What can wages and employment tell us about the UK's productivity puzzle?[1]

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This paper uses individual data on employment and wages to shed light on the UK's productivity puzzle. It finds that workforce composition cannot explain the reduction in wages and hence productivity that we observe; instead, real wages have fallen significantly within jobs. Why? One possibility we investigate is higher labour supply in this recession than in the past. Another is lower trade union membership. Alternatively, it might be driven by a fall in productivity as a result of a lower capital-labour ratio. We cannot tell whether productivity is driving wages or vice versa, but understanding why wages have fallen within jobs is at the heart of the UK's productivity puzzle.

Key words: productivity, employment, wages, recession

JEL codes: J01, J21

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1   Introduction

The UK has recently experienced its deepest recession since the Second World War, with real GDP falling by over 6% (see Figure 1). At the same time, there have been substantially smaller falls in employment and hours – decreasing by just over 2% and 4% respectively – leading to falling output per worker and stagnating output per hour. These changes are very different to what happened in previous recessions in the UK in the late 1970s/early 1980s and the early 1990s. For example, Figure 2 shows that, nearly five years later, real output per hour remains 3% lower than it was at the start of the recession in 2008, while it was nearly 15% higher following the recession in the early 1990s and nearly 13% higher following the recession in the early 1980s. Although these changes are not dramatically different to what has happened in other European countries (e.g. Disney et al., 2013; Van Reenen, 2013), they have given rise to a so-called "productivity puzzle" in the UK.

Figure 1   Changes to output, employment and hours in the UK since 2008

Source: each of the three series is normalised to 100 at 2008Q1 (quarter 0). Real output is based on ONS series ABMI, which is real GDP seasonally adjusted; employment is based on ONS series MGRZ, which is the total in employment aged 16 and over. Total weekly hours comes from ONS series YBUS.

The aim of this paper is to try to shed light on this puzzle. In a competitive economy, one would expect individuals' wages to reflect their marginal productivities, thus one might anticipate changes in productivity to be correlated with changes in wages at some micro level. Figure 3 provides some supportive evidence for this at the region level during the recent recession, showing a clear positive correlation between changes to average real hourly wages and changes to gross value added per hour between 2007 and 2011. The same is also true at the industry level and Crawford et al. (2013)

also provide some suggestive evidence at firm level, showing that changes in labour costs are able to explain a substantial proportion of the within-firm changes in productivity that occurred in 2008-09.

Figure 2   **Changes to real output per hour in the UK by recession**

Source: each of the three series is normalised to 100 at the labelled quarter 2008Q1, 1990Q2 and 1979Q4 (quarter 0). Sources for real output and hours are the same as in Figure 1.

Figure 3   **Changes to productivity and wages at the regional level in the UK, 2007-11**

Source: % changes to wages come from authors' calculation using the Labour Force Survey by region of workplace. % changes to GVA/hour come from the ONS Regional Labour Productivity revisions, available at http://www.ons.gov.uk/ons/guide-method/method-quality/specific/economy/productivity-measures/labour-productivity/gor-revisions.xls.

At an aggregate level, Figure 4 shows that what has happened to average real hourly wages is similar to what has happened 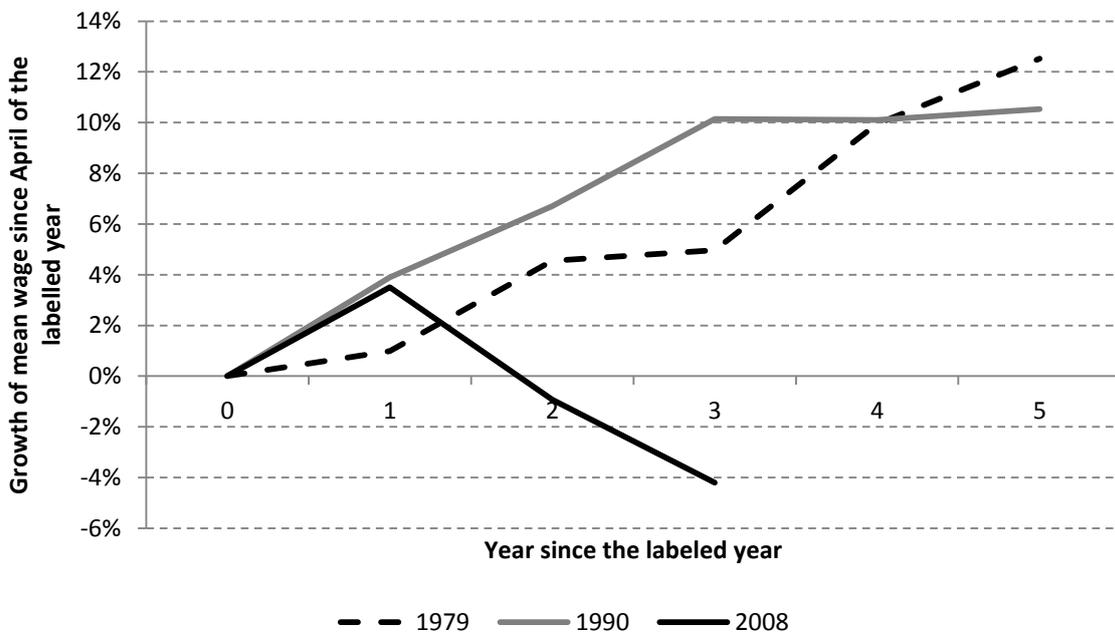to productivity during this recession, and dramatically different from what has happened to wages (and indeed productivity) during previous recessions. For example, in April 2011, average real hourly wages (deflated using the Retail Prices Index) were 4% lower than they were at the start of the recession in April 2008, compared to 5% higher in the early 1980s and 10% higher in the early 1990s.[2] Moreover, these changes have occurred across the distribution. For example, Figure 5 shows that average real hourly wages have fallen by more amongst individuals at the top of the distribution than amongst individuals in the middle and at the bottom of the distribution in this recession[3], while in previous recessions wages continued to grow for individuals at the top of the distribution. This means that earnings inequality has stagnated or even fallen slightly during the recent recession, while it continued to increase during previous recessions.

Figure 4   Changes to average real hourly wages in the UK by recession

Source: New Earnings Survey Panel Dataset, excluding employees whose pay was affected by absence, those with non-positive hours or earnings, and overtime. Nominal wages have been deflated using the Retail Prices Index.

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[2] The magnitude but not the pattern of these differences would change if we used the Consumer Prices Index (CPI) or the GDP deflator to deflate nominal wages. The corresponding figure using the GDP deflator can be found in Disney et al. (2013). The CPI is not available before the early 1990s; it has gone up by 10.9% between April 2008 and April 2011, compared to 9.55% for the RPI.

[3] Stagnation (rather than reductions) in wages at the bottom of the distribution may be at least partly attributable to the floor introduced by the minimum wage in 1999, which has been shown to have helped reduce earnings inequality in the UK (see, for example, Dolton et al., 2012).

Figure 5   The distribution of real hourly wages over time in the UK
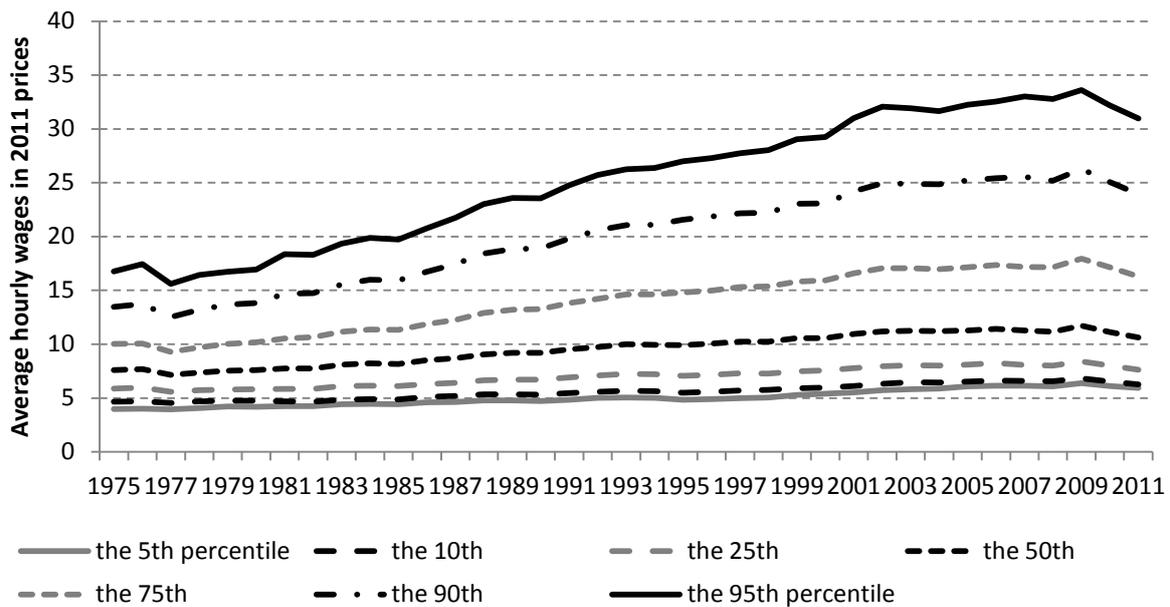

Source: New Earnings Survey Panel Dataset, excluding employees whose pay was affected by absence, those with non-positive hours or earnings, and overtime. Nominal wages have been inflated to April 2011 prices using the RPI.

This paper builds on the growing literature attempting to explain the UK's productivity puzzle (e.g. Goodridge et. al, 2013; Grice 2012; Hughes & Saleheen, 2012; Patterson, 2012; Van Reenen, 2013) by focusing on wages rather than productivity as the outcome of interest (although the two are clearly correlated), and examines three potential explanations for why wages and hence productivity have fallen so much during this recession compared to previous recessions in the UK.

