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ABSTRACT

There remains a puzzle around the world over why wage growth is so benign given the unemployment rate has returned to pre-recession levels. It is our contention that a considerable part of the explanation is the rise in underemployment which rose in the Great Recession but has not returned to pre-recession levels even though the unemployment rate has. Involuntary part-time employment rose in every advanced country and remains elevated in many in 2018.

In the UK we construct the Bell/Blanchflower underemployment index based on reports of whether workers, including full-timers and those who want to be part-time, who say they want to increase or decrease their hours at the going wage rate. If they want to change their hours they report by how many. Prior to 2008 our underemployment rate was below the unemployment rate. Over the period 2001-2017 we find little change in the number of hours of workers who want fewer hours, but a big rise in the numbers wanting more hours. Underemployment reduces wage pressure.

We also provide evidence that the UK Phillips Curve has flattened and conclude that the UK NAIRU has shifted down. The underemployment rate likely would need to fall below 3%, compared to its current rate of 4.9% before wage growth is likely to reach pre-recession levels. The UK is a long way from full-employment.

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There remains a puzzle around the world over why wage growth is so benign given the low levels of unemployment. In the US, the unemployment rate at the time of writing is 4.1% and in the UK 4.3%. The wage growth of production and non-supervisory workers in the US, which accounts for 82% of private sector workers, has remained flat at 2.3% for twenty-for months in a row as the unemployment rate fell from 4.9% to 4.1%. In the UK wage growth in January 2018 was 2.8%.

There has also been little wage growth across the OECD. Table 1 reports real wage growth in the period 2000-2008 and then from 2008 through 2016 using data from the OECD on annual earnings in local currencies at 2016 prices. Real wage growth across the OECD has been low in the years since 2008 and much lower than in the period 2000-2008. Over this eight-year period only France, Germany; Iceland; Norway and Sweden saw average growth rates of above 1%. In the UK, real wages grew not at all and they fell in Greece, Italy and Portugal. The highest growth rate was 11% in Sweden, compared with the highest in the previous period of 27% in Norway.

The weakness of wage growth has continued surprise policymakers. At the press conference following the FOMC rate increase decision on March 21st, 2018 the new Fed chairman Jerome Powell in response to a reporter's question as to whether he was satisfied by the current pace of wage growth said the following. *"(A)s the market is tightened, as labor markets have tightened, and we hear reports of labor shortages that we see that, you know, groups of unemployed are diminishing, and the unemployment rate is going down, we haven't seen, you know, higher wages, wages going up more. And I would--I think I've been surprised by that, and I think others have as well. In terms of what's the right level, I don't think I have a view on what the right level of wages is, but I think we will know that the labor market is getting tight when we do see a more meaningful upward move in wages."*[1]

It is our contention in this paper that a considerable part of the explanation for the benign wage growth in the advanced world is the rise in underemployment. This is also reported in Table 1, here measured as the proportion of those who say they are involuntarily part-time as a percentage of total employment. This measure of underemployment picked up for most countries after 2008 and then turned down subsequently. However, it is notable that in Australia, Italy, New Zealand and the Netherlands, the rate rose steadily over the period. With the exception of Belgium, Finland, Germany, Israel and Sweden, the 2016 rate is still above the 2007 rate. It is about the same in Japan. This contrasts with the unemployment rate, which, as noted above, for the US and UK has returned to pre-recession levels. In 2016, underemployment rates on this measure were especially high in Australia (8.9%), France (7.8%), Spain (9.9%) and Italy (11.9%).

This lack of wage pressure has continued to generate consternation among policy makers, who continue to expect nominal annual wage growth to revert to pre-recession averages of 4% or higher and real wage growth nearer to 2%. We begin by looking at wages and wage growth in the UK and how wage growth weakness is related to the rise in underemployment. We then move on to examine wage growth in 28 OECD countries and also find that underemployment plays a significant role. We find that productivity growth has been flat despite strong employment growth. Low productivity workers have disproportionately been hired Flat productivity led to flat wage growth. We examine arguments that suggest the natural rate of unemployment, the NAIRU, has fallen sharply. We present evidence to show that the UK Phillips curve has flattened.

[1] https://www.federalreserve.gov/mediacenter/files/FOMCpresconf20180321.pdf

Lack of wage growth in the UK

Policymakers in the UK have long been expecting wage growth to accelerate. For example, in the opening statement at the February 2018 press conference for the Inflation Report Bank of England Governor Carney argued

"*The firming of shorter-term measures of wage growth in recent quarters, and a range of survey indicators that suggests pay growth will rise further in response to the tightening labour market, give increasing confidence that growth in wages and unit labour costs will pick up to target-consistent rates*."

Twelve months earlier, Governor Carney at the February 2017 press conference had argued "*following a long period of consistently overestimating wage growth, the MPC has updated its view of the natural rate of unemployment. Specifically, the MPC now judges that the rate of unemployment the economy can achieve while being consistent with sustainable rates of wage growth to be around 4½%, down from around 5% previously.*"

The February 2018 Inflation report reduced it again to 4¼%. "Based on a range of evidence, the MPC judges that the long-term equilibrium unemployment rate is around 4¼%, a little lower than judged a year ago and broadly in line with the current headline rate of unemployment."

On February 21st, 2018 the Bank of England's chief economist, Andy Haldane continued the hopeful theme that wages were set to rocket

"*The long-awaited -- and we have been waiting for a long time -- pickup in wages is starting to take root. We get intelligence from our agents that would suggest that wage settlements this year were going to pick up, perhaps to a number with a three in front of it, rather than a two in front of it.*"[2]

In large part the MPC has had to reduce its estimates of the natural rate of unemployment because it has continued to over-estimate wage growth. Table 2 shows the MPC's forecast for wage growth in the last seventeen inflation reports dating from February 2014 through February 2018. Each of these forecasts over-estimated wage growth and there has been little or no learning from previous errors. The forecasts have been poor to say the least. Three-year ahead wage forecasts in every case were around 4%, but over time the forecasts were reduced as the data showed that a 2% pay norm existed. Pay settlements have continued to suggest a pay norm over the last several years of around 2%. Even in February 2018, the MPC is forecasting wage growth of 3% in 2018, 3¼% in 2019 and 3½% in 2020 which seems most unlikely. The outcomes reported in the final row of the table are the averages for the year-on-year growth rates by month of AWE Total Pay. It makes little sense to focus on regular pay excluding bonuses as we are interested in how much workers are paid rather than what the payments are called; many bonuses are paid regularly.

[2] David Goodman, 'BOE's Haldane Says U.K. Wage Growth Is Starting to Take Root' Bloomberg, 21st February 2018.

It does appear that at the start of 2018 that there are some small signs that a pick-up in wage growth may have begun. Results from the Bank's Agents' annual pay survey are consistent with an increase in pay growth. The survey recorded an average pay settlement in the private sector of 2.6% in 2017, higher than companies had expected in the survey a year ago. In 2018, the average private sector pay settlement was expected to be half a percentage point higher, at 3.1%. With the exception of construction, average pay settlements were predicted to rise in all sectors in 2018. Respondents to the survey had reported that the main factors pushing up total labour cost growth per employee were the difficulty of recruiting and retaining staff, employer pension contributions, higher consumer price inflation and the National Living Wage.

Pay experts XPertHr also reported a rise in settlements at the start of 2018. Median pay deals in the three months to the end of January 2018 were 2.5%, which marks an increase on the 2% median award recorded in every rolling quarter during 2017, and is the highest figure seen since the three months to the end of March 2014 (when pay awards were also at a median rate of 2.5%). Maybe it will all change in 2018 and after seventeen failed attempts they will have it right this time? We doubt it.

In a recent speech Sir John Cunliffe, Deputy Governor at the Bank of England took a somewhat more dovish tone arguing that there was likely more capacity in the UK labour market because of underemployment.

"*A straightforward explanation of why pay growth is subdued at very low levels of unemployment is that we are under-measuring the amount of spare capacity – or 'slack' – in the labour market. Recent trends in the world of work have meant greater (voluntary and involuntary) self-employment and part-time employment. Measures incorporating under-employment as well as unemployment – i.e. how much more people who are in work would like to work – may give a better indication of the amount of spare capacity in the labour market. In such a world, low pay is simply telling the policy maker that there is more labour market slack than the unemployment indicators are registering, that the output gap is larger than thought and that the economy can grow at a faster rate without generating domestic inflation pressure*." That seems right.

It is our contention that the MPC's failure to forecast wage growth appropriately and hence the natural rate of unemployment is because they have focused on unemployment and have largely ignored underemployment. We described in Bell and Blanchflower (2014) how the MPC argued in May 2014 that it was appropriate to consider the rise in underemployment but would only take account of half of this increase because "only around half of the present gap between actual hours and the estimate of desired hours represents labour market slack". This judgement was based on calculations presented in a speech by Martin Weale (2014) which seemed unusual given that underemployment historically had disappeared when labour markets tightened.

In fact, rather than being above the unemployment rate, our measure (see below) of underemployment was lower than the unemployment rate for the years 2001-2008. So, the Weale adjustment looks in error. The subsequent path of wage growth indicated that judgement led to continuing overestimation of wage growth - the MPC forecast for wage growth in 2016 was 3½% and for 2017 it was 3¾%.

Involuntary unemployment as reported in Table 1 is measured slightly differently across countries. In the United States it is the number of part-time workers who say they are part-time for economic reasons (PTER). The Office of National Statistics (ONS) in the UK measures the number of part-time workers who want a full-time job (PTWFT). Chart 1 reports these two measures for the USA and the UK, expressed as a proportion of total employment. In both countries they rose sharply, peaking at 6.7% in the US in March 2010 and at 4.8% in the UK between June and August 2013. Both series declined more slowly than the unemployment rates, which by the end of 2017 in both countries had returned to their pre-recession levels. But not so, for these two underemployment data series, which remained well above their starting levels. There were similar rises across countries in mainland Europe which also use the PTWFT definition.[3]

In previous papers we have examined underemployment in the UK using micro-data (Bell and Blanchflower, 2011, 2013, 2014, 2015, 2018). The data used in this and previous studies are the quarterly Labour Force Surveys (LFS) produced by the ONS, in this case from April 2001, when they were first available through to December 2017. Individuals are surveyed in up to five consecutive waves. Overall there are 6,119,687 observations on individuals age 16+ of whom 3,027,991 are employees and 480,558 self-employed. We have hourly wage data on 856,366 employees across the pooled data file. We drop around 10,000 cases in the regressions due to missing values. Wages are only reported in waves 1 and 5. The self-employed do not report earnings so therefore they cannot be included in the wage analysis.

The simplest variable to construct to identify who is underemployed is the "part time-wants full-time" (PTWFT) category which is included as part of the variable *ftptw* in the LFS. This variable is used to construct the UK time series in Chart 1. However, there is also an *overhrs* (*undhrs*) variable which measures how many fewer (more) hours those who want less (more) hours would like to work *at the going wage rate*. We set these variables to zero for those who do not respond. Anyone who is satisfied with their hours therefore has both variables set to zero. These questions are asked of all workers, no matter what their status, not only for those who are PTWFT. This potentially matters as we find below that less than one third of total "under hours" come from those who are PTWFT. In the US only PTER is available from the Current Population Survey and there is no data availability on the number of "under hours" or "over hours" desired.

