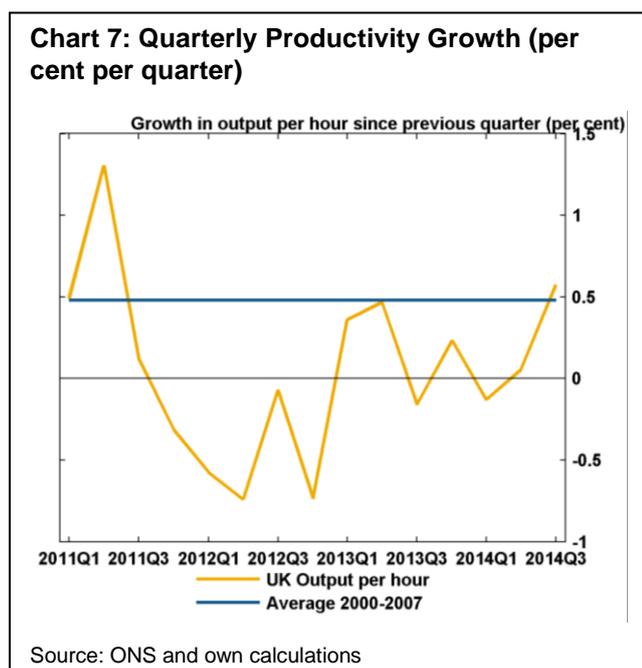
Financial Markets Views of Economic Growth

No one would want to assume that financial markets possess a clairvoyance denied to the rest of us. Nevertheless, it is worth pointing out that movements in financial markets during the course of the year are consistent with investors downgrading their views of the prospects for economic growth, perhaps because they think the productivity growth rate since 2010 is the new normal. A conventional way of examining movements in equity markets is through the lens of the dividend discount model, as described in Inkinen, Stringa and Voutsinou (2010). This is an accounting framework which uses as inputs expected future cash flows, the risk-free rate and the equity risk premium. These variables are however unobservable, so various assumptions and proxy measures are used instead. As a result, any conclusion drawn from the output of the model depends crucially on the plausibility of these assumptions and proxies, which could change over time.

One assumption made is that the expected long-term growth rate of money dividends is constant at five per cent per annum.¹² Along with the other assumptions, described in detail by Inkinen, Stringa and Voutsinou (2010), the model then provides an implied level of the equity risk premium at each point in time. Recently we have seen falling long-term interest rates but no comparable uplift in share prices (see Broadbent, 2014 for a wider discussion of this). The explanation usually drawn from the dividend discount model is that the risk premium associated with shares has increased; people have become more risk averse. An alternative explanation is, however, that the expected long-term rate of growth of dividends has fallen. This is consistent with inflation being on target but a fall in the expected long-term growth rate of real GDP such as might arise if the sort of movement in labour productivity compared to before the crisis were expected to be permanent.

¹² In reality, the annual growth rate of dividends may be less than 5%. Although it is reasonable to assume that money GDP will grow at this rate, dividends per share should be expected to grow less rapidly because an increase in the share issue is likely to be needed to finance an expanding capital stock. This is the historical experience. Nevertheless this does not greatly affect my point here.

In both 2006 and 2010 the implied average risk premium consistent with five per cent growth in dividends per



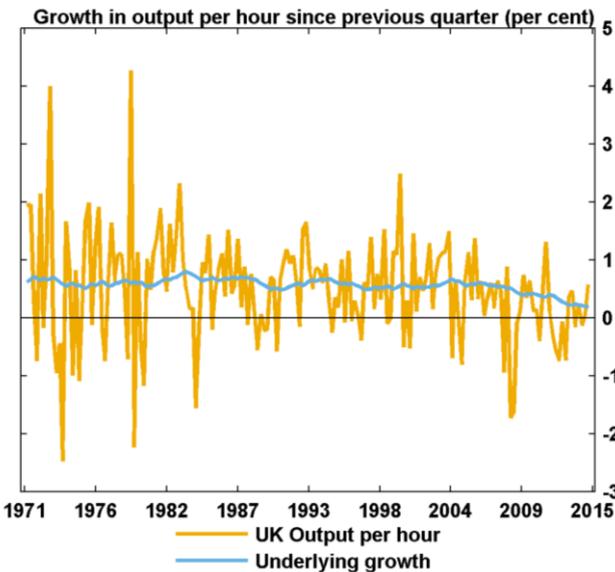
share was 4.85 per cent and that was also true at the start of this year. Setting the risk premium at this level and instead calculating the implied long-run growth rate from the accounting identity, I find that the expected money rate of growth of dividends per share has dropped by around one percentage point since the start of the year. Such a decline would be expected to result from a decline in expected labour productivity growth of similar magnitude. The adjustment in share prices and long-term interest rates during the course of this year could be seen as recognition by investors of weak productivity growth and an assumption that this will prove more or less permanent. I now turn to the question of whether this is likely to be the case or not.