One obvious possibility is that labour supply is substantially greater during this recession than in the past. We know that the population of working age has increased substantially over the last 30 years – from 35.4 million in 1981 to 40.5 million in 2011[4] – a substantial proportion of which is due to net migration.[5] This would mean that there are more individuals willing to work at any given wage and thus that there is likely to be greater competition for jobs. This might mean that workers have lower reservation wages than in the past and that they attach more weight to staying in work (because their expected time to find another job is longer than in the past) than on securing higher wages.

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[4] Source: http://www.neighbourhood.statistics.gov.uk/HTMLDocs/dvc1/UKPyramid.html.

[5] For example, between 2001 and 2011, just over half of the increase in population could be attributed to net migration. Source: authors' calculations based on http://www.ons.gov.uk/ons/rel/pop-estimate/population-estimates-for-england-and-wales/mid-2002-to-mid-2010-revised--national-/sty-components-of-population-change.html. There is, however, relatively little evidence that higher immigration has lead to a reduction in wages amongst the native born population (e.g. Dustmann et al. 2005; Manacorda et al., 2012) and some suggestion that the effect on average wages might even have been positive (e.g. Dustmann et al., 2013).

Section 2 provides some suggestive evidence that labour supply has indeed been more robust in this recession than in previous recessions, particularly amongst older workers (those aged 55-74). These patterns are consistent with recent changes to welfare policy in the UK, such as the increase in the state pension age for women and the greater conditionality attached to benefits claimed by lone parents and disabled workers. Another potential explanation might be that older people have experienced substantial wealth shocks (or shocks to expectations of their future income) as a result of the financial crisis that mean they decide to work for longer, although Section 2 provides only limited support for this hypothesis.

To the extent that labour supply increased amongst individuals with lower productivity, firms may be able to employ more of these low-productive, low-paid workers, or substitute them for more-expensive workers or capital. Thus, one potential cause of both low productivity and low wages at the aggregate level might be a reduction in the average quality of labour. While we do not observe the quality or productivity of workers directly, we can examine this composition hypothesis by looking at the individual characteristics of the workforce over time.

Section 3 investigates how the composition of the workforce changed during this recession compared to previous recessions. We would usually expect the composition of the workforce to shift towards more productive workers during a recession, as a reduction in aggregate demand would typically lead firms to lay off their least productive workers first. This is exactly what we see during this recession too: based on the characteristics we observe, compositional changes should have increased productivity and average wages since 2008, and the magnitude of these changes appears to be as productivity-enhancing, if not more so, than in previous recessions. There is thus strong evidence against the composition or quality-of-labour hypothesis as a potential explanation for the reduction in wages and hence productivity that has occurred during the recent recession.

This suggests that much of the change in wages must have occurred as a result of decreases in the returns to particular characteristics and thus that we would expect wages to have fallen significantly amongst individuals who have stayed in the same job year-on-year. This is indeed borne out by the evidence presented in Section 4, which shows that one third of workers experienced nominal wage freezes or cuts between 2010 and 2011 (12% experienced freezes and 21% experienced cuts) and 70% experienced real wage cuts (on the basis of the Retail Prices Index). Moreover, these experiences were felt across the distribution. So the real question is: why have wages for existing workers been able to fall so much in this recession compared to previous recessions?

Part of the explanation is the substantial increase in labour supply – and hence competition for jobs – that we discussed above. This is consistent with the findings of Gregg et al. (2013), who show that wages have become more responsive to local unemployment rates since the early 2000s. Another likely factor is that the labour market is now substantially more flexible than it was in the 1980s or 1990s. There has been a dramatic decline in trade union membership over the last 30 years, which has reduced the proportion of employees covered by collective bargaining. This appears to have made it easier for employers to hold constant or reduce insiders' wages: nominal wage freezes were more prevalent in jobs without collective agreements and average wages have fallen least amongst those covered by collective agreements at the national or industry level. A third possibility is that employers are capturing a higher proportion of economic rents now than in earlier periods.

A final piece in the puzzle – discussed extensively in Van Reenen (2013) – is that the reduction in productivity might be driven by a reduction in the capital-labour ratio as a result of an increase in the cost of capital (particularly for small and medium sized firms) or the continuing misallocation of capital to less efficient firms or projects. There has certainly been a sharp reduction in business investment over the course of the recent recession, which has been significantly larger than in previous recessions (Benito et al., 2010) and amongst small and medium-sized firms (Crawford et al., 2013). While Crawford et al. (2013) provide some evidence that the reduction in investment can explain only a small proportion of the within-firm changes in productivity in 2008-09, it is plausible that reductions in productivity resulting from a fall in the capital-labour ratio also contributed to reductions in real wages and hence labour costs, which Crawford et al. (2013) find to be the primary driver of productivity falls.

This paper now proceeds as follows: Section 2 presents evidence on changes to labour supply (and their determinants) over the short- and longer-term. Section 3 considers the extent to which changes to the composition of the workforce might explain the fall in real wages that we observe. Section 4 documents and discusses potential explanations for the substantial proportion of nominal wage freezes and cuts that have occurred within jobs. Section 5 concludes.

2   How has labour supply in the UK changed over time?

This section uses a range of individual-level micro-data to examine whether labour supply has been greater or more resilient in the recent recession in the UK compared to previous recessions.[6]

We start by comparing employment rates across recessions by gender, age group and highest educational qualification. We also document what has happened in terms of self-employment. We
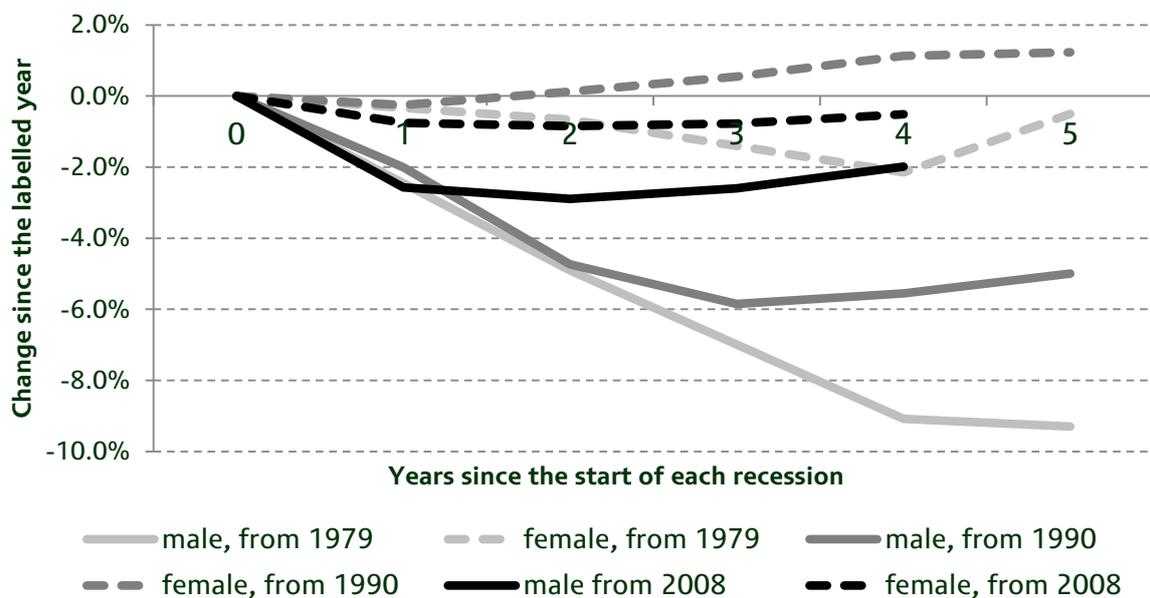
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[6] Appendix 1 offers a brief description of the key data sources used in this analysis.

then move on to examine the drivers of increases in labour supply for particular demographic or socio-economic groups, including older people (those aged 55 and over) and lone mothers.

The big picture: employment rates

Figure 6 looks at what happened to the proportion of the working-age majority (those aged 23-64) in work during and after the recessions starting in 1979, 1990 and 2008, separately for males and females. This recession saw a smaller fall in the proportion of men in work than in previous recessions, with 3% fewer men in work two years after the start of the recession, compared to 6% after three years in the 1990s and nearly 10% after five years in the 1980s. This pattern arises both from a smaller increase in the proportion of men that are unemployed than in previous recessions and no change (rather than an increase) in the inactivity rate.

Figure 6   Changes to the employment rates of 23-64 year olds in the UK by recession
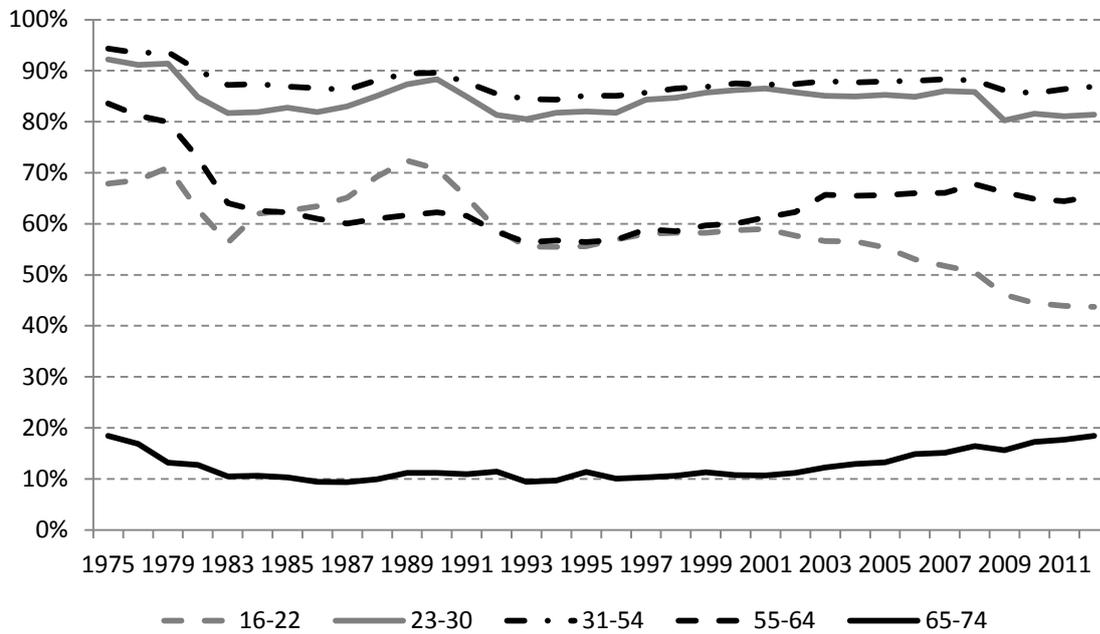

Source: Labour Force Survey. No data point for 1980 or 1982. Quarter 2 is used for years since 1992.