Table 3 reports the distribution of workers available in the UK LFS sample pre-recession (2001-2008) and post-recession (2009-2017). It identifies five different types of part-time work, one of which is PTWFT, and full-time work. A number of points stand out.

1) There is a rise over time in the proportion of workers who are PTWFT.
2) There is a roughly equivalent fall in the proportion of full-timers.
3) The number of under hours reported is positive in all six categories and rises in all of them over time.
4) There is little or no change over time in the number of over hours.
5) Overall only 23% of under hours in the first period and 31% in the second is accounted for by PTWFT.

[3] See 'Underemployment and potential additional labour force statistics', Eurostat, May 2017. http://ec.europa.eu/eurostat/statistics-explained/index.php/Underemployment_and_potential_additional_labour_force_statistics

6) On average the PTWFT want to increase their hours by 10 hours pre-recession and by 11 post-recession. There also are a lot more of them.

Chart 2 presents quarterly time series evidence on the Bell/Blanchflower underemployment index (Bell and Blanchflower 2013). It compares the unemployment rate with the underemployment rate we construct using the excess hours data that we translate to unemployment equivalents. We add up the total number of under hours and deduct from it total over hours and then transpose that into unemployment equivalents based on average usual hours worked in the quarter. So, if average hours are 30 then we just divide excess hours by that to generate unemployment equivalents and add it to unemployment. In the pre-recession period the underemployment rate is *below* the unemployment rate and in the years after 2008 it is above it. Why?

Chart 3 shows how that comes about. It plots aggregate under hours and aggregate over hours. The under hours series is below the over hours pre-2008 when the series cross. The over hours series starts to rise from around 2014, whereas the under hours series seems to have been rising from around 2004 and then declines in 2014. The two are quite close to each other by 2017 Q4, with the unemployment rate and the underemployment rate at 4.6% and the underemployment rate at 4.9% (SA).

A number of commentators have taken that chart to suggest that the underemployment slack is used up, but Chart 4 suggests that may not be right. In equilibrium it may well be that workers disproportionately want *less* hours. For the entire period 2001-2008Q2 the number of desired hours was negative, because, in aggregate, the desire for more hours was exceeded by the desire for fewer hours. In such circumstances the number of excess hours desired is negative. This suggests, there may be a lot more labour market slack to be used up to get back to conditions prevailing from 2002-2004 when the monthly unemployment rate averaged 5.1%. The underemployment rate was as low as 3.8% in 2004.

Wages

We now turn to examine wage determination using the LFS micro-level data for the period 2001-2017. This builds on earlier work estimating wage equations for the UK in Blanchflower and Oswald (1994a, b) and Blanchflower and Bryson (2010).

Table 4 estimates a log hourly wage equation for employees, for the period 2001-2017 and then for 2001-2008 and 2009-2017. The equations include standard controls for age and its square, gender, schooling, tenure and its square. They all perform similarly across the three specifications.

In our previous work on underemployment, we have not estimated a wage equation that included both underemployment and over-employment terms. Table 4 therefore includes both the under hours and over hours variables which are negative and positive, respectively and (highly) significant. This implies that wages will be depressed the greater is the willingness of workers to provide more hours at the going wage rate. Similarly, upward pressure on wages is moderated when fewer workers wish to cut their hours. Over and above these effects, all five of the part-time categories are significantly negative, in comparison to full-timers. Part-timers who want extra hours are paid less than part-timers who are content with their hours. It seems that having workers

in jobs where they want more hours keeps wages down as they accept lower pay, conditional on their characteristics. Underemployment impacts wages.

In a recent paper from the IMF Hong et al (2018) examined wage changes in 29 advanced countries from 2000 to 2016. Like us, they augmented the unemployment rate with measures of underemployment because they argued that headline unemployment rates may not be as indicative of labor market slack as they used to be. The authors found that "involuntary part-time employment appears to have weakened wage growth even in economies where headline unemployment rates are now at, or below, their averages in the years leading up to the recession." In a wage change equation, the involuntary part-time employment share enters negatively and significantly in most specifications. Across all countries, on average, a 1 percentage point increase in the involuntary part-time employment share is associated with a 0.3 percentage point decline in nominal wage growth. It should be said, though, that their equations look to be miss-specified as they do not contain a lagged wage term.

The authors have very kindly shared their data with us. We have an unbalanced panel of 688 observations available on wages, the share of involuntary employment as a share of total employment and the unemployment rate on 28 countries.[4] Table 5 reports the results of estimating wage change equations that also include a highly significant lagged wage term. As was found in the Hong et al paper, both the unemployment rate and the involuntary share variables enter significantly negative.

It is clear that in the years since the Great Recession the unemployment rate understates the level of slack prevailing in most OECD countries. But it does seem that the levels of underemployment that exists cannot on its own explain the low levels of wage growth. We turn next to wages. A further possibility exists, that there has been a structural shift in the UK economy such that the natural rate of unemployment, or the NAIRU has shifted downwards. The data seems to support such a contention. Price inflation and wage inflation both remain benign. The UK seems to be a long way from full employment.

The natural rate of unemployment or the NAIRU in the UK has fallen

In his 1968 address to the American Economic Association, Milton Friedman famously argued that the natural rate of unemployment can be expected to depend upon the degree of labor mobility in the economy.[5] The functioning of the labor market will thus be shaped not just by long-studied

[4] Australia 1999-2016; Austria 1995-2016; Belgium 1983-2016; Canada 1976-2016; Czech Republic 1998-2016; Denmark 1983-2016; Estonia 2005-2016; Finland 1985-2016; France 1993-2016; Germany 1992-2016; Greece 1996-2016; Iceland 2007-2016; Ireland 1990-2016; Israel 1996-2016; Italy 1983-2016; Japan 2002-2016; Lithuania 2005-2016; Netherlands 1983-2016; New Zealand 1986-2016; Norway 1989-2016; Portugal 1996-2016; Slovak Republic 1994-2016; Slovenia 2005-2016; Spain 1987-2016; Sweden 1976-2016; Switzerland 1991-2016; United Kingdom 1983-2016; United States 1998-2016.

[5] Friedman explained what the natural rate of unemployment is and what determines it. "The "natural rate of unemployment," in other words, is the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is imbedded in them the actual structural characteristics of the labor and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availabilities, the costs of mobility, and so on."

factors such as the generosity of unemployment benefits and the strength of trade unions but also by the nature, and inherent flexibility and dynamism of, the housing market.

Friedman also made clear that the natural rate of unemployment is not unchanging "*I do not suggest that it is immutable or unchangeable. On the contrary, many of the market characteristics that determine its level are man-made and policy-made*." Friedman goes on to argue, for example, that the strength of union power and the size of the minimum wage all make the natural rate higher; their declines in recent years, then make the natural rate lower. He goes on to argue that improvements in labor exchanges, in availability of information about job vacancies and labor supply, all of which have been enhanced by the internet, tend to lower the natural rate. That, we contend, is what has happened. The natural rate of unemployment in advanced countries has fallen sharply since the Great Recession.

Friedman continues. "*The natural rate of unemployment is such that at a lower rate of unemployment indicates that there would be an excess demand for labor that will push up wage rates. A higher level of unemployment is an indication that there is an excess supply of labor that will produce downward pressure on real wage rates*." (p.8).

Then Chair of the US Federal Reserve, Janet Yellen, in a speech in September 2017, raised the possibility that indeed, the natural rate has fallen and perhaps by a lot:[6]

> "*some key assumptions underlying the baseline outlook could be wrong in ways that imply that inflation will remain low for longer than currently projected. For example, labor market conditions may not be as tight as they appear to be, and thus they may exert less upward pressure on inflation than anticipated*."

And later

> "*The unemployment rate consistent with long-run price stability at any time is not known with certainty; we can only estimate it. The median of the longer-run unemployment rate projections submitted by FOMC participants last week is around 4-1/2 percent. But the long-run sustainable unemployment rate can drift over time because of demographic changes and other factors, some of which can be difficult to quantify--or even identify--in real time. For these and other reasons, the statistical precision of such estimates is limited, and the actual value of the sustainable rate could well be noticeably lower than currently projected.*"

That makes sense. It is our contention that the natural rate of unemployment in most advanced countries is well below 4% and perhaps even below 3%. Employment rates and participation rates can rise and unemployment rates can fall and by a lot. Globalization has weakened worker's bargaining power. Migrant flows have put downward pressure on wages and greased the wheels of the labor market as their presence increased mobility (Blanchflower and Shadforth, 2009). The

[6] Janet L. Yellen, 'Inflation, uncertainty, and monetary policy, speech at the Prospects for Growth: Reassessing the Fundamentals, 59th Annual Meeting of the National Association for Business Economics, Cleveland, Ohio, September 26th, 2017.

decline in the home ownership rate, which slows job creation and increases unemployment, has helped mobility and lowered the natural rate (Blanchflower and Oswald, 2013).

The Great Recession exposed underlying weaknesses and displayed to the populace the possibility of catastrophic declines in house prices and pension pots. The balance between capital and labor shifted once again towards capital. Workers are frightened in a way that they weren't pre-recession. They are afraid the firm will move its production facilities abroad or out-source: a public sector pay freeze has kept private sector pay levels in check. Workers are frightened and have less bargaining power than before. Hence the natural rate has fallen and that is why there has been no spurt in wage growth as the unemployment rate fell from 8% to 6% and from 6% to 4%. A related argument that employers' monopsony power increases during recessions has found support in Germany (Hirsch, Jahn and Schnabel, 2017).

As William Beveridge noted in 1944, "*full employment means that unemployment is reduced to short intervals of **standing by**, with the certainty that very soon will be wanted in one's old job again or will be wanted in a new job that is within one's powers…it means that the jobs are at fair wages, of such a kind, and so located that the unemployed men can reasonably be expected to take them: it means, by consequence, that the normal lag between losing one job and finding another will be short*" (p.18). We are a long way from that. We are standing by.

Nobel Economics Laureate Ned Phelps concurs.[7] Workers he argues have been shaken by the Great Recession. Unemployment can surprise on the low side before wages start to rise back to the 4% or so they were growing at pre-recession.

"*For me, a compelling hypothesis is that workers, shaken by the 2008 financial crisis and the deep recession that resulted, have grown afraid to demand promotions or to search for better-paying employers – despite the ease of finding work in the recently tight labor market. A corollary hypothesis is that employers, disturbed by the extremely slow growth of productivity, especially in the past ten years, have grown leery of granting pay raises – despite the return of demand to pre-crisis proportions.... as the return of a strong dollar by early 2015 threatened to inundate American markets with imports, firms became scared to supply more output at the same price. Or else they supplied the same output as before at reduced prices. And they refused to raise employees' wages. In short, more competition created "super-employment" – low unemployment and low inflation*.". That looks right.