The First Sign of a Thaw? The outlook for UK productivity growth

Recent data from the Office for National Statistics suggest that productivity growth in the third quarter of this year was around 0.6 per cent. This is the first time for over three years that productivity growth has been faster than the average of 2000-2007. After the disappointments of the last few years one would be bold indeed to be confident that this is the start of a sustained revival. I have not been able to identify factors responsible for the weak productivity growth, except in the broad sense that it is related to the financial crisis and the experience of countries during the period 2008-2010, so I cannot be confident that shadow of this is now easing. But in real life time is a great healer and perhaps we can hope that is true even for Britain's productivity growth.

In the period before the crisis, the statistical evidence supports the idea that there is a clear underlying rate of productivity growth; slow growth in one year does not imply a sustained period of slow growth. So the question is whether the underlying rate of growth has declined or not. It is a general feature of noisy time-series data that changes of this type cannot be identified with any degree of precision; even if one concludes that the underlying pattern has changed, that does not in any case mean that the change is permanent. One means of identifying an underlying growth rate is provided by Harvey (2013). An attraction of this method is that it deals coherently with fact that there are, from time to time, very large movements in productivity. These are more common than would be expected if productivity growth rates could be represented by the Gaussian bell-curve distribution.

Chart 8: UK productivity growth and estimated underlying growth



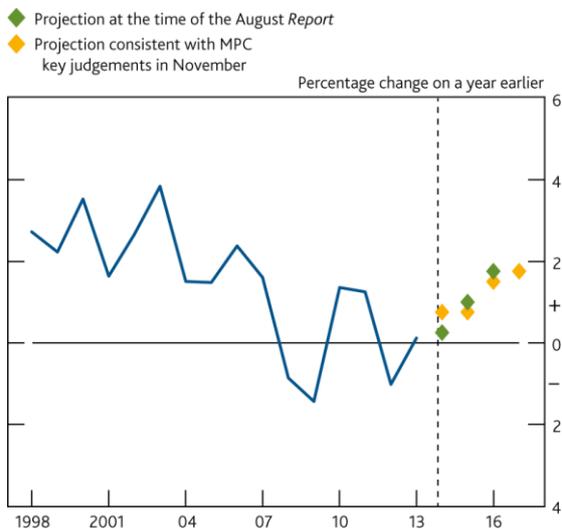
Source: ONS (including Labour Force Survey) and Bank calculations.

A method which fails to reflect this is likely to overstate swings in underlying growth. Chart 8 suggests that the third quarter of this year is no more than a brief ray of sunshine in the gloom.

If my earlier discussion has highlighted the past and current weakness in UK productivity, what does the future hold? I have pointed out that the sense of the near-term outlook for productivity is that we can hope for a modest recovery, although not yet back to the growth rates enjoyed before the crisis.

Chart 9 shows the MPC's best prediction of the productivity pickup as projected in the November *Inflation Report*. Supporting this is an impression from the Bank's short-term forecast models (see Bell et al (2014)) that GDP growth will continue to grow above its long-run average rate over the next few quarters, before settling down to trend.

Chart 9: November 2014 *Inflation Report* projection for Productivity growth^(a)



Sources: ONS and Bank calculations, November 2014 *Inflation Report*.

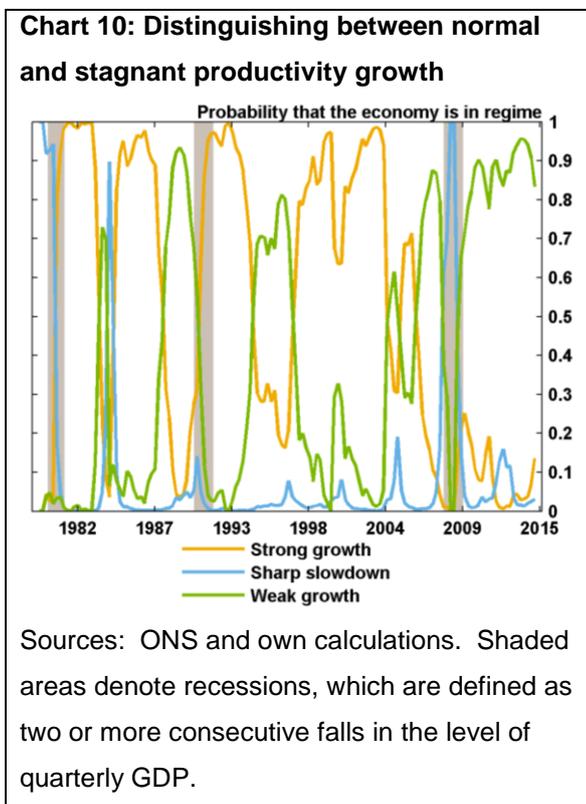
(a) GDP per hour worked. GDP is at market prices and projections are based on the mode of the MPC's backcast.