In contrast to men, the pattern in terms of the proportion of women in work (and participating in the labour market) does not differ dramatically across recessions, although the proportion of women that are unemployed has been slightly higher in this recession than in previous recessions. This picture does not change if we account for the increasing labour market participation of women over time by taking a linear or quadratic trend out of the employment time series.

Figure 7 analyses the changes in male employment rates in more detail, by showing how different age groups have been affected over time. It is clear that most groups have experienced smaller declines in employment in this recession compared to previous recessions, but that this difference is

particularly striking for those aged 55-64, especially compared to the recession of the early 1980s. The more robust participation rates amongst older men are also evident for those above state pension age, with the employment rates of 65-74 year old men continuing to rise over time.

Figure 7   Male employment rates over time in the UK by broad age group

Source: Labour Force Survey. No data point for 1980 or 1982. Quarter 2 is used for years since 1992.

Figure 8   Employment rate of those aged 16-22 vs. 23-64 in the UK by recession

Source: Labour Force Survey. No data point for 1980 or 1982. Quarter 2 is used for years since 1992.

Figure 7 also shows that the employment rates of young people tend to be hardest hit during a recession, and Figure 8 brings this into sharp relief by comparing the employment rates of those

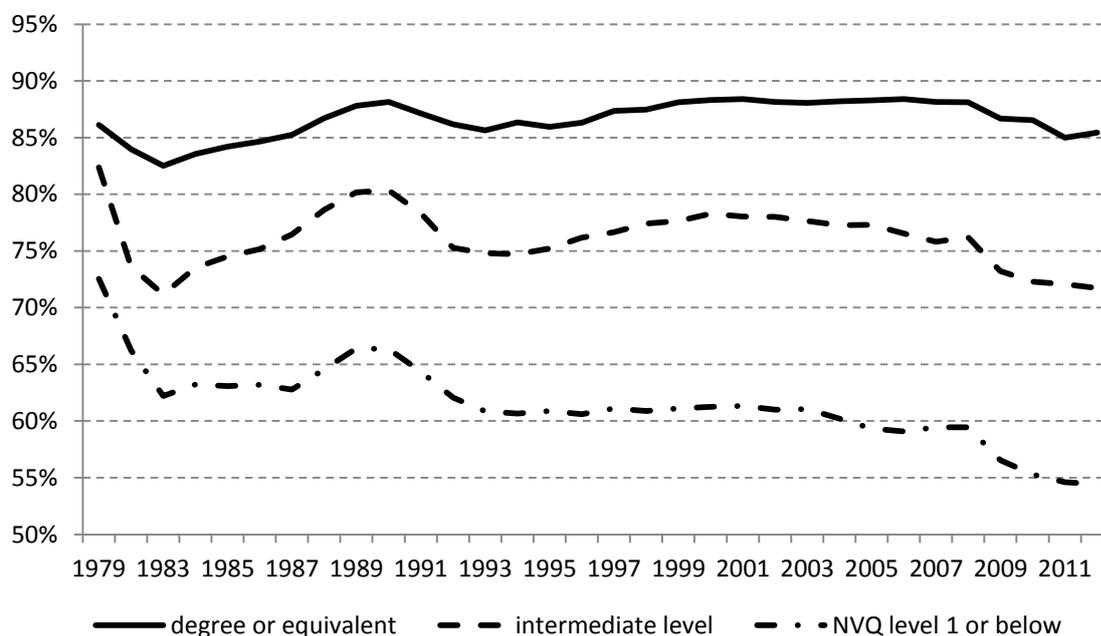aged 16-22 and 23-64 through the first five years during and after the recessions starting in 1979, 1990 and 2008. It emphasises that young people's employment rates do indeed fall substantially more than those of prime age workers, but that, in line with the overall picture, the employment rates of young people have fallen less in this recession compared to previous recessions: for example, four years after the start of most recent recession, just over 6% less young people are in work, compared to 11% less after the 1980s recession and 13% less than after the 1990s recession. This may be partially (but not entirely) explained by higher education participation rates amongst young people in this recession than in previous recessions, particularly amongst 16-17 year olds.

Finally, Figure 9 shows that, as is typical during a recession, employment rates fell by more amongst lower-skilled individuals than amongst higher-skilled individuals. The employment rate of those with less than 5 GCSEs at grades A*-C or equivalent (the benchmark typically required for young people to continue beyond compulsory schooling in the UK) fell by 5 percentage points between 2008 and 2012 (from 59% to 54%), having never recovered following the 1990s recession. This compares to a reduction of 4 percentage points amongst those with intermediate qualifications and 2 percentage points amongst those with a university degree or equivalent.

Figure 9   Employment rates by level of highest qualification

Source: Labour Force Survey. No data point for 1980 or 1982. Quarter 2 is used for years since 1992. Sample restricted to 16-59 year olds, as the questions about qualifications were not applicable to those aged 60 and above in some years.

The self-employed

It has been hypothesised that one reason why the proportion of individuals in work has not fallen further during the most recent recession in the UK is because there has been an increase in the

proportion of self-employed workers with very low incomes, who may be regarded as the "hidden unemployed". It is certainly the case that a substantial proportion of workers are self-employed: Figure 10 shows that this figure is at an historical high (of 14% in 2012 according to the ONS figures and 13% in 2010 according to the Family Expenditure Survey).

Figure 10   Proportion of workers who are self-employed in the UK over time

Source: the FES trend presents figures from the Family Expenditure Survey, 1979-2010; the ONS trend comes from annual ONS statistics on the number of self-employed (series MGRQ) and the total number in work (series MGRZ).

Figure 11   Proportions of self-employed individuals with low self-employment income
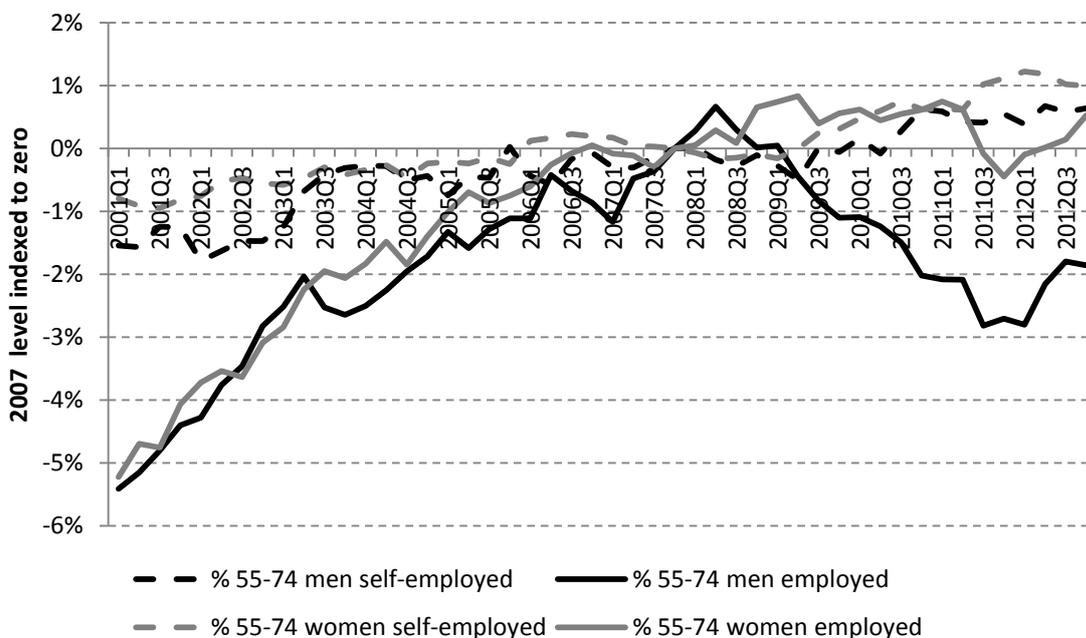

Source: authors' calculation using the Family Expenditure Survey. The first two thresholds are the 10th percentile and the 20th percentile of the non=zero distribution of gross earnings in the year.

Figure 11 also shows that there has been an increase in the proportion of self-employed workers who earn less than employees at the lower end of the earnings distribution (on various measures) since 2008.[7] Thus, while the pro-cyclicality of self-employment earnings is to be expected, an increase in the proportion of low-paid self-employed workers – particularly at a time when average real hourly wages are falling (see Figures 5 and 6) – provides some suggestion that an increasing proportion of self-employed workers would be better off as employees and thus that at least part of the reason why they are self-employed may be because they cannot find appropriate employment. It is not clear that this is happening to a greater extent now than in previous recessions though.

The older generation

We saw in Figure 7 that the proportion of 55-74 year old men in work had been broadly flat or even increasing over the course of the recent recession. Figure 12 shows how this is broken up into employment and self-employment for men, and presents the same breakdown for women in this age group as well. It shows that the overall picture for men is driven by a fall in the proportion in employment (of similar magnitude to that for prime age men) and a rise in the proportion that are self-employed. The proportion of 55-74 year old women in self-employment has also risen since 2007, and there has been a less marked decline (and even a small overall increase) in the proportion in employment over the same period.