Staiger, Stock and Watson (1997a) examined the precision of estimates of the natural rate of unemployment. They note that the NAIRU 'is commonly taken to be the rate of unemployment at which inflation remains constant. Unfortunately, the NAIRU is not directly observable…. The task of measuring the NAIRU is further complicated by the general recognition that, plausibly, the NAIRU has changed over the post-war period, perhaps as a consequence of changes in labor markets." They further note that "a wide range of values of the NAIRU are consistent with the empirical evidence" and crucially, that the trigger point – when wages and prices start to rise – is poorly estimated. For example, they estimate a NAIRU for the US of 6.2% in 1990 with a 95% confidence interval of 5.1% to 7.7%. In Staiger, Stock and Watson (1997b) they argue that the

[7] Edmund S. Phelps, 'Nothing natural about the natural rate of unemployment', Project Syndicate, November 2nd, 2017.

tightest of the 95 percent confidence intervals for 1994 in the US is 4.8% to 6.6%. They conclude that "it is difficult to estimate the level of unemployment at which the curve predicts is constant rate inflation."

It is our contention that the NAIRU has fallen sharply in the UK post the Great Recession and is likely closer to 3% - and maybe well below it – than to 4% or so as claimed by the MPC and others.

In a recent speech MPC member Gertjan Vlieghe argues that a credible Phillips curve still exists in the UK. We disagree. His main evidence was, firstly, a plot of wage changes against the unemployment rate using AWE data published by the Office of National Statistics monthly for the period 2001-2017. He focused on regular pay, excluding bonuses, which makes little sense given that workers don't care what their pay is called. No other wage series in the world separates bonuses from total pay. Vlieghe showed, that the data showed a negative relationship between unemployment and wage growth in the UK since 2001.

Chart 5 shows quarterly plots between wage growth from the National Statistic Average Weekly Earnings Total Pay and the unemployment rate. Chart 6 does the same for the underemployment rate. We put labels on each of the data points. Chart 7 plots the monthly wage growth series and the monthly unemployment rates. There are too many points to label.

Another way to present the relationships is to estimate a best fit line. For the whole period the lines are

Wage change = 7.1590 - .7054 * Unemployment rate (1a)
Wage change = 5.9133 - .4751 * Underemployment rate (2)

In Chart 7 using monthly data the fit is similar to equation (1a)

Wage change = 7.2611 - .7385 * Unemployment rate (1b)

The best fit lines to the data period 2009Q1 through 2017Q4 gives a much smaller wage response for an equivalent unemployment rate.

Wage change = 3.8114 - .2862 * Unemployment rate (3)
Wage change = 3.6424 - .2259 * Underemployment rate (4)

Both the constant and the slope have approximately halved. A 4.5% unemployment rate in equations 1a and 1b generates wage growth of about 4%. Equation 3 generates wage growth of 2.8%. An underemployment rate of 3.5% in equation 2 generates wage growth of 4.3% versus 2.9% in (4).

In all of the equations above the coefficient of the unemployment rate is statistically significant. Of note though is that there is *no* relation between wage growth and the unemployment rate in the years 2001-2008. The line of best fit has an R^2 very close to zero and the coefficient on the unemployment rate is insignificant.

It seems that the Phillips curve has flattened. This is equally true when one uses the underemployment rate as the measure of labour market slack rather than the unemployment rate. Further, the sharp changes in the coefficients between the two periods suggest instability in the relationship over the period. Thus, a hypothesis of no structural break in the relationship between underemployment or unemployment and wage inflation is rejected for each year from 2006 onward using standard Wald tests. In addition, the Elliott-Muller test for the absence of persistent time variation in the underemployment coefficient is decisively rejected (test statistic = -45.232, 1% critical value = -11.05) with a similar result being obtained for the unemployment coefficient.

A simpler approach is to separate the unemployment, underemployment and wage inflation data into pre-recession, recession and post-recession time periods. We do this in Charts 5 and 6 respectively where we calculate averages for the pre-recession (2001Q2 to 2007Q4), recession (2008Q1 to 2015Q4) and post-recession (2016Q1 onward) and link these with the straight orange lines shown in the charts. The ellipses largely encapsulate outcomes within these three periods and vividly capture the transition to a flatter Phillips curve. Those points not captured belong to transition periods between the different states. Both curves show a flattening of the relationship between labour market slack and wage inflation after the Great Recession as in equations (3) and (4), with almost exactly the same slope. Thus, for example, an underemployment rate of 4.5% and an unemployment rate of 4% are broadly compatible with wage inflation outcomes between 2.5% in 2.8%.

The monthly data plotted in Chart 7, with the data provided in Appendix 2, make clear that there is an obvious transition path between the ellipse to the bottom right and the most recent one in the middle left. The line of twenty-six plots go from August 2013 through September 2015, as the unemployment rate drops from 7.6% to 5.5%, and includes one month of negative wage growth of -0.3% in June 2014. From then on, we are in the flat zone. There are also four obvious transition plots between top left and bottom right as the unemployment rate rises to around 6% and wage growth was still approximately 3%, but not for long.

The second piece of evidence in Vlieghe's speech was an econometric analysis estimating a wage growth – Phillips curve - equation using 256 observations at the industry level from 1997 through 2017. That is 21 years by 12 industries. He includes a lagged unemployment rate and a lagged dependent variable and a set of sector dummies but does not include a full set of year effects, which is what would be required to find credible results. In any case his finding suggests an implausibly large impact of unemployment on pay – he finds that a "one percentage point increase in the unemployment rate in a sector lowers wage growth in that sector by half a percent in the following year." So, given that the unemployment rate has fallen from 8.5% to 4.3% then wage growth should have risen by approximately two percentage points. It has not, of course.

The UK unemployment rate hit 8.5% in September-November 2011, when the AWE total pay annual 3mth/3mth growth rate was 1.9%. In October-December 2017 the unemployment rate was 4.3% while December 2017 wage growth was 2.5%, so that goes in the wrong direction. Of note also is that the earnings of full-time workers from the quarterly LFS averaged 4.0% in the years from 1998 through Jan-Mar 2008 and 1.9% subsequently.[8] Wage growth in the four quarters of 2011 averaged 1% versus 1.9% in the four quarters of 2017.

[8] Available as spreadsheet earn05.xls from the ONS.

The concern is that aggregating wages and unemployment by industry sector may be a particular problem in the most recent years. First, new entrants to the labour market, such as the young, don't have an industry. Secondly, temporary workers, of which there are around 1.5 million, will likely switch industries frequently. Third, workers shift between industries more than they do between regions. A computer specialist works for three months for a retail store; then for three at a bank; then for three in a university and then three at an electronics company. A worker's present industry may not be their next or last. The gig economy has meant people move industries more than they did in the past. Fourth, the longer the spell of unemployment the less likely it is that the unemployed individual will return to their prior industry. Industry seems the wrong level of aggregation in a post Great Recession world.

We explored this issue further using the same LFS micro-data for the years 2001-2017. We constructed unemployment, underemployment and wages by twenty regions across 67 quarterly waves, using earnings weights, and then constructed equivalent annual wage change measure from the LFS across four waves and then a four-wave lag. In total there are 1180 observations.[9] Using a broadly equivalent specification to Vlieghe's we were unable to find any significant unemployment or underemployment effects on wage growth. Vlieghe's analysis cannot rule out the possibility of a structural break in the series. In private communications, Jan admitted as much.

"The point of the analysis was not about whether sectoral or regional data is preferred. We tried both, we were agnostic ex ante. As explained (in footnote 20), the results for regional data showed that inclusion of year dummies rendered the regional unemployment rate insignificant. After inspection of the data, we concluded that this is because, aside from permanent level differences, there is not enough cross-sectional variation across regions, everything moves too closely with the aggregate. There is more cross-sectional variation across sectors, so sectoral unemployment effects on wages are better identified. Whether there is more or less substitutability across regions or sectors is an empirical issue. Our results suggest there is sufficiently low substitutability across sectors to identify a significant effect of sectoral unemployment on sectoral wages, and the effect does not appear to be weakening over time.

Our results are consistent with a downshift in the Phillips Curve (less wage pressure for given unemployment rate). The downshift could be due a number of factors as we explain in the speech, and one of those factors is indeed a reduction in the NAIRU, which we discuss explicitly."

We conclude the relationship between wage growth and unemployment is much flatter in the recent period than in previous periods; a change in the unemployment rate has about half the response in wage growth compared to the prior period. That is not to say that wage growth will not rise toward 4% but not until there is much less slack in the labour market.

Productivity Growth and Employment Growth

[9] As an example, we regressed hourly wage changes on a 1-year lag (coeff=-.472, t=18.8) and the unemployment rate (coeff=-.0112, t=0.37) with n=1180, adjusted R^2=.2505. The results are similar with the underemployment rate and with weekly wages.

Chart 8 plots productivity growth rates per worker and employment growth rates for the UK from 2001.[10] Employment growth picked up as productivity slowed. Employment growth rates, according to the ONS were as follows – where we calculate the average monthly annual growth rates of employment.

1970s	0.4%
1980s	0.6%
1990s	0.2%
2000-2007	1.0%
2008-2010	-0.1%
2011-2017	1.3%

The Great Recession saw a fall in employment from 2008 through 2012. By January 2012 employment was still 300,000 below employment in January 2008. After that employment rose at an average record annual pace of 1.3% and by January 2018 was about two and a half million higher. Of note is that over the period January 2010 through January 2018, the employment rate rose from 58.0% to 60.9%, while real average weekly wages fell from a high of £522 in February 2008 to £488 in January 2018, or by over 6%. In contrast in the USA employment rates fell from 62.9% to 60.4% while real weekly wages of private sector, in 1982-1984 dollars, rose from $343.72 to $369.72.

As background we should note that productivity growth has declined steadily over time in the UK. According to the ONS productivity rates were as follows

1960s	2.88%
1970s	2.48%
1980s	2.07%
1990s	2.04%
2000s	1.01%
2010-2017	0.73%

To put this in context, UK productivity is 17% below the average for the rest of the G7 in 2015.[11] By 2015, the UK produces in five days what it takes the US, Germany and France to produce in four. There is little or no sign of catch-up. It is hardly surprising that wages have not risen – something structural has happened. The NAIRU appears to now be markedly lower than in the past. Productivity growth is a third of what it was from 1960-2000.

[10] The employment annual growth rates were simply taken from the ONS labour market release a01mar2018.xls, Table 1. We used the data for Jan-Mar for Q1; Apr-Jun for Q2; Jul-Sep for Q3 and Oct-Dec for Q4. Output per worker was obtained from the ONS series Output per workers: Whole Economy SA: Index 2015=100, UK. https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/labourproductivity/timeseries/a4ym/prdy

[11] 'International comparisons of UK productivity (ICP), final estimates, 2015', Statistical Bulletin, ONS, 5th April 2017.

Higher productivity tends to lead to higher real wages and is associated with higher consumption levels and better health.[12] It seems that wage growth has fallen as productivity has fallen and employment growth has slowed. The very low wage growth rates in the last few periods have occurred when output per head was growing at less than 1% and employment growth was slowing.[13] Low paid workers were hired. There was an industry-wide slowdown in business investment during the crisis and subdued growth since, which helps to explain the productivity slowdown.