Looking further ahead at the prospects for productivity growth over the medium term, I can explore the UK data in a little more detail.

Given the estimate of underlying UK productivity growth in Chart 8, I can explore whether the decline in productivity dates from the onset of the financial crisis, or whether there were signs of its arrival before then, as suggested for the US by Gordon (2014). Using statistical tests to identify a fall in the underlying trend, I find no evidence that the decline started before the crisis.¹³ The crisis itself had a very large impact, and it is of course possible that this will have a permanent effect on the level of productivity.

¹³ Details of the general modelling method are provided by Hendry, Johansen and Santos (2008).

Another method is to use statistical tools to distinguish between three different states of the world – one in which the UK enjoyed strong productivity growth; one with weak growth, and another of sharp slowdown. We can then infer from the model which state we are more likely to be in currently, and this provides us with an insight into the likely future behaviour of the economy.



The result of this exercise is shown in Chart 10, with the ‘strong growth’ regime in yellow, ‘weak growth’ in green and ‘sharp slowdown’ in blue. Each line represents the probability of the economy being in one state at any point in time, and the probabilities always sum to one. I have shaded the past three recessions to illustrate how differently productivity has behaved in each one. Since the run up to the financial crisis, the economy seems to have been stuck in a regime of weak growth, interrupted only by the sharp slowdown during the crisis itself. The model points to a path for productivity over the next three years very similar to that forecast by the MPC, even though it assumes that the long-run growth potential of the economy is no different from what it was before the crisis. This is based on the assumption that the probability of a shift from weak growth to strong growth is no different from what it was before the crisis.

Conclusions

Perhaps the main conclusion to be drawn from this is that, to the extent we are interested in growth since 2010 we should talk about an international productivity puzzle rather than a UK productivity puzzle. Labour productivity growth rates are generally lower than they were in the years before the crisis and, as Gilhooly, Weale and Wieladek (2012) suggest, this is perhaps a consequence of international rather than domestic factors. Both the depth of the recession from 2007 and productivity growth during the recession and immediate recovery explain some part of the productivity weakness and in that sense the financial crisis is casting a long shadow. Equally attempts to explain productivity differences in terms of market structures and other indicators of the economic environment in different countries do not seem to be markedly successful.

There is no clear evidence that productivity growth in euro area countries was particularly badly affected after taking into account experience during the recession and immediate recovery. Underlying productivity growth in the United Kingdom declined in the aftermath of the recession after many years when it had not fluctuated a great deal. On the other hand the most recent data do suggest some improvement. An analysis which

separates the economy into periods of falling productivity, weak productivity growth and strong productivity growth suggests that productivity growth should be expected to pick up largely in line with the MPC's forecast. This is, however, based on the assumption that the extended period of weak growth we have seen since the recession does not, itself imply that weak growth has become more likely. If that is the case, then the MPCs forecast has to be seen as optimistic.

In the February *Inflation Report* (page 47) the Monetary Policy Committee explored the implications of weaker productivity growth; it resulted in higher inflation within about a year. Persistently slower productivity growth would have two implications for interest rates; in the short term, interest rates would need to be higher in order to prevent demand running ahead of supply. But over the medium term, interest rates may remain lower than they were before the crisis, reflecting weaker underlying growth.

The MPC does not have the luxury of being able to wait for the fog of uncertainty over productivity growth to clear up. Exploration of recent trends provides some help, but understanding what they imply for the future remains essentially a matter of individual judgement. It may well be sensible for the MPC to take an optimistic stance, partly on the grounds that brisk demand growth will pull productivity up by its own bootstraps, but the evidence for this is at best tenuous. Only hindsight will help us judge how performance was affected by the financial crisis.