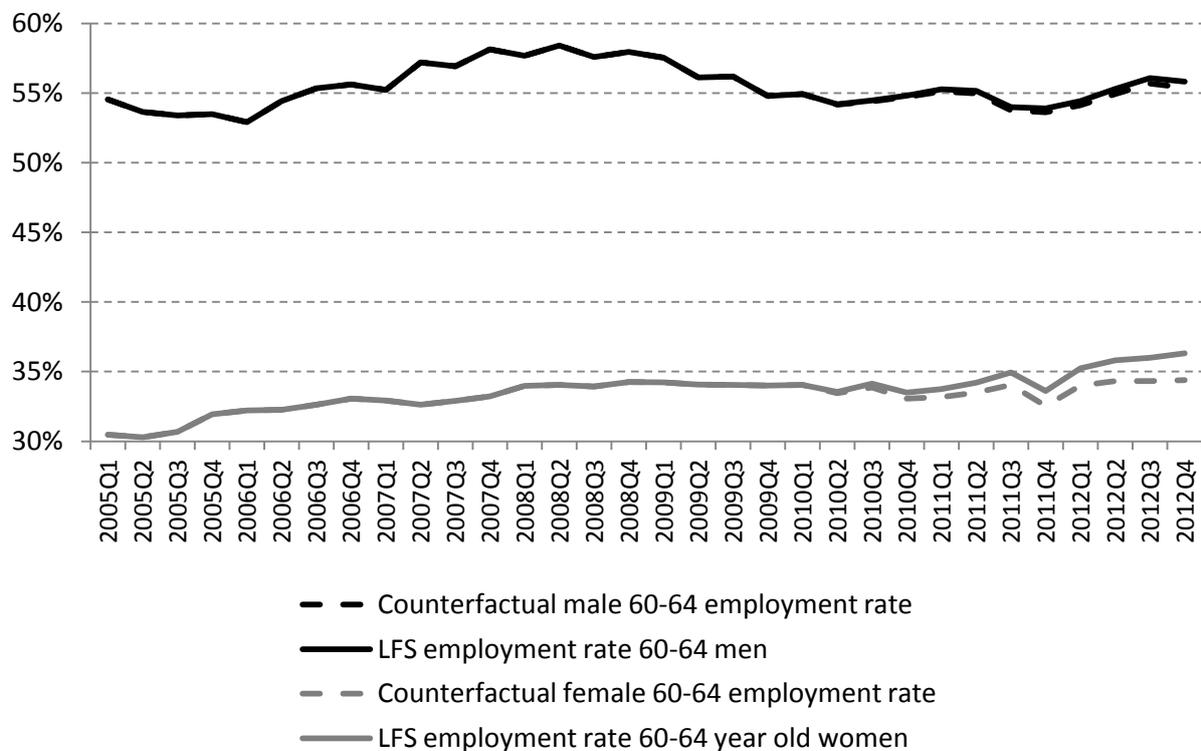**Figure 12   Employment and self-employment rates of 55-74 year olds by recession**

Source: authors' calculations using quarterly Labour Force Survey.

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[7] The 10th percentile of non-zero earnings was around £116 per week in 2010.

Some of the increase in labour market participation among older people can potentially be explained by the increase in the state pension age for women from 60 towards 65, beginning in the second quarter of 2010. Figure 13 uses estimates of the impact of the policy from Cribb et al. (2013) to calculate counterfactual employment rates for men and women – i.e. what we would have expected their employment rates to look like in the absence of the policy – and compares this to the actual employment rates observed. It shows that the raising of the state pension age accounts for almost the entire rise in employment rates among 60-64-year-old women since 2010, and a smaller proportion of the rise in male employment rates as well, as the partners of affected women delay their retirement as well.

Figure 13   Employment rates of 60-64 year old men and women, and estimated counterfactual rates without the State Pension Age increase

Source: quarterly Labour Force Survey combined with estimates of the impact of the policy from Cribb et al. (2013).

Overall, however, the raising of the state pension age for women can explain only a small proportion of the aggregate rise in labour supply among older people. As we saw in Figure 12, employment and self-employment rates, particularly for women, held up reasonably well throughout the recession, even before the policy was introduced in 2010 (although this could potentially be at least partially explained by anticipation effects). More importantly, employment rates among women who are already above state pension age – and thus are unaffected by this policy – have also risen since 2008. Figure 14 shows that this increase has been particularly strong among 65-69 year olds.

Figure 14   Changes to employment rates among older women relative to 2007Q4

Source: Quarterly Labour Force Survey. "In work" includes both employment and self-employment.

Another plausible explanation for the increasing employment rates among older people may be that they have increased their labour supply in response to unexpected wealth shocks (and/or lower expectations of future income from assets) as a result of the financial crisis. Banks et al. (2012) estimate the effect of the financial crisis on the finances of those aged 50 plus using the English Longitudinal Study of Ageing (ELSA). They document the magnitude of changes to observed housing and financial wealth between the Wave 3 and 4 interviews (which took place in May 2006-August 2007 and June 2008- July 2009) and also attempt to simulate the magnitude of shocks to housing and risky financial assets that respondents might have experienced between the height of the boom (May 2007) and the depth of the recession (March 2009), as well as between the Wave 3 and Wave 4 interviews.[8]

Housing wealth shocks were simulated on the basis of self-reported house value in Wave 3 and regional house price indices, whereas shocks to risky financial assets were estimated on the basis of holdings of risky financial assets and defined contribution pensions in 2006-07 and two stock market (FTSE) indices. The peak-to-trough shocks are likely to capture the largest change in assets that households might have experienced as a result of the financial crisis, but rely only on initial asset holdings, plus regional variation in house prices and national variation in stock market indices to generate variation in the magnitude of the shocks. By contrast, the Wave 3 to Wave 4 simulations

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[8] These two periods overlap to a large extent. For most respondents, the Wave 3 interviews took place a few months before May 2007 and the Wave 4 interviews took place a few months before March 2009.

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introduce additional variation arising from the timing of the interviews, but may not fully capture the change in assets experienced over the course of the recession.

We focus on individuals aged 55-74 and use the estimates from Banks et al. (2012) to document the relationship between changes to wealth and subsequent labour supply. Specifically, we investigate whether variation in the magnitude of changes to wealth (relative to initial asset holdings) can help to explain differences in employment status in 2010-11 (Wave 5), conditional on employment status in 2006-07 (Wave 3) and a range of other individual characteristics. In doing so, we build on the work of Crawford (2011), who looked at the impact of wealth shocks on retirement intentions. We consider both observed and simulated changes to wealth, as while real data will undoubtedly provide a more accurate reflection of the changes in wealth that respondents actually experienced, simulated wealth shocks may better capture the unanticipated effects of the financial crisis on household wealth, since individuals may save or dis-save over time in response to expected as well as unexpected changes in their circumstances.

Table 1 reports the results from three regressions run using a linear probability model[9], in which the outcome is whether an individual is in paid work (including self-employment) in 2010-11, and the key covariates of interest are dummy variables indicating the quintile of the distribution of relative changes to financial wealth into which the individual falls. Table 2 reports results from similar analysis using quintiles of the actual or simulated change in housing wealth as the key covariates of interest. In each case, the omitted category is those who experience (or are simulated to experience) the smallest negative wealth shocks as a proportion of their total wealth.

Both tables highlight that there was considerable variation in the magnitude of changes to financial and housing wealth that were experienced or that might have been expected on the basis of regional or national trends, given initial wealth. For example, Table 1 shows that, from peak-to-trough (May 2007 to March 2009), amongst the fifth of the sample who were hardest hit, the simulated financial wealth shock amounted to a fall of 10.5%, on average, while two fifths of the sample experienced no change in financial wealth. The relevant range in terms of housing wealth shocks (shown in Table 2) was from -10.5% amongst the 20% worst affected to -0.5% amongst the 20% least affected. Between Waves 3 and 4 (which occurred a few months before the peak-to-trough period for most respondents), the simulated shocks were less negative, on average, in terms of both financial and housing wealth, with those who were expected to be hit least hard experiencing positive rather than zero or negative changes. In terms of housing wealth, these

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[9] Estimates from a probit regression model show a similar pattern to those obtained from a linear probability model, but the magnitudes differ.

differences seem to stem from the general house price growth that occurred just before May 2007 and the fall that occurred in months leading up to March 2009. It is also clear that actual changes to self-assessed financial and housing wealth between Waves 3 and 4 are significantly more varied than simulated changes for the same period, with the hardest hit (bottom quintile) reporting falls of 13.4% and 20.1%, on average, in financial and housing wealth respectively, while the top quintile reported increases of 23.2% and 17.7% respectively.