Consistent with that is the recent work by Haltiwanger et al (2018), in the United States who found strong evidence of a firm wage ladder that was highly pro-cyclical. During the Great Recession, this firm wage ladder collapsed, with net worker reallocation to higher wage firms falling to zero. They found that in the Great Recession, movement out of the bottom rung of the wage ladder declined by 85 percent, with an associated 40 percent decline in earnings growth. They find that upward progress from the bottom rung of the job ladder declines by 40 percent in contractions, relative to expansions.

Productivity is low when wage growth is low. A pay freeze in the public sector that has existed in the UK since 2010 has not helped to motivate staff. Workers on low pay are not motivated to work harder. In addition, in contrast to the United States, the employment rate in the UK has recovered to post-recession levels, in large part due to the hiring of more low-paid, less productive workers.[14] In both countries private sector unionization rates have collapsed, so workers appear to have less bargaining power than in the past.[15]

Stansbury and Summers (2018) for the US find evidence of linkage between productivity and compensation: over 1973-2016, one percentage point higher productivity growth has been associated with 0.7 to 1 percentage points higher median and average compensation growth and with 0.4 to 0.7 percentage points higher production/nonsupervisory compensation growth. They further find the relationship between average compensation and productivity in Canada; West Germany (pre-unification) the UK and the USA to be strong and positive with the effects somewhat weaker for France, Italy and Japan.

UK forecasters, including the Bank of England, have consistently predicted that productivity growth would recover to a rate close to its 1970s-2000s average. For many successive quarters the Office for Budget Responsibility (OBR) in the UK assumed a return to pre-recession rates of productivity growth, whose sole justification appeared to be the weight of history in the time series.

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[12] Silvana Tenreyro 'The fall in productivity growth: causes and implications', Peston Lecture, Queen Mary University of London 15 January 2018.

[13] Rates were 2015Q3 0.4% 2015Q4 -0.1%; 2016Q1 0.3%; 2016Q2 -0.5%; 2016Q3 0.4%; 2016Q4 0.9%; 2017Q1 0.8%; 2017Q2 0.8%; 2017Q3 0.9%.

[14] The 16+ employment rate in the US in January 2008 was 62.9% versus 60.4% in January 2018. In contrast in the UK they were 60.4% and 60.9% respectively on these dates – source BLS and ONS.

[15] According to www.unionstats.gsu.edu private sector unionization rates in the US in 2017 were 6.5% down from 10.3% since 1995 versus, according to the ONS, were 13.4% in the UK down from 21.4% in 1995. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/616966/trade-union-membership-statistical-bulletin-2016-rev.pdf

Chart 9 is taken from the OBR's March 2017 report and shows successive and essentially unchanging and terrible OBR productivity forecasts alongside the actual data. The black line on the chart shows the outcome over the period from 2009 through 2017 along with sixteen successive forecasts. Each successive forecast parallels its predecessor in sloping up sharply and therefore implies an explosion of productivity growth, which never happened. Unfortunately, prolonged, consistent errors did not lead to a change in forecast behaviour. Only in the March 2017 report was there a slight shallowing in the productivity growth rate. Each assumed the productivity puzzle was solved when it wasn't.

Of interest is the timing of the collapse of productivity growth which was coincidental with the onset of austerity in the coalition government's Budget of June 2010. The changes took a little time to have an impact so if we assume 2011Q2 as a reasonable starting point for the effects of austerity output per hour was 103.7, with 2009=100. By 2017Q2 output per hour was 103.9.

In October 2017, in its Forecast Evaluation Report (FER) the OBR produced a mea culpa admitting it had been wrong all along; the productivity puzzle had not been solved and the UK economy was not set to mean revert to pre-recession levels.

"*One recurring theme in past FERs has been productivity falling short of our forecasts…. Our rationale for basing successive forecasts on an assumed pick-up in prospective productivity growth has been that the post-crisis period of weakness was likely to reflect a combination of temporary, albeit persistent, influences. And as those factors waned, so it seemed likely that productivity growth would return towards its long-run historical average*." (p.6)

And later

"*While we continue to believe that there will be some recovery from the very weak productivity performance of recent years, the continued disappointing outturns, together with the likelihood that heightened uncertainty will continue to weigh on investment, means that we anticipate significantly reducing our assumption for potential productivity growth over the next five years in our forthcoming November 2017 forecast*," (p.7).

There was no learning. Productivity still hasn't taken off.

Conclusion

The UK Phillips curve appears to have flattened sharply – the constant and the slope have both halved.

Wage growth continues to be benign despite low unemployment rates in the UK and the US in particular. It seems that the unemployment rate understates labour market slack. But perhaps more importantly, something has changed in the years since the Great Recession. The very low level of the unemployment of 4.3% prevailing in the UK at the time of writing may not indicate that the UK is close to full-employment.

Our findings suggest that some of the reason for that is because the unemployment rate understates labour market slack. Underemployment is more important than unemployment in explaining the

weakness of wage growth in the UK. In the pre-recession years the underemployment rate hit a low of 3.8% in 2004 Q1 and was associated with steadily rising wage growth which hit 4.5% in 2005 Q3 (Appendix 1). There is every reason to believe that now it could go even lower - perhaps even below 3% - before there is an equivalent up-tick in wage growth. In our view, the natural rate of unemployment has fallen sharply since the Great Recession. That is why there hasn't been a burst of wage growth as the unemployment rate has fallen, from 8% to 6% to close to 4%. In our view the NAIRU in the UK may well be nearer to 3%, and even below it.

In its February 2018 Inflation Report the MPC noted that they had lowered their estimate of equilibrium unemployment or the NAIRU to 4¼%. Of course, it could be lower than that given the work of Staiger et al (1997a, b) which suggests a large error band around such estimates, of around 1%. So, 3% is not out of the ballpark. The MPC has a long history of having to revise down such estimates; in 2011 they claimed the NAIRU was 8%. Hindsight shows that estimate, as well as all the subsequent lower revisions were still too high and probably are now too given the continuing lack of wage growth. In congressional testimony on February 27th, 2018 Fed Chair Jerome Powell admitted that the natural rate of unemployment in the United States could be as low as 3½%.[16]

Q. *"Mr. Chairman, what do you consider full employment? I have the number 5.5 percent, but if you differ, I'd like to hear your number please.*

A. *I would -- so I -- if I had to make an estimate, I'd say it's somewhere in the low fours, but I would stress that it could be that -- what that really means is it could, and it could be 3.5."*

In the years 2000-2008 there was no relationship between (high) wage growth, which averaged 4%, and the relatively low unemployment rate. Then the Great Recession came along, and everything shifted down with lower wage growth and higher unemployment. Once recovery happened there was a transition to a new flatter equilibrium with low unemployment of less that 5% and low wage growth of around 2%.

A big question is how low can unemployment go. William Beveridge (1960) tells the story in the prologue to his book, written sixteen years later, that as a 'conservative rather than unduly hopeful aim' of the amount of temporary idleness that might be expected under full employment he had suggested in 1944 a figure of 3% of the labor force at any time. When Keynes saw this number, he wrote to Beveridge to say that he saw no harm in aiming at 3 percent but that he would be surprised if it could go so low in practice. Beveridge reported in 1960 that the UK unemployment rate had surprised to the low side, averaging 1.5% from 1948 to 1959. Here are the UK numbers he reported: 1948-1950=1.5%; 1951=1.2%;1952=2.0%; 1953=1.6%; 1954=1.3%; 1955=1.1%; 1956=1.2%; 1957=1.4%; 1958=2.1% and 1959=2.2%. Unemployment can surprise on the downside again.

Underemployment continues to push down on wages even though the unemployment rate is low. Over and above that we present evidence that the UK Phillips curve has flattened and as a result

[16] Evidence from hearing of the House Financial Services Committee on the Monetary Policy Report and the State of the Economy.

the UK NAIRU has shifted down. At the same time productivity growth has also been flat even though employment growth has been strong. Flat productivity led to flat wage growth. Flat wage growth led to low productivity. The newly hired low wage workers had low productivity. The combination of elevated underemployment and a flattened Phillips curve means that wage growth is not going to take off any time soon.

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Table 1. Annual real wage growth % in 2016 constant prices and involuntary part-time as a % total employment, 2007, 2012 and 2016.

	Real wage growth		Involuntary part-time rate		
	2000-2008	2008-2016	2007	2012	2016
Australia	12	5	6.7	7.6	8.9
Austria	8	1	2.7	2.5	3.6
Belgium	2	2	3.6	2.6	2.3
Canada	14	9	4.0	5.1	4.8
Denmark	14	9	3.1	4.3	3.7
Finland	14	3	2.9	3.2	0.9
France	9	10	5.3	5.3	7.8
Germany	2	10	5.3	3.9	3.1
Greece	18	-18	2.4	4.8	6.9
Iceland	9	10	1.2	4.5	3.0
Ireland	21	8	2.0	10.2	7.2
Israel	-4	7	5.0	3.6	2.7
Italy	4	-1	5.4	9.7	11.9
Japan	-1	0	4.5	5.2	4.4
Luxembourg	8	6	0.9	2.5	2.4
Netherlands	7	6	2.0	3.9	4.2
New Zealand	20	8	3.9	4.9	5.4
Norway	27	10	1.5	1.6	1.7
Portugal	-2	-3	3.4	5.4	4.7
Spain	5	2	4.1	9.6	9.9
Sweden	17	11	7.7	8.1	5.9
Switzerland	8	5	1.8	2.5	2.9
United Kingdom	15	0	2.4	5.0	3.9
United States	8	7	0.8	1.8	1.3

Source: OECD and Hong et al (2018).

Table 2. Seventeen Successive MPC Wage Forecasts, for 2014-2020 (%)

	2014	2015	2016	2017	2018	2019	2020
Q12014	2¾	3¾	3¾				
Q22014	2½	3½	3¾				
Q32014	1¼	3.3	4				
Q42014	1¼	3.3	3¾	3¾			
Q12015		3½	4	4			
Q22015		2½	4	4			
Q32015		3	3¾	4½			
Q42015		2½	3¾	4	4¼		
Q12016			3	3¾	4¼		
Q22016			3	3¾	4		
Q32016			2¾	3	3½		
Q42016			2½	2¾	3¾	3¾	
Q12017				3	3¾	3¼	
Q22017				2	3½	3¾	
Q32017				2	3	3¼	
Q42017				2¼	3	3¼	3¼
Q12018				2½	3	3¼	3½
AWE Outcome	1.1	2.6	2.4	1.9			

Source: Conditioning assumptions for Inflation Reports

Table 3. Distribution of under and over hours

	2001-2008		
	Under hours	Over hours	% total
Part-time: student	2.8	0.2	4.0
Part-time: ill or disabled	2.7	0.5	0.6
Part-time: could not find full-time job	10.0	0.1	2.2
Part-time: did not want full-time job	1.4	0.5	18.3
Part-time: no reason given	5.1	0.4	0.1
Full-time	0.4	1.3	74.8
Percent accounted for by PTNOFT	23%		

	2009-2017		
	Under hours	Over hours	% total
Part-time: student	3.6	0.1	3.6
Part-time: ill or disabled	3.2	0.5	0.7
Part-time: could not find full-time job	11.0	0.1	4.1
Part-time: did not want full-time job	1.7	0.5	18.1
Part-time: no reason given	5.4	0.3	0.2
Full-time	0.6	1.3	73.3
Percent accounted for by PTWFT	31%		