References

- Barnett, A., S. Batten, A. Chiu, J. Franklin and M. Sebastián-Barriol. (2014).** 'The UK productivity puzzle', *Bank of England Quarterly Bulletin*, 54 (2)
- Barnes, S., R. Bouis, P. Briard, S. Dougherty and M. Eris. (2013).** 'The GDP Impact of Reform: a Simple Simulation Framework'. OECD Working Papers No 834.
- Bell, V., L.W. Co, L. W., S. Stone and G. Wallis. (2014).** 'Nowcasting UK GDP growth', *Bank of England Quarterly Bulletin*, 54 (1)
- Broadbent, B. (2014).** 'Monetary policy, asset prices and distribution', speech to the Society of Business Economists Annual Conference.
- Bryson, A., J. Forth and P. Askenazy. (2014).** 'Productivity Puzzles in Europe: a Comparison of the UK, France, Germany and Spain'. Presented at NIESR Conference 'Productivity and Firm Growth'. 11th November 2014.
- Crafts, N. (2014).** 'Secular stagnation: US hypochondria, European disease?' in *Secular Stagnation: Facts, Causes and Cures*. Ed C. Teulings and R. Baldwin. CEPR.
http://www.voxeu.org/sites/default/files/Vox_secular_stagnation.pdf. Pp. 91-97.
- Gilhooly, R., M. Weale and T. Wieladek. (2012).** 'Disaggregating the International Business Cycle.' *External MPC Unit Discussion Paper*, 37.
- Hamilton, J. (1989).** 'A New Approach to the Economic Analysis of Nonstationary Time Series and the Business Cycle,' *Econometrica*, 57(2), 357-84.
- Harvey, A. C. (2013).** *Dynamic Models for Volatility and Heavy Tails*, Cambridge University Press
- Hendry, D. F., S. Johansen and C. Santos. (2008).** 'Automatic selection of indicators in a fully saturated Regression', *Computational Statistics*, 33, 317–335. Erratum, 337–339.
- Hughes, A. and J. Saleheen. (2012)** 'UK labour productivity since the onset of the crisis – an international and historical perspective', *Bank of England Quarterly Bulletin*, 52 (2)
- Gordon, R. (2014).** 'The Demise of US Economic Growth: Restatement, Rebuttal, and Reflections', NBER Working Paper 19895.
- Inkinen, M. J., M. Stringa and K. Voutsinou. (2010).** 'Interpreting Equity Price Movements Since the Start of the Financial Crisis', *Bank of England Quarterly Bulletin*, 50 (1).
- Islam, N. (1995).** 'Growth empirics: a panel data approach', *Quarterly Journal of Economics*, 110 (4), 1127-1170.
- Lee, K., M.H. Pesaran and R. Smith. (1997).** 'Growth and convergence in a multi-country empirical stochastic Solow model', *Journal of Applied Econometrics*, 12, 357-392.
- Marris, R. (1982).** 'How much of the slow-down was catch-up?', in 'Slower Growth in the Western World'. Ed. R.C.O. Matthews.
- Nelson, C. and C. Plosser (1982).** Trends and Random Walks in Macroeconomics Time Series: Some Evidence and Implications, *Journal of Monetary Economics*, 10, 139-162.
- Ollivaud, P. and D. Turner. (2014).** 'The Effect of the Global Financial Crisis on OECD Potential Output'. OECD Working Paper No 1166. <http://dx.doi.org/10.1787/5jxwtl8h75bw-en>
- Oulton, N. and M. Sebastián-Barriol. (2013).** 'Long and short-term effects of the financial crisis on labour productivity, capital and output', *Bank of England Working Paper*, 470.

Pessoa, J. P. and J. van Reenen. (2014). 'The UK productivity and jobs puzzle: does the answer lie in wage flexibility?', *Economic Journal*, 124 (May), 433-452

Pritchett, L. and L. Summers. (2014). 'Asiaphoria meets Regression to the Mean'. NBER Working Paper No 20573

Riley, R. , C. Rosazza-Bondibene and G. Young. (2014). 'The Financial Crisis, Bank Lending and UK Productivity: Sectoral and Firm-level Evidence'. *National Institute Economic Review*, 228, R17-R34.

Solomou, S. and M.R. Weale (2010). 'Unemployment and Real Wages in the Great Depression'. *National Institute Economic Review*, 214, 51-60.

Solow, R. (1957). 'Technical Change and the Aggregate Production Function', *Review of Economics and Statistics*, 39 (3), 312-320.