Table 1   **Effect of simulated and actual changes to financial wealth between 2007 and 2009 on employment status in 2010-11 among 55-74-year-olds**

	Simulated change: May 2007 to March 2009		Simulated change: Wave 3 to Wave 4		Actual change: Wave 3 to Wave 4	
	% change	Effect of change on employment	% change	Effect of change on employment	% change	Effect of change on employment
Bottom quintile: most negative change	-10.5%	-0.023 [0.016]	-4.8%	-0.020 [0.024]	-13.4%	0.006 [0.016]
2nd quintile	-3.5%	0.001 [0.015]	-0.9%	-0.025 [0.024]	-1.4%	0.009 [0.016]
3rd quintile	-1.1%	-0.008 [0.015]	-0.2%	-0.004 [0.023]	0.0%	0.011 [0.017]
4th quintile	0.0%	(omitted)	0.0%	0.004 [0.023]	0.9%	0.012 [0.018]
Top quintile: least negative change (reference category)	0.0%	(omitted)	0.6%	(omitted)	23.2%	(omitted)
Observations	4,286		4,286		4,286	
R-squared	0.523		0.524		0.523	

Notes: "% shock" shows simulated shock as a proportion of initial total wealth, averaged within the quintile as defined by the proportional shock. Controls include whether the person was in work, looking for work, or inactive in 2006-07, quarter of interview in 2006-07 and 2010-11, dummies for 5-year-age-band in 2010-11 separately for each gender, and individual characteristics measured in 2006-07: highest qualification, marital status, whether the person reports a long-term illness, a work-limiting illness, a temporary illness, whether the person owns their home outright or with a mortgage, or whether they rent, household size, whether has children and whether they think they can rely on the children. Robust standard errors are reported in brackets. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

Despite substantial variation in actual and expected changes to financial and housing wealth between 2007 and 2009, however, Table 1 shows that financial wealth changes do not appear to affect the likelihood of being in work two years later, while Table 2 shows that the estimated effects of housing wealth changes vary across the three measures used. For example, in Column 1 of Table 2, the peak-to-trough measure suggests that there is a clear positive and monotonically increasing effect of wealth shocks on employment status: relative to the 20% of the sample whose housing wealth decreased least as a share of initial total wealth, the 20% who lost most were 11.6% significantly more likely to be in work in 2010-11, compared to 10% more likely for the next 20% and 9% more likely for the middle quintile. It seems intuitive that older people may be more inclined to work for longer if their house loses value and if housing accounts for a larger share of their total

wealth[10], and these estimates imply a sizeable labour supply elasticity with regard to housing wealth of about -1. If people had been expecting no nominal change to their housing wealth (on average), then these estimates would translate into an aggregate employment effect of negative housing wealth shocks of 4.8% on 55-74 year olds. However, it seems likely that people would have expected house prices to appreciate in nominal terms, in which case 4.8% would underestimate the resultant positive employment effects.

Table 2   Effect of simulated and actual changes to housing wealth between 2007 and 2009 on employment status in 2010-11 among 55-74-year-olds

	Simulated change: May 2007 to March 2009		Simulated change: Wave 3 to Wave 4		Actual change: Wave 3 to Wave 4	
	% change	Effect of change on employment	% change	Effect of change on employment	% change	Effect of change on employment
Bottom quintile: most negative change	-10.5%	0.116*** [0.031]	-5.7%	-0.001 [0.022]	-20.1%	0.001 [0.017]
2nd quintile	-7.4%	0.100*** [0.030]	-2.8%	-0.005 [0.020]	-3.5%	-0.012 [0.017]
3rd quintile	-5.7%	0.090*** [0.029]	-0.3%	-0.013 [0.021]	0.0%	-0.020 [0.018]
4th quintile	-4.0%	0.055* [0.029]	0.6%	-0.047*** [0.018]	2.3%	-0.030 [0.020]
Top quintile: least negative change (reference category)	-0.5%	(omitted)	3.1%	(omitted)	17.7%	(omitted)
Observations	4,205		4,205		4,205	
R-squared	0.527		0.525		0.524	

See Notes to Table 1.

However, the estimates from the other two measures of housing wealth changes are qualitatively different. They point to near-zero effects of housing wealth changes on employment. Further, if we restrict the sample to home-owners who did not move house, the estimated effects of actual housing wealth changes would still be small and insignificant. The contrast between the first and second sets of estimates is particularly surprising, given that the only difference between the two measures is the time period. One possibility is that the first measure relies too heavily on regional variation in house prices which could be highly correlated with differential employment opportunities across regions. This seems unlikely, however, as the regions with the most resilient

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[10] We found some preliminary evidence that these wealth effects vary significantly by gender, whether the person has a long-term illness, and whether they are above state pension age. We also found some preliminary evidence that the estimates would be smaller and less significant if we focus on employment rather than paid work. This means that self-employment might be an important channel through which older individuals adjust their labour supply in response to wealth shocks. These differences should be investigated more comprehensively in future.

house prices (e.g. London) are also the ones which saw more of an increase in employment. On the basis of these contradictory results, therefore, we remain agnostic about the relationship between housing wealth shocks and employment among older people.

Welfare recipients

A number of changes have been made to the welfare system in the UK in recent years in order to try to encourage various groups of claimants to start or return to work. For example, the benefit available to individuals who are too sick or disabled to work was reformed in 2008 in order to introduce stricter work capability tests, plus job search requirements as a condition of continuing receipt for those who are deemed capable of returning to work.[11]
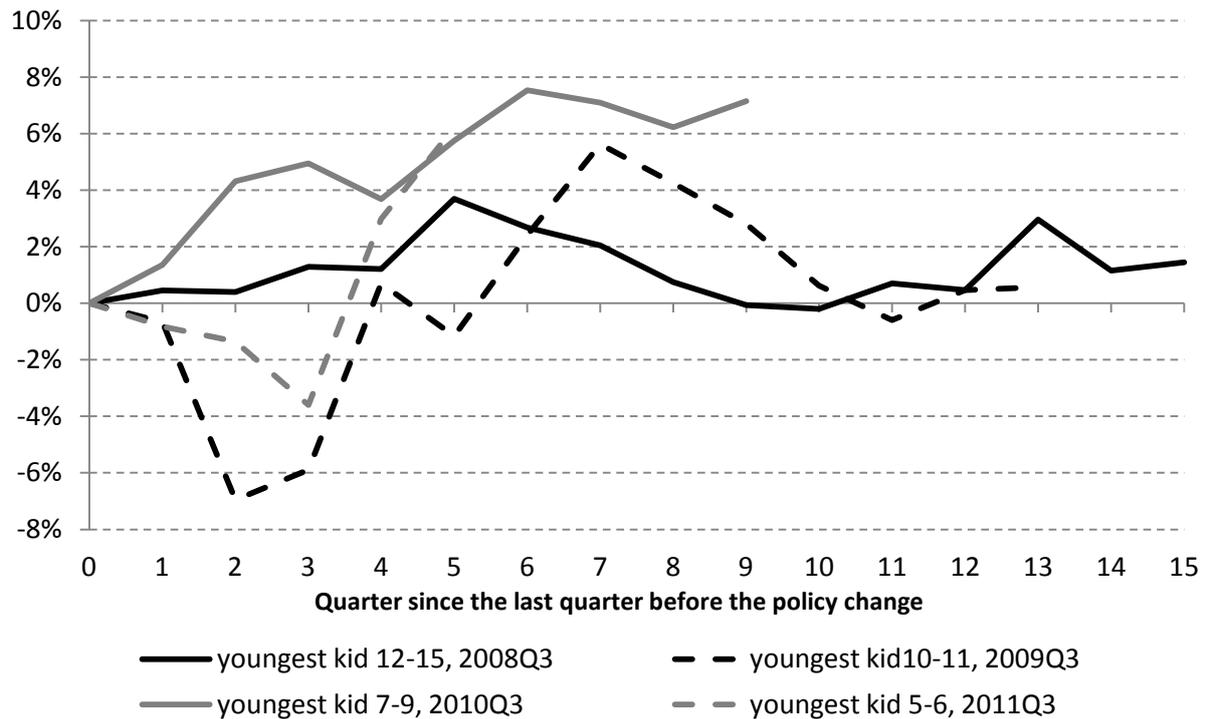
Changes have also been made to the benefits that can be claimed by out-of-work lone parents. Before November 2008, most lone parents who were not in work could claim a benefit for those on low incomes with no job search conditions attached (Income Support). In order to encourage lone parents to work, however, it is no longer possible to claim Income Support if their youngest child is above a certain age limit. This means that out-of-work lone parents with older children must instead claim Jobseeker's Allowance, which is a benefit of equivalent value, but that has strict job search conditions attached. The age limit for youngest child was set at 12 in November 2008 for all new claimants of Income Support, and was lowered to 10 in October 2009, seven in October 2010 and five in October 2011. For lone parents who were already claiming Income Support, the changes were phased in over a year from the date of policy change for new claimants.

Previous research has suggested that lone parents are a group whose labour supply is particularly sensitive to welfare policies. For example, they are often the group found to be most responsive to childcare subsidies (e.g. Cascio, 2009; Fitzpatrick, 2012) as well as the in-work support offered via tax credits (e.g. Blundell & Hoynes, 2004; Blundell et al., 2000, 2008; Brewer, 2001; Brewer et al., 2006). The changes in participation and employment rates amongst lone parents that have occurred since the introduction of this policy provide some tentative descriptive evidence that these reforms may be having a similarly positive effect on labour supply now, in spite of the recent recession.[12]

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[11] These changes were heralded by the switch from Incapacity Benefit to Employment Support Allowance for new claimants in 2008. For further details of the old and new benefit regimes, see Browne & Hood (2013).
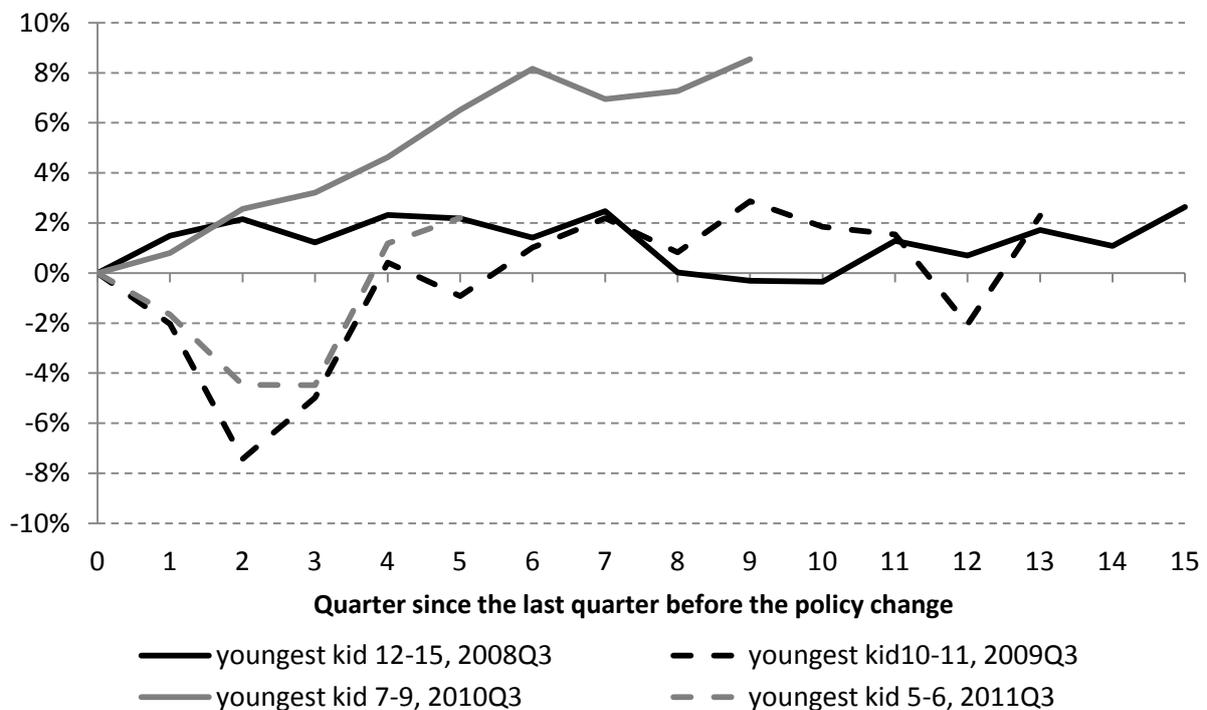[12] A formal evaluation of this policy change is being carried out by researchers at the Institute for Fiscal Studies and is expected to report in a few months time.