Table 4. Hourly wage equations, 2001-2017

	2001-2017	**2001-2008**	**2009-2017**
Under hours	-.0058 (41.72)	-.0048 (23.91)	-.0066 (33.94)
Over hours	.0031 (23.58)	.0031 (17.65)	.0029 (14.79)
PT student	-.1791 (57.56)	-.1792 (44.70)	-.1740 (35.69)
PT disabled	-.2560 (40.38)	-.2488 (28.42)	-.2632 (28.70)
PTWFT	-.1760 (53.29)	-.1714 (33.63)	-.1757 (39.98)
PT DWFT	-.1239 (87.87)	-.1363 (71.88)	-.1094 (52.09)
PT no reason	-.1141 (7.50)	-.1272 (6.19)	-.1081 (4.80)
Age	.0538 (201.70)	.0566 (158.52)	.0528 (131.12)
Age squared	-.0006 (185.79)	-.0006 (148.08)	-.0006 (119.27)
Male	.1611 (146.68)	.1596 (107.47)	.1623 (99.79)
NVQ 4	-.2462 (133.98)	-.2437 (95.97)	-.2544 (95.48)
NVQ 3	-.3965 (257.32)	-.4055 (187.66)	-.3912 (177.54)
Apprenticeship	-.5238 (209.04)	-.5443 (170.06)	-.4955 (123.14)
NVQ 2	-.5192 (341.58)	-.5292 (260.61)	-.5160 (222.37)
Other qualifications	-.5979 (343.55)	-.6267 (260.66)	-.5713 (225.79)
No qualifications	-.7210 (339.35)	-.7364 (274.64)	-.6930 (196.68)
Years tenure	.0185 (109.19)	.0190 (82.39)	.0179 (71.42)
Tenure squared	-.0002 (44.94)	-.0003 (34.80)	-.0002 (29.07)
Wave dummies	66	30	35
Region dummies	19	19	19
Constant	1.07731	1.0541	1.3075
Adjusted R^2	.4250	.4287	.3768
N	842,929	446,968	395,961

Notes: excluded category; FT; no qualifications.
Source: LFS 2001Q4-2017Q4.

Table 5. Time series log wage and wage growth equations in an unbalanced country panel, 1976-2016

Dependent variable	Log W_t	Log W_t	Log W_t	$LogW_t$-$LogW_{t-1}$
Log unemployment $rate_{t-1}$	-.0336 (15.03)	-.0289 (9.66)	-.0239 (7.25)	-.0239 (7.25)
Log $Wage_{t-1}$	.9931 (1026.25)	.9558 (368.52)	.9063 (119.96)	-.0937 (12.40)
Log PTWFT%	-.0143 (7.54)	-.0114 (4.79)	-.0144 (5.91)	-.0144 (5.91)
Country dummies	No	Yes	Yes	Yes
Year dummies	No	No	Yes	Yes
Constant	.1424	.2598	.3312	.3312
Adjusted R^2	.9994	.9998	.9998	.6333
N	686	686	686	686