Figure 15   De-trended change in lone mothers' labour market participation rates since the policy change, by age of youngest child

Source: Quarterly Labour Force Survey. Sample restricted to lone mothers aged between 20 and 54. De-trended labour market participation rates are calculated by regressing participation on three quarterly dummies and year between 2001Q1 and 2012Q4 and plotting the residuals.

Figure 16   De-trended change in lone mothers' employment rates since the policy change, by age of youngest child

Figure 15 plots the change in labour market participation rates of lone mothers since the policy change for the four groups of interest (split according to age of youngest child), after taking out seasonal effects and a linear time trend.[13] Figure 16 does the same for employment rates. Both participation and employment rates appear to have increased strongly (by around 8-9%) amongst lone mothers whose youngest child is aged 7-9 since the policy change occurred for this group. There are relatively smaller changes for other groups, but in most cases participation rates are higher than employment rates. Thus, while this is not a formal evaluation of the effects of these policy changes, it seems plausible that they would have lead affected lone parents to engage in more job search activities, a smaller proportion of which would have resulted in a successful job match.[14]

3   Can changes to the composition of the workforce help explain falls in productivity?

Section 2 provided some descriptive evidence that labour supply has been greater in this recession than in previous recessions, particularly amongst older people and certain types of welfare recipients, such as lone parents. If such individuals were found to have relatively lower productivity, on average, than the existing workforce, then it is possible that this increase in labour supply could reduce the average productivity of the workforce, as more productive (and presumably more expensive) workers are replaced by cheaper, less productive workers. If this were to have been the case, then this composition (or aggregate quality of labour) hypothesis might provide a potential explanation for the UK's so-called productivity puzzle.

Assuming that individual wages proxy individual productivity, then we may be able to help shed light on this puzzle by quantifying how much of the aggregate change in wages (and hence productivity) can be explained by changes to the composition of the workforce (as measured by observed individual characteristics, X, such as age and occupation) and how much is due to changes to the parameter values associated with (or "returns" to) particular characteristics (e.g. education). To do so, we run separate wage equations at the start and end of the period of interest and then carry out a simple Oaxaca decomposition, as per equation 1:

$$\widehat{Y1} - \widehat{Y0} = \widehat{\beta 1}(X1 - X0) + (\widehat{\beta 1} - \widehat{\beta 0})X0 \tag{1}$$
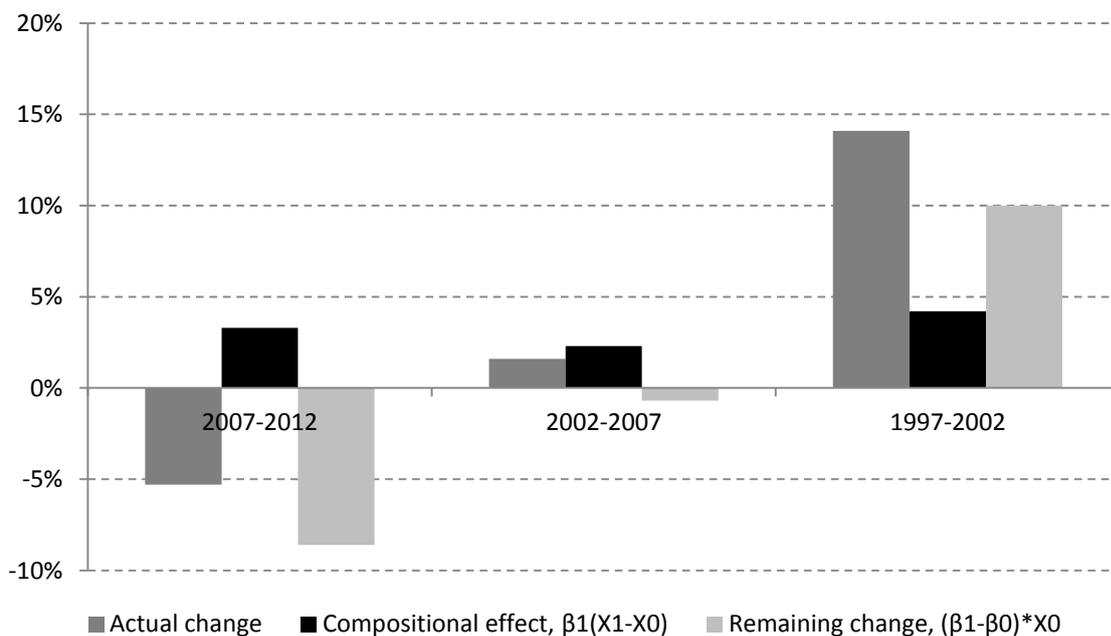
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[13] For each group, we regress a binary outcome (e.g. employment) on three quarterly dummies and year between 2001Q1 and 2012Q4. The figure shows changes to residuals since the labelled quarter.

[14] Alternatively, people may simply be more inclined to report that they are available and seeking work in surveys when their benefit entitlement requires them to do so.

To investigate the extent to which a shift towards less productive workers might help to explain the fall in productivity during the recent recession, we run wage equations in 2007 and 2012 using data from the Labour Force Survey (LFS), which contains a reasonably rich set of individual characteristics, including gender, age, education, family composition, region, industry, occupation and tenure. Figure 17 presents the results of this analysis, and compares the results for 2007 to 2012 with those over two recent boom periods: 1997-2002 and 2002-2007.

Figure 17 shows that between 2007 and 2012, mean log wages fell by 5.3% in real terms (i.e. the aggregate change was -5.3%). Of this, +3.3% could be explained by compositional changes: in other words, on the basis of changes to the characteristics of individuals in the workforce and the jobs that they do, we would have expected wages to increase by 3.3%, all other things being equal.[15] This means that none of the aggregate wage fall can be explained by changes to the composition of the workforce on the basis of characteristics that we observe and hence must instead all be due to changes to the parameter values associated with (or returns to) particular characteristics instead.

Figure 17   Decomposing changes in real log hourly wages into changes in the composition of the workforce and changes to the returns to particular characteristics, 1997 to 2012

Notes: observations missing any individual characteristics are dropped from the analysis. Regressions are weighted by the income weight in LFS. Age bands are 16-17, 18-24, 25-34, 35-44, 45-54, 55-64, 65+. There are three categories of highest qualification: degree and equivalent, secondary (e.g. A levels, A*-C GCSEs), and elementary/none. There are 6 categories for number of kids, from 0 to 5+. Age of youngest child has 18 dummies. Occupation has 9 groups according to SOC. Industry is at SIC 1992 section level.

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[15] One might expect the compositional effect to be more positive during recessions if lower-skilled lower-paid workers are laid off first or hiring at the junior level stops, but this does not seem to be the case here, as the contribution made by changes to the composition of the workforce is approximately similar in 2007-2012 as it was on average over the preceding decade.

Another way of saying this is that the vast majority of the change in wages must have occurred amongst those who stay in work across periods, rather than because of flows into or out of work. This is exactly what we see in Figure 18, which plots year-on-year percentage changes in average real hourly wages and decomposes this into the amount accounted for by flows into employment, the amount accounted for by flows out of employment and the amount accounted for by those who stay in employment. Mechanically, this can be calculated as follows:

$$\text{Meanwage}_t - \text{meanwage}_{t-1} = n3/(n3+n2)*(w3_t-w2_t) +n1/(n1+n2)*(w2_{t-1}-w1_{t-1}) +(w2_t-w2_{t-1}) \qquad (2)$$

where n1 is the number of people in work at time t-1 but out of work at time t, n2 is the number of people in work at both time t-1 and time t, and n3 is the number of people who are not in work in t-1 but are at time t; w1, w2, w3 represent average wages of the groups at specified time points.

The first component of equation 2 is the change in average wages arising from inflows, the second the change arising from outflows, and the third the change that occurs within existing workers. We would expect the inflow contribution to be negative, because new recruits tend to be lower paid than existing workers.[16] By contrast, we would expect the outflow contribution to be positive, because those leaving work also tend to be lower paid than those who stay on. Given the relative size of each of these groups[17], it is perhaps unsurprising that the aggregate change in real hourly wages is driven largely by what happens to those who remain in work year-on-year, which is exactly what Figure 18 (and indeed Figure 17) suggests.
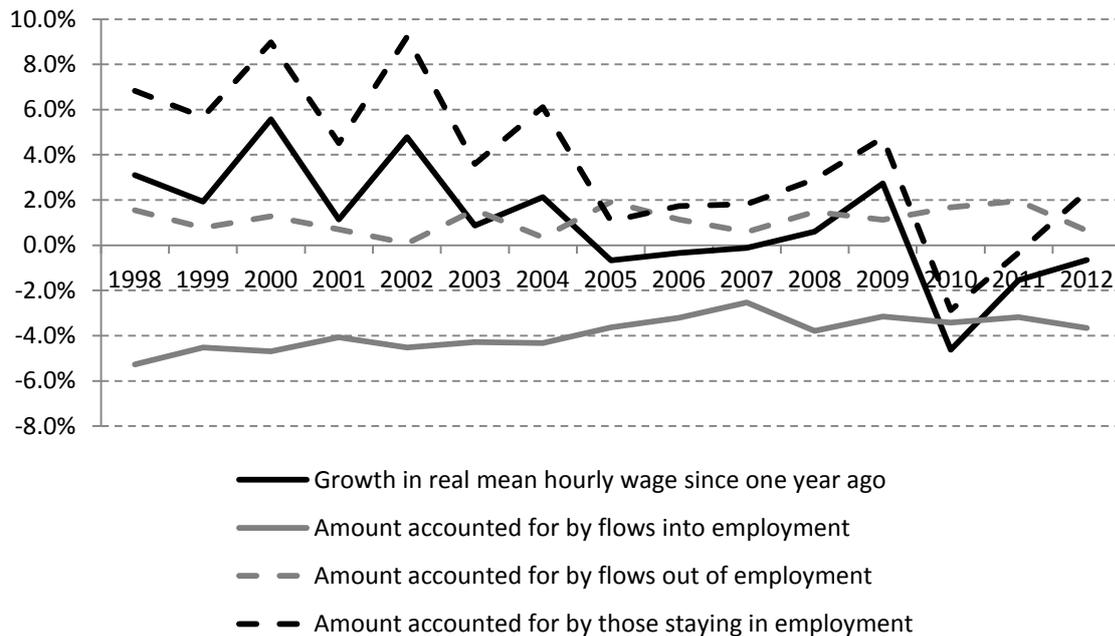
For this to help us to understand why the labour market performance of this recession has been so different to previous recessions, we would expect the picture presented by these decompositions to vary by recession. To examine whether this is the case, we run a series of Oaxaca decompositions for each of the recessionary periods of interest (1980-83, 1990-93 and 2007-10) using data from the Family Expenditure Survey, the results of which are shown in Figure 19.[18]

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[16] This is largely because workers entering the labour market are relatively inexperienced (or have been out of work for a period of time), but a small part of this may be attributable to the fact that an increasing proportion of the jobs created each year are temporary rather than permanent positions, which tend to be lower paid.

[17] Each year, around 7-10% of all current workers were not in work one year ago and 6-9% of current workers will not be in work one year later.
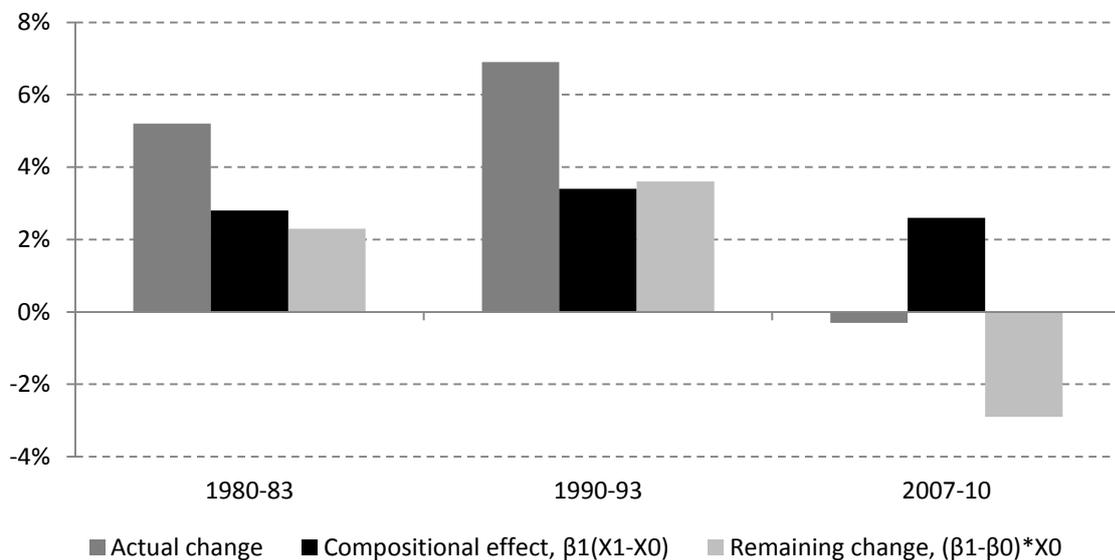
[18] We use data from the Family Expenditure Survey (FES) because wages are not collected this far back in LFS. The FES contains similar individual characteristics to the LFS, but fewer job characteristics. At the time of writing, the latest year for which FES data is available is 2010.

Figure 18   Decomposition of aggregate year-on-year real hourly wage growth into inflows, outflows and those who stay in employment, 1998-2012

Growth in real mean hourly wage since one year ago

Amount accounted for by flows into employment

Amount accounted for by flows out of employment

Amount accounted for by those staying in employment

Source: Labour Force Survey. Wages are deflated using the RPI and are scaled to be consistent with quarterly cross-sectional figures; however, we would get a qualitatively similar picture if we did not apply such scaling.

Figure 19   Decomposing changes in real log hourly wages into changes in the composition of the workforce and changes to the returns to particular characteristics, 1980 to 2010

■ Actual change   ■ Compositional effect, $\beta_1(X_1-X_0)$ ■ Remaining change, $(\beta_1-\beta_0)*X_0$

Source: Family Expenditure Survey. Age, number of children and age of youngest child are accounted for in the same way as described in Figure 16. Age when ceased education is controlled for by dummies for individual years between 15 and 25.

Figure 19 shows that while the compositional effect in this recession is estimated to be less positive than in previous ones, the difference is very small relative to the difference in actual wage growth in each period. What is strikingly different about this recession compared to previous ones is that the
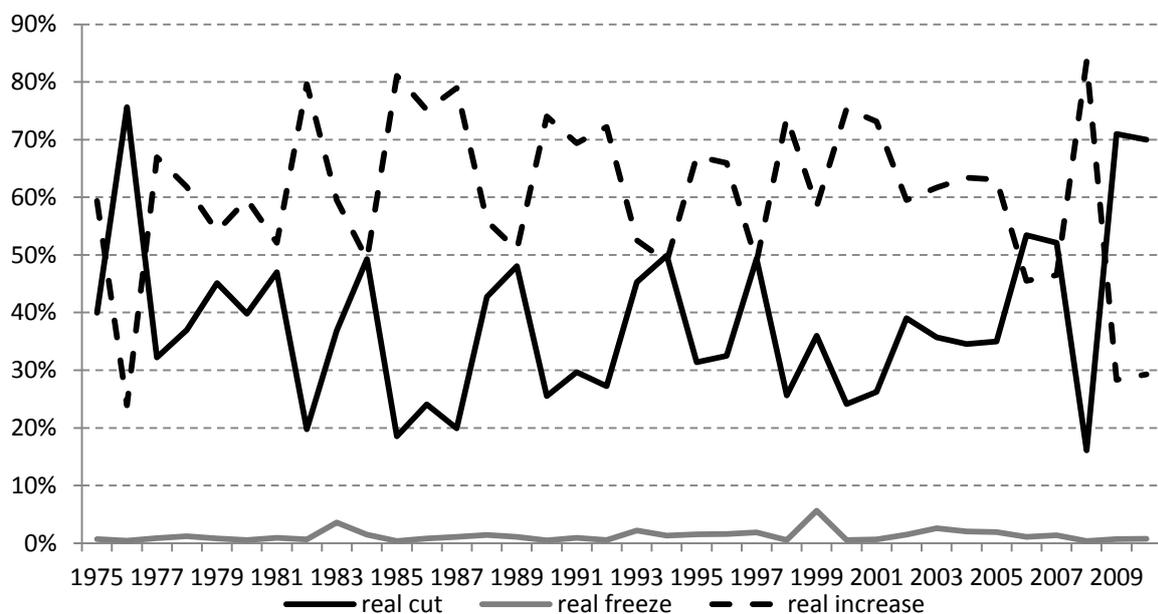
parameters associated with (or returns to) individual characteristics have fallen dramatically in this recession, while they remained strong and positive in previous recessions. In other words, changes in the composition of the workforce cannot explain why real wages continued growing in the recessions of the early 1980s and 1990s but stagnated in the current downturn; instead we must try to explain why wages have fallen so dramatically amongst existing workers in this recession.