Source: Hong et al (2018) and own calculations

Chart 1. Part-time For Economic Reasons as % of employment, US v UK

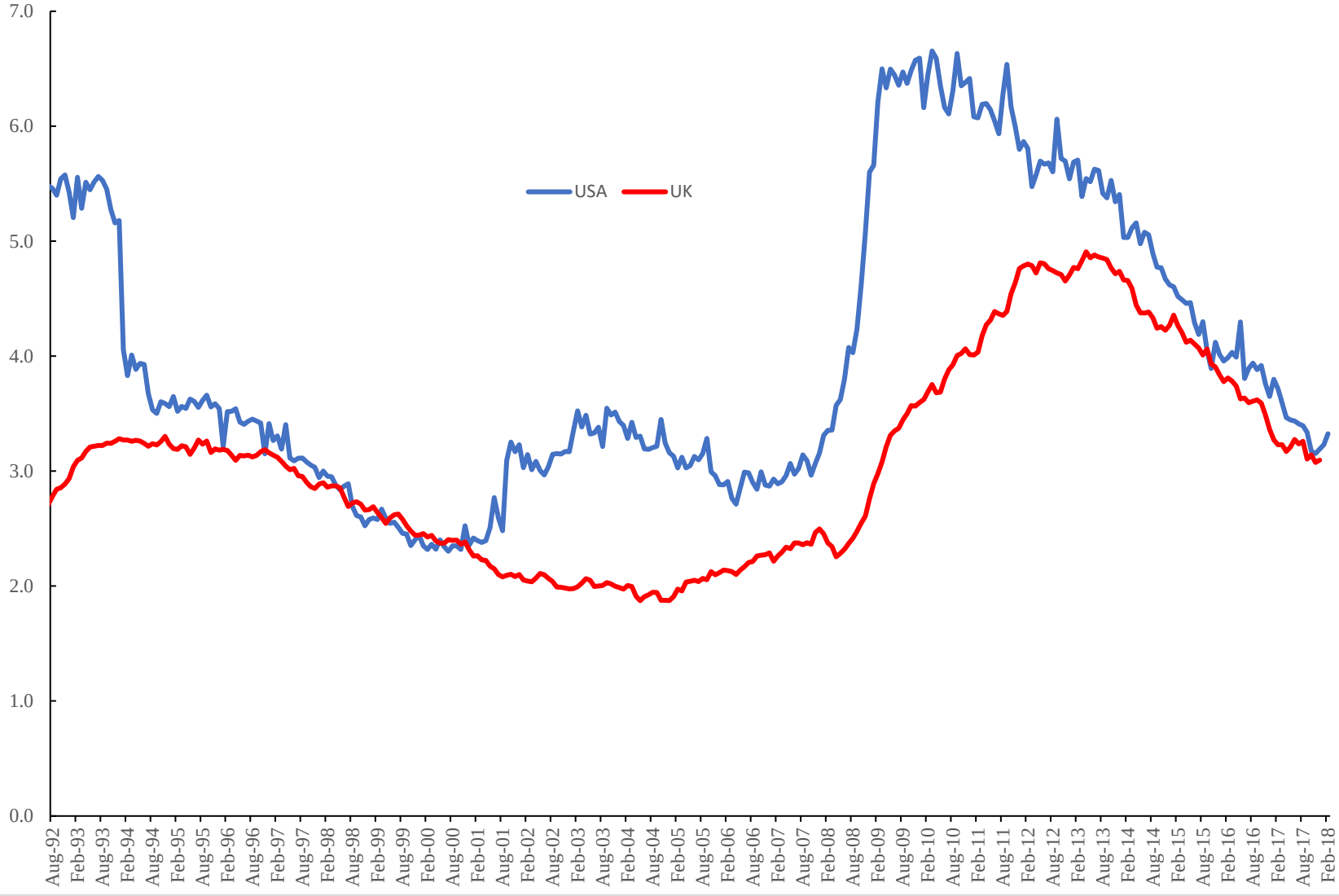


Chart 2. Unemployment and Underemployment Rates

Chart 3. More and Fewer Desired Hours

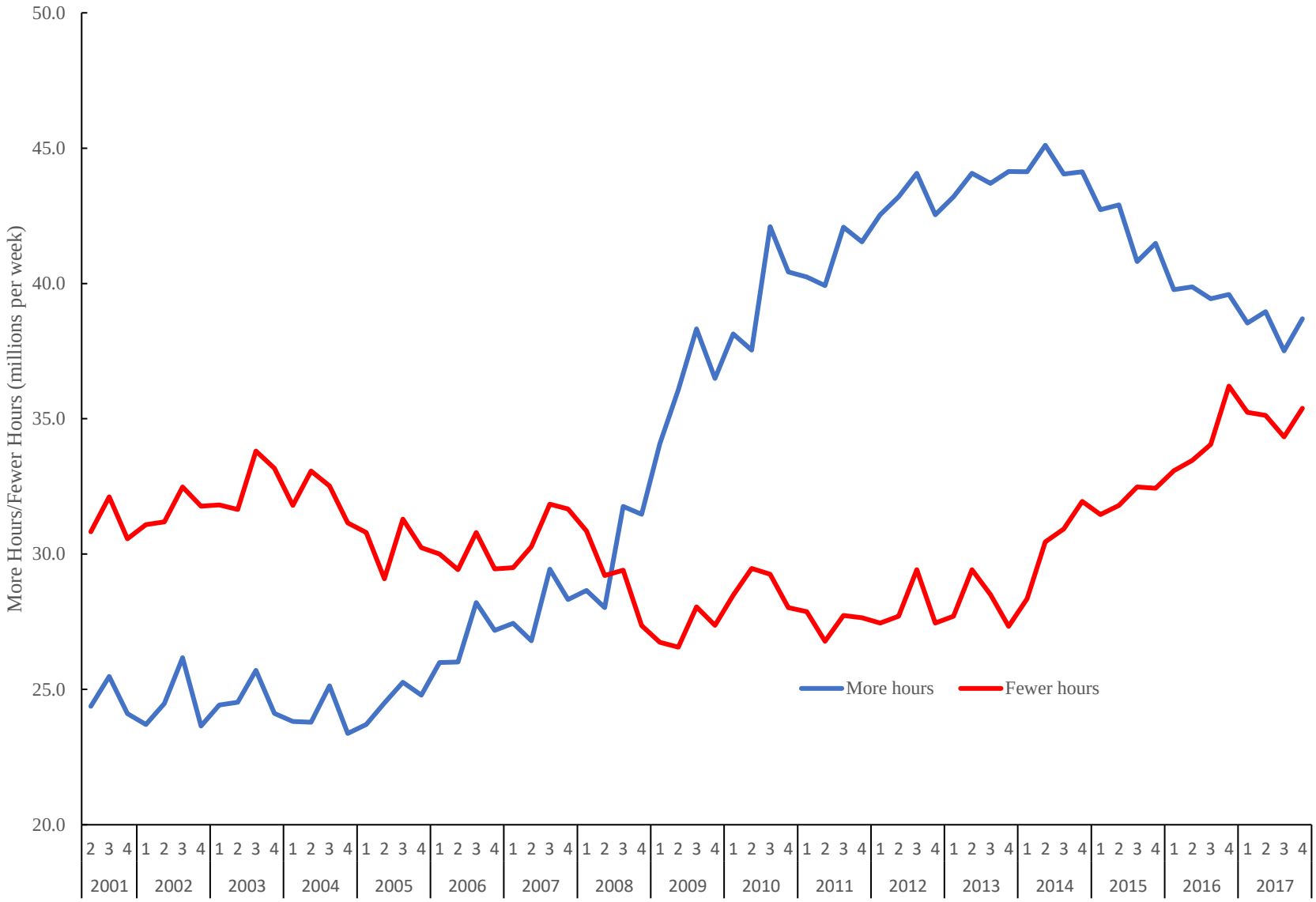


Chart 4. Difference Between the Underemployment and Unemployment Rates

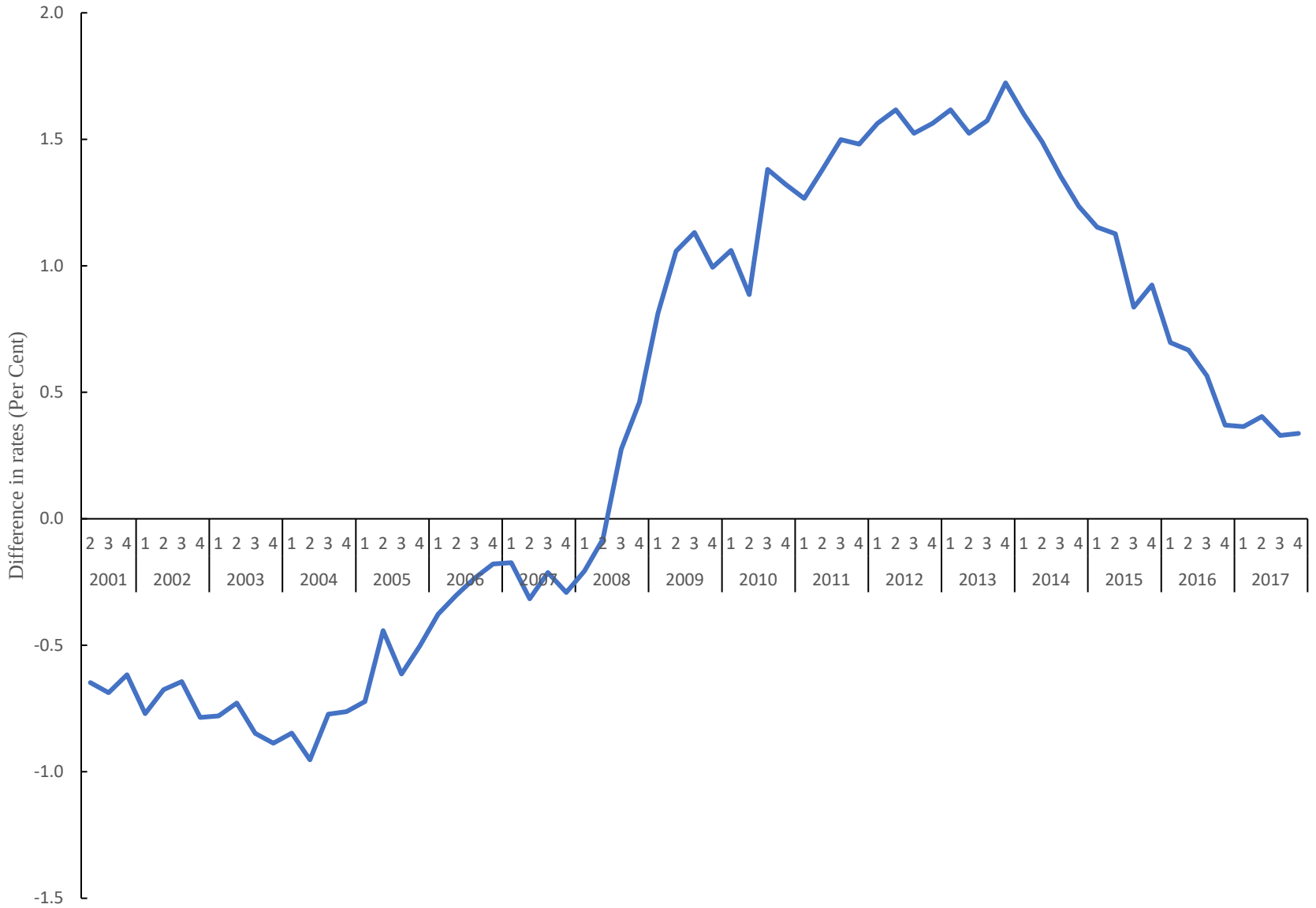


Chart 5: Unemployment and Wage Inflation 2001-2017

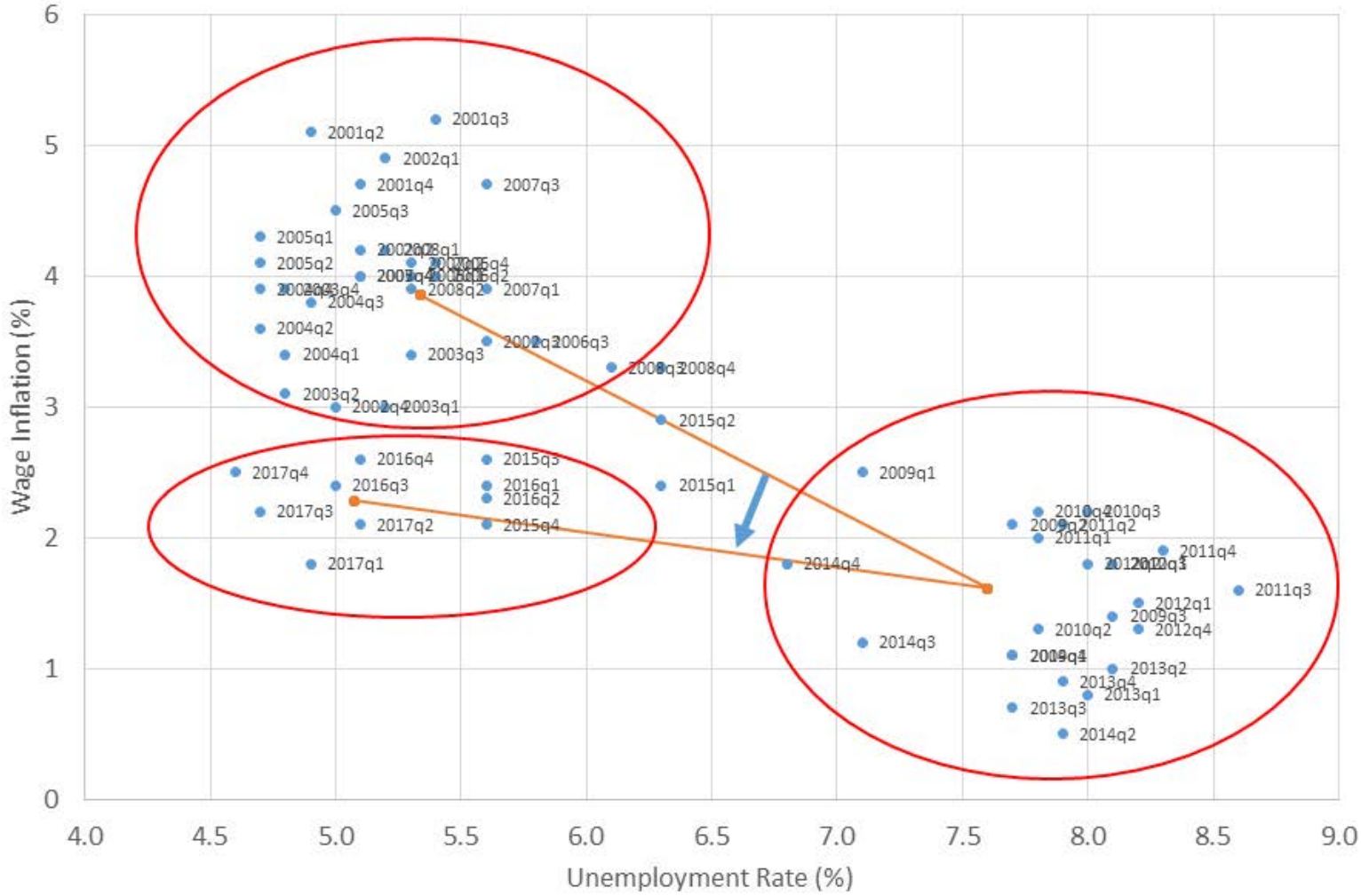


Chart 6: Underemployment and Wage Inflation 2001-2017

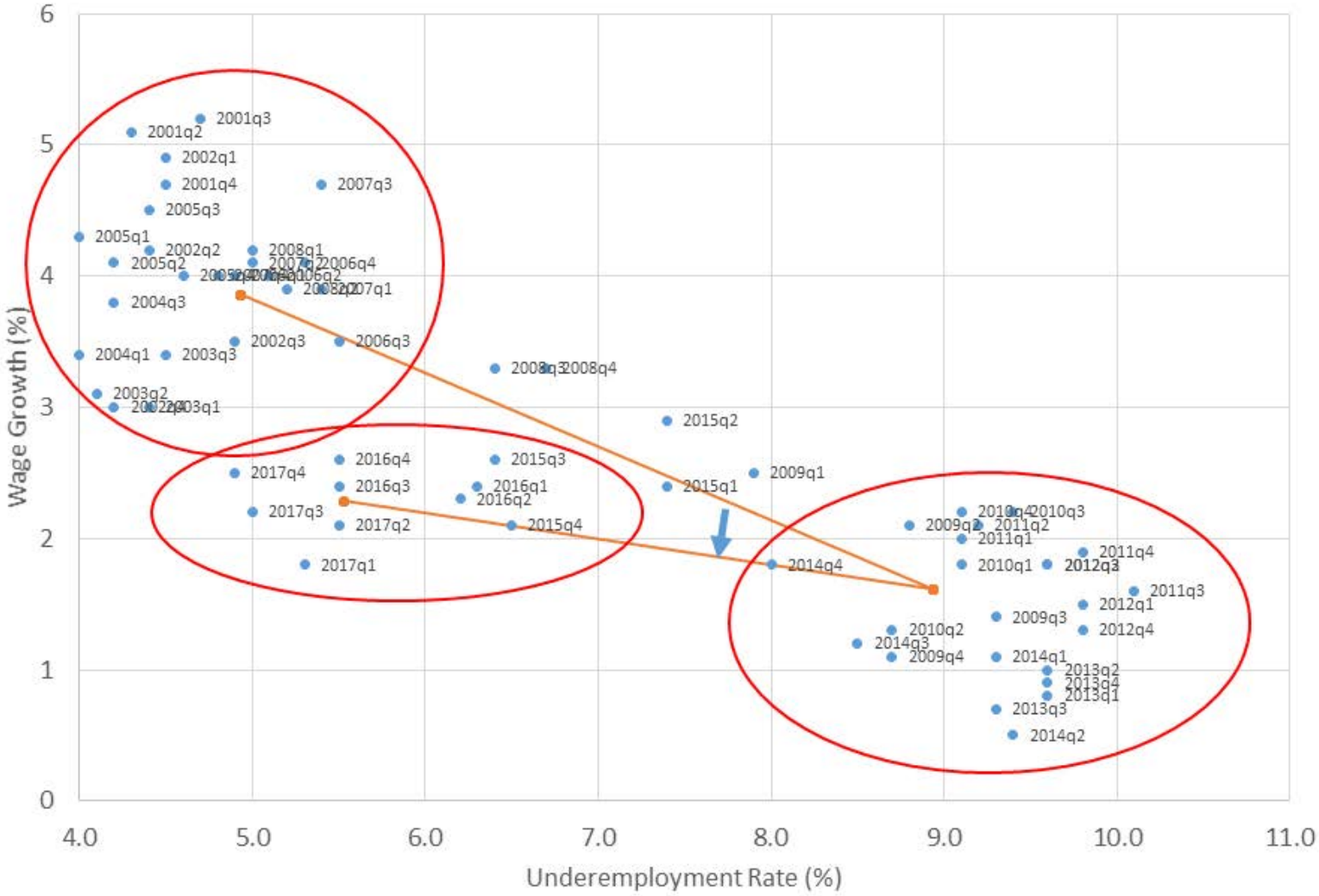


Chart 7. Monthly Wage Phillips Curve and Unemployment, March 2001-December 2017

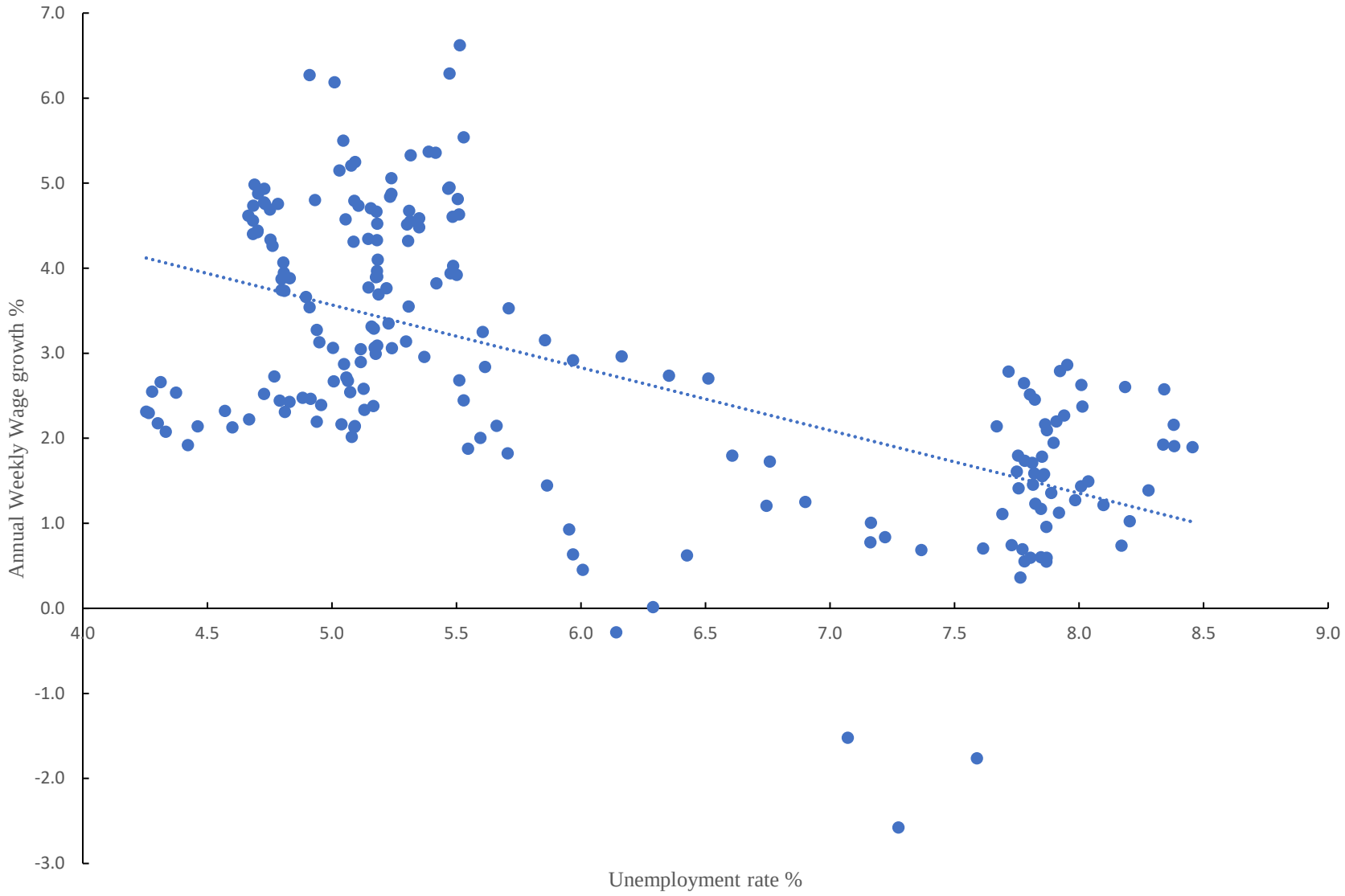


Chart 8. Productivity Growth Per Worker and Employment Growth Rates %, Q12001-Q32017

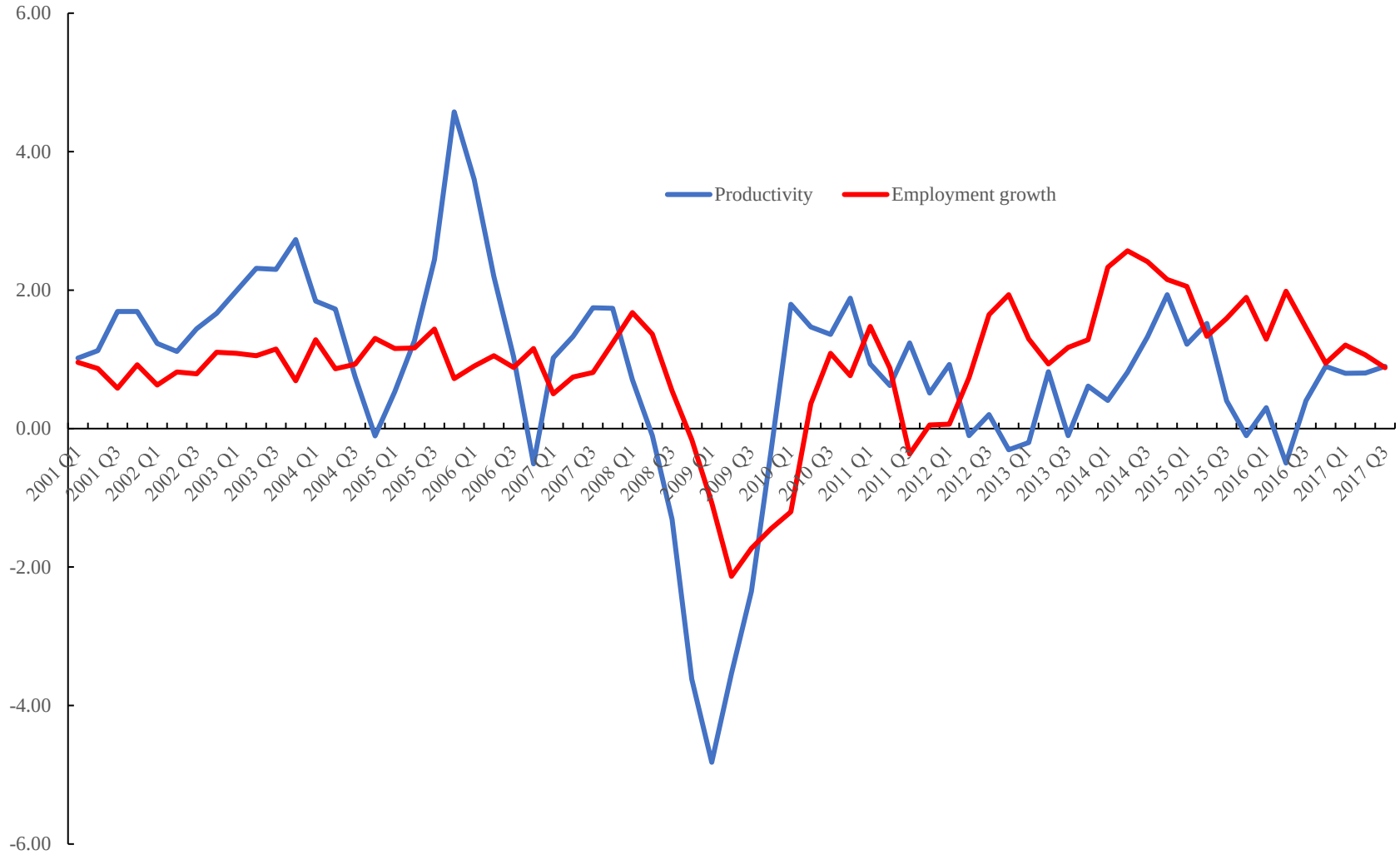
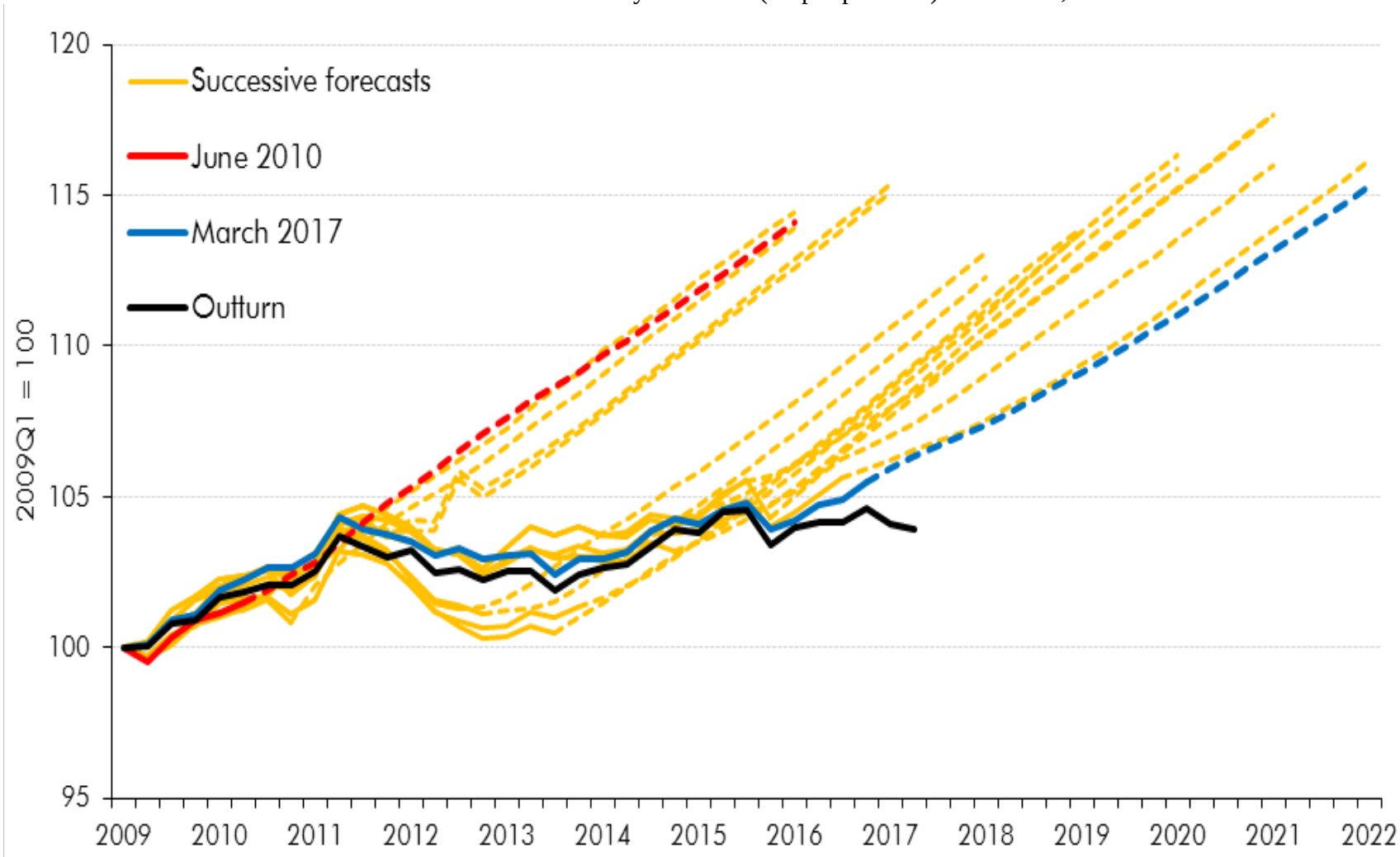


Chart 9. Successive OBR Productivity Forecasts (output per hour) for the UK; 2010-2017



Note: Solid lines represent the outturn data that underpinned the forecasts at the time (the dashed lines).
Source: ONS, OBR

Appendix 1. Unemployment Rate and Underemployment Rate for all (not seasonally adjusted)

Year	Quarter	Unemployment Rate	Underemployment Rate	AWE total pay growth rate
2001	Q2	4.9	4.3	5.1
	Q3	5.4	4.7	5.2
	Q4	5.1	4.5	4.7
2002	Q1	5.2	4.5	4.9
	Q2	5.1	4.4	4.2
	Q3	5.6	4.9	3.5
	Q4	5.0	4.2	3.0
2003	Q1	5.2	4.4	3.0
	Q2	4.8	4.1	3.1
	Q3	5.3	4.5	3.4
	Q4	4.8	3.9	3.9
2004	Q1	4.8	4.0	3.4
	Q2	4.7	3.8	3.6
	Q3	4.9	4.2	3.8
	Q4	4.7	3.9	3.9
2005	Q1	4.7	4.0	4.3
	Q2	4.7	4.2	4.1
	Q3	5.0	4.4	4.5
	Q4	5.1	4.6	4.0
2006	Q1	5.3	4.9	4.0
	Q2	5.4	5.1	4.0
	Q3	5.8	5.5	3.5
	Q4	5.4	5.3	4.1
2007	Q1	5.6	5.4	3.9
	Q2	5.3	5.0	4.1
	Q3	5.6	5.4	4.7
	Q4	5.1	4.8	4.0
2008	Q1	5.2	5.0	4.2
	Q2	5.3	5.2	3.9
	Q3	6.1	6.4	3.3
	Q4	6.3	6.7	3.3
2009	Q1	7.1	7.9	2.5
	Q2	7.7	8.8	2.1
	Q3	8.1	9.3	1.4
	Q4	7.7	8.7	1.1
2010	Q1	8.1	9.1	1.8
	Q2	7.8	8.7	1.3
	Q3	8.0	9.4	2.2
	Q4	7.8	9.1	2.2
2011	Q1	7.8	9.1	2.0
	Q2	7.9	9.2	2.1
	Q3	8.6	10.1	1.6
	Q4	8.3	9.8	1.9

2012	Q1	8.2	9.8	1.5
	Q2	8.0	9.6	1.8
	Q3	8.1	9.6	1.8
	Q4	8.2	9.8	1.3
2013	Q1	8.0	9.6	0.8
	Q2	8.1	9.6	1.0
	Q3	7.7	9.3	0.7
	Q4	7.9	9.6	0.9
2014	Q1	7.7	9.3	1.1
	Q2	7.9	9.4	0.5
	Q3	7.1	8.5	1.2
	Q4	6.8	8.0	1.8
2015	Q1	6.3	7.4	2.4
	Q2	6.3	7.4	2.9
	Q3	5.6	6.4	2.6
	Q4	5.6	6.5	2.1
2016	Q1	5.6	6.3	2.4
	Q2	5.6	6.2	2.3
	Q3	5.0	5.5	2.4
	Q4	5.1	5.5	2.6
2017	Q1	4.9	5.3	1.8
	Q2	5.1	5.5	2.1
	Q3	4.7	5.0	2.2
	Q4	4.6	4.9	2.5

Appendix 2. Monthly wage growth and the Unemployment rate

	Unemployment	Wages		Unemployment	Wages
Mar-01	5.0	6.2	Nov-04	4.7	4.9
Apr-01	4.9	6.3	Dec-04	4.7	4.8
May-01	5.0	5.1	Jan-05	4.8	4.8
Jun-01	5.0	5.5	Feb-05	4.7	5.0
Jul-01	5.1	5.2	Mar-05	4.7	4.9
Aug-01	5.1	5.2	Apr-05	4.8	4.7
Sep-01	5.1	4.8	May-05	4.8	4.3
Oct-01	5.1	4.7	Jun-05	4.7	4.4
Nov-01	5.2	4.5	Jul-05	4.7	4.6
Dec-01	5.2	4.1	Aug-05	4.7	4.8
Jan-02	5.1	3.8	Sep-05	4.9	4.8
Feb-02	5.2	3.3	Oct-05	5.1	4.6
Mar-02	5.2	3.1	Nov-05	5.1	4.3
Apr-02	5.2	3.1	Dec-05	5.1	4.3
May-02	5.2	3.3	Jan-06	5.2	4.3
Jun-02	5.2	3.7	Feb-06	5.2	4.8
Jul-02	5.2	3.8	Mar-06	5.3	5.3
Aug-02	5.3	3.5	Apr-06	5.4	5.4
Sep-02	5.2	3.4	May-06	5.5	4.9
Oct-02	5.2	3.0	Jun-06	5.5	4.8
Nov-02	5.1	2.9	Jul-06	5.5	4.9
Dec-02	5.0	2.7	Aug-06	5.5	4.6
Jan-03	5.1	2.6	Sep-06	5.5	3.9
Feb-03	5.2	2.4	Oct-06	5.4	3.8
Mar-03	5.1	3.0	Nov-06	5.5	3.9
Apr-03	5.0	3.1	Dec-06	5.5	4.6
May-03	4.9	3.3	Jan-07	5.5	5.5
Jun-03	5.1	2.7	Feb-07	5.5	6.6
Jul-03	5.1	2.7	Mar-07	5.5	6.3
Aug-03	5.0	2.9	Apr-07	5.4	5.4
Sep-03	5.0	3.1	May-07	5.4	4.5
Oct-03	4.9	3.5	Jun-07	5.3	4.3
Nov-03	4.9	3.7	Jul-07	5.3	4.5
Dec-03	4.8	3.9	Aug-07	5.3	4.7
Jan-04	4.8	3.9	Sep-07	5.2	5.1
Feb-04	4.8	3.9	Oct-07	5.2	4.9
Mar-04	4.8	3.7	Nov-07	5.2	4.7
Apr-04	4.8	3.7	Dec-07	5.2	3.9
May-04	4.8	4.1	Jan-08	5.2	4.0
Jun-04	4.8	4.3	Feb-08	5.2	3.9
Jul-04	4.7	4.4	Mar-08	5.3	4.5
Aug-04	4.7	4.4	Apr-08	5.2	4.7
Sep-04	4.7	4.6	May-08	5.4	4.6
Oct-04	4.7	4.7	Jun-08	5.5	4.0

Jul-08	5.7	3.5
Aug-08	5.9	3.2
Sep-08	6.0	2.9
Oct-08	6.2	3.0
Nov-08	6.4	2.7
Dec-08	6.5	2.7
Jan-09	6.7	1.2
Feb-09	7.1	-1.5
Mar-09	7.3	-2.6
Apr-09	7.6	-1.8
May-09	7.8	0.4
Jun-09	7.9	1.0
Jul-09	7.9	0.6
Aug-09	7.8	0.6
Sep-09	7.9	0.6
Oct-09	7.8	0.6
Nov-09	7.8	0.7
Dec-09	7.7	0.7
Jan-10	7.9	1.1
Feb-10	8.0	2.6
Mar-10	8.0	2.9
Apr-10	7.9	2.8
May-10	7.9	1.6
Jun-10	7.8	1.6
Jul-10	7.8	1.7
Aug-10	7.8	1.8
Sep-10	7.9	1.9
Oct-10	7.9	2.1
Nov-10	7.9	2.2
Dec-10	7.9	2.2
Jan-11	7.8	2.5
Feb-11	7.8	2.6
Mar-11	7.7	2.8
Apr-11	7.8	2.5
May-11	7.9	2.3
Jun-11	8.0	2.4
Jul-11	8.2	2.6
Aug-11	8.3	2.6
Sep-11	8.4	2.2
Oct-11	8.5	1.9
Nov-11	8.4	1.9
Dec-11	8.3	1.9
Jan-12	8.3	1.4
Feb-12	8.2	1.0
Mar-12	8.2	0.7
Apr-12	8.1	1.2
May-12	8.0	1.4
Jun-12	8.0	1.5
Jul-12	7.9	1.4
Aug-12	7.9	1.6
Sep-12	7.9	1.8
Oct-12	7.8	1.7
Nov-12	7.8	1.5
Dec-12	7.8	1.2
Jan-13	8.0	1.3
Feb-13	7.8	1.2
Mar-13	7.8	0.6
Apr-13	7.8	1.4
May-13	7.7	1.6
Jun-13	7.7	2.1
Jul-13	7.7	1.1
Aug-13	7.6	0.7
Sep-13	7.4	0.7
Oct-13	7.2	0.8
Nov-13	7.2	0.8
Dec-13	7.2	1.0
Jan-14	6.9	1.3
Feb-14	6.8	1.7
Mar-14	6.6	1.8
Apr-14	6.4	0.6
May-14	6.3	0.0
Jun-14	6.1	-0.3
Jul-14	6.0	0.5
Aug-14	6.0	0.6
Sep-14	6.0	0.9
Oct-14	5.9	1.4
Nov-14	5.7	1.8
Dec-14	5.7	2.1
Jan-15	5.6	2.0
Feb-15	5.5	1.9
Mar-15	5.5	2.4
Apr-15	5.6	2.8
May-15	5.6	3.2
Jun-15	5.5	2.7
Jul-15	5.4	3.0
Aug-15	5.3	3.1
Sep-15	5.2	3.1
Oct-15	5.1	2.5
Nov-15	5.1	2.1
Dec-15	5.1	2.0
Jan-16	5.1	2.3
Feb-16	5.1	2.1

Mar-16	5.0	2.2
Apr-16	4.9	2.2
May-16	4.9	2.5
Jun-16	4.9	2.5
Jul-16	5.0	2.4
Aug-16	4.8	2.3
Sep-16	4.8	2.4
Oct-16	4.8	2.4
Nov-16	4.8	2.7
Dec-16	4.7	2.5
Jan-17	4.7	2.2
Feb-17	4.6	2.1
Mar-17	4.6	2.3
Apr-17	4.5	2.1
May-17	4.4	1.9
Jun-17	4.3	2.1
Jul-17	4.3	2.2
Aug-17	4.3	2.3
Sep-17	4.3	2.3
Oct-17	4.3	2.5
Nov-17	4.4	2.5
Dec-17	4.3	2.7