4   What has happened to nominal and real wages during the recent recession?

This section documents in more detail what has happened to nominal and real wages over the course of the recent recession and how this differs from previous recessions. It also attempts to provide some potential explanations for the differences that we observe.
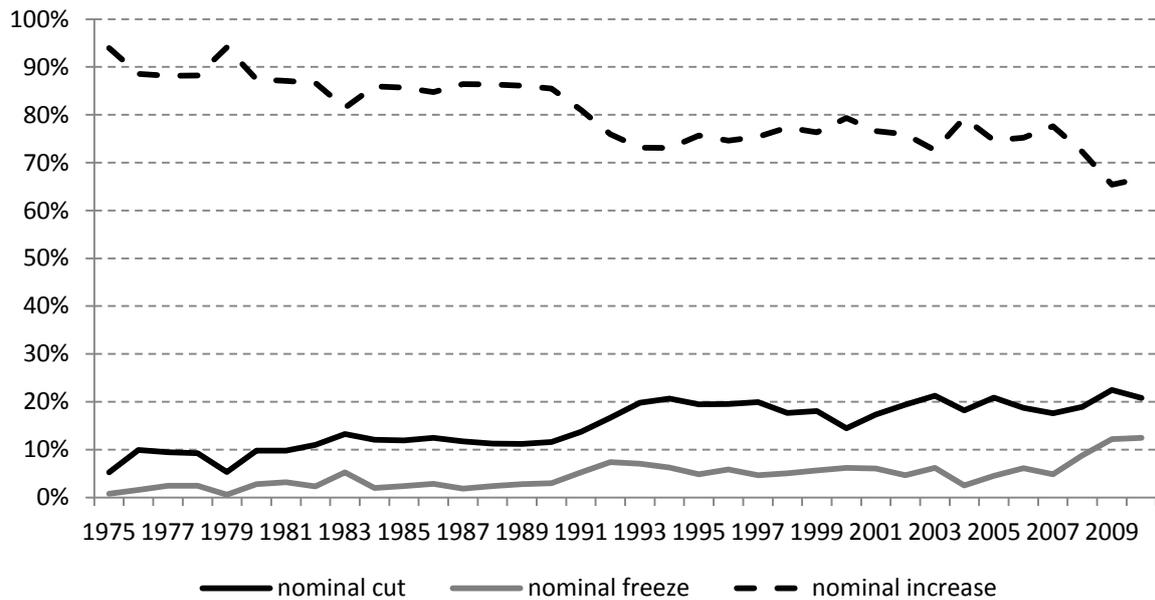
The first thing to note is that the reduction in average real hourly wages amongst existing workers documented in the previous section is not just being driven by individuals being made redundant and having to take lower paid jobs: there is also strong evidence of substantial nominal and real wage reductions occurring *within jobs*. Figures 20 and 21 focus on individuals who are in the same job as one year ago (which covers around 80% of workers throughout the period) and document the proportions of individuals whose hourly pay was cut, frozen or raised compared to a year ago in real terms (on the basis of the Retail Prices Index) (Figure 20) and nominal terms (Figure 21).

Figure 20   Percentage of employees in the same job whose real hourly wages were cut, frozen or raised in the coming year
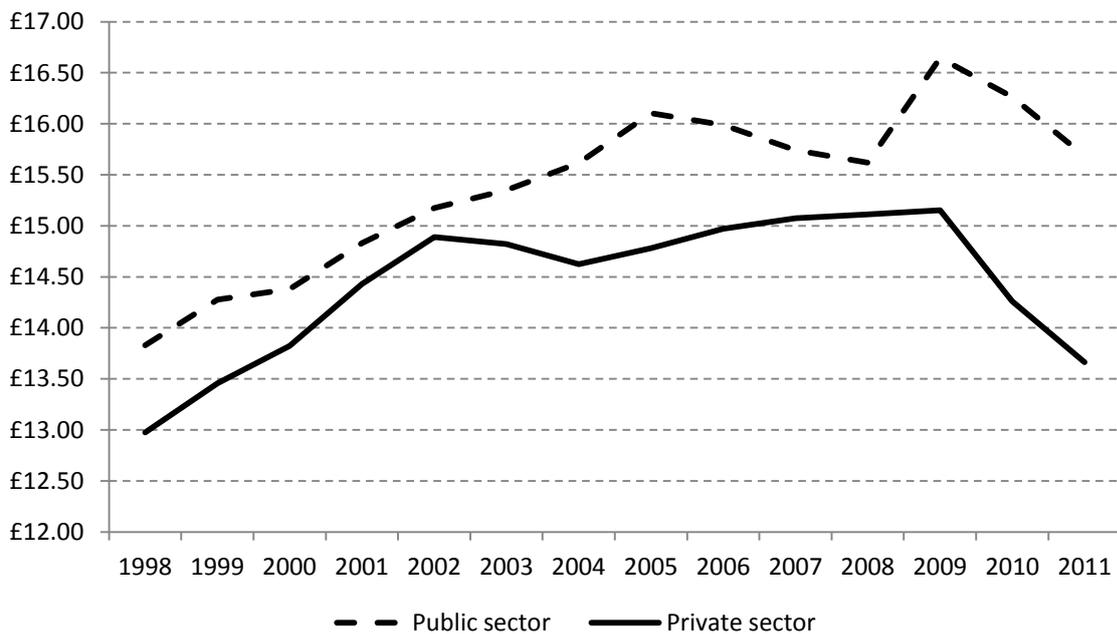

Source: New Earnings Survey Panel Dataset 1975-2011. Freeze defined as |%change|<0.1%.

Figure 21   Percentage of employees in the same job whose nominal hourly wages were cut, frozen or raised in the coming year

Source: New Earnings Survey Panel Dataset 1975-2011. Freeze defined as |%change|<0.1%.

Figure 22   Average real hourly wages in the public vs. private sector

Source: Annual Survey of Hours and Earnings 2005-2011 (unweighted). Conditional on the individual being in the same job as the preceding year. Main job (i.e. job that gives the highest weekly earnings) only. Wages are in April 2011 prices.

Figure 20 shows that between 2010 and 2011, 70% of employees who stayed in the same job faced real wage cuts[19], while Figure 21 shows that a third of those workers faced nominal wage freezes or

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[19] This percentage would have been lower if we had used another deflator (such as the Consumer Prices Index or the GDP deflator), but the broad pattern would have remained the same.

cuts (12% experienced freezes and 21% experienced cuts). Moreover, these changes are occurring across the initial wage distribution. The last time that such a high proportion of workers faced real wage cuts was between 1976 and 1977, when inflation exceeded 15%, while the proportions of nominal wage freezes and cuts are the highest since the series began in the mid 1970s.

It is also interesting to note that despite widespread discussion and acknowledgement of public sector pay restraint, Figure 22 shows that average real hourly wages (amongst workers who stay in the same job) have actually fallen faster in the private sector than in the public sector over the last few years, such that the public-private sector wage gap has increased substantially over this period.

Why are workers so much more likely to have experienced nominal wage freezes or cuts during this recession compared to previous recession? One hypothesis that we are able to test (at least to some extent) is that it is because the labour market is now substantially more flexible than it was in the 1980s or 1990s. There has been a dramatic decline in trade union membership over the last 30 years, from a peak of around 13 million members (37% of the working age population) in the early 1980s to around 7.5 million (19%) in 2008.[20] This decline has been accompanied by a reduction in the proportion of employees covered by collective bargaining, which appears to have made it easier for employers to hold constant or reduce insiders' wages.
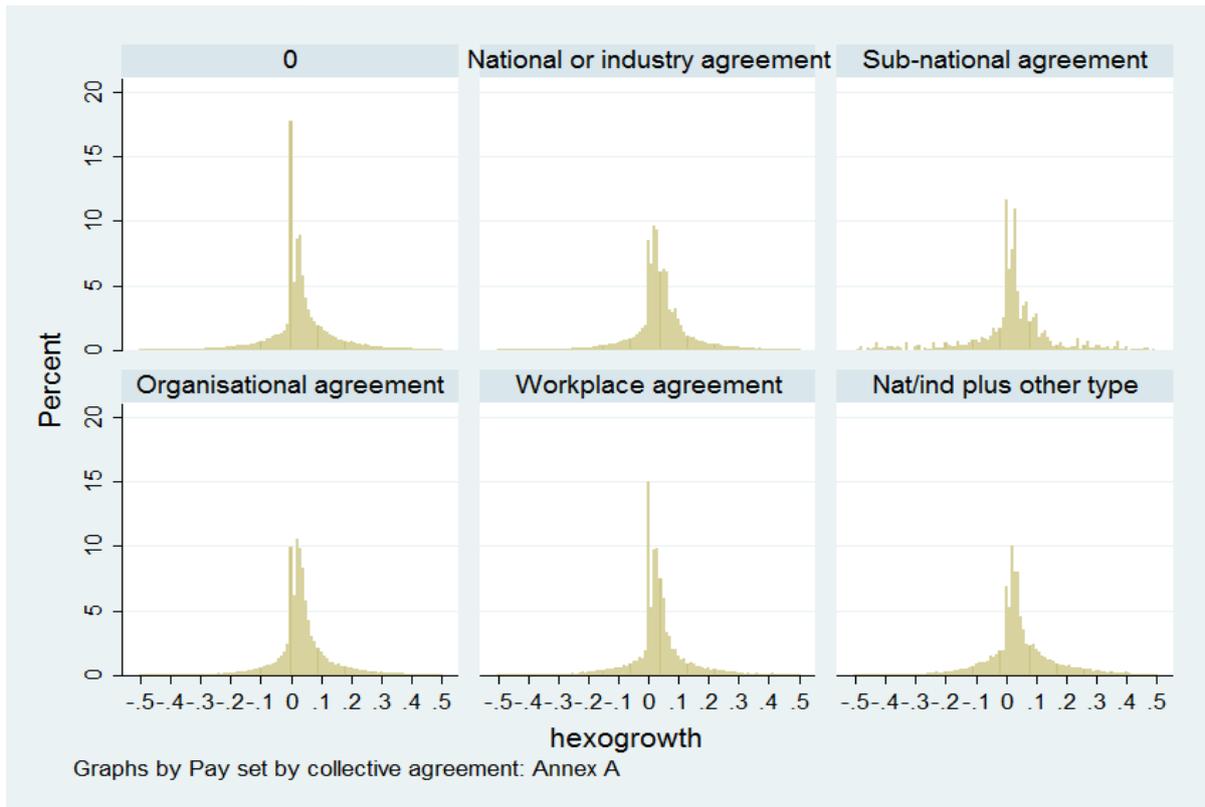
Figure 23 shows that year-on-year nominal wage freezes over the period 2008 to 2011 were more prevalent in jobs without collective agreements, and that where pay awards were agreed at the national, industry or organisational level, proportionally more workers experienced small positive nominal wage growth.

Similarly, Figure 24 shows that average real wages have fallen least amongst those covered by collective agreements at the national or industry level.[21] Taken together, these patterns suggest that the decline in collective bargaining which has accompanied rapidly falling trade union membership may have contributed to wage stagnation during the recent recession and hence may help to explain why wages have fallen further in this recession than in the past.

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[20] Source: authors' calculations using Achur (2010) for trade union membership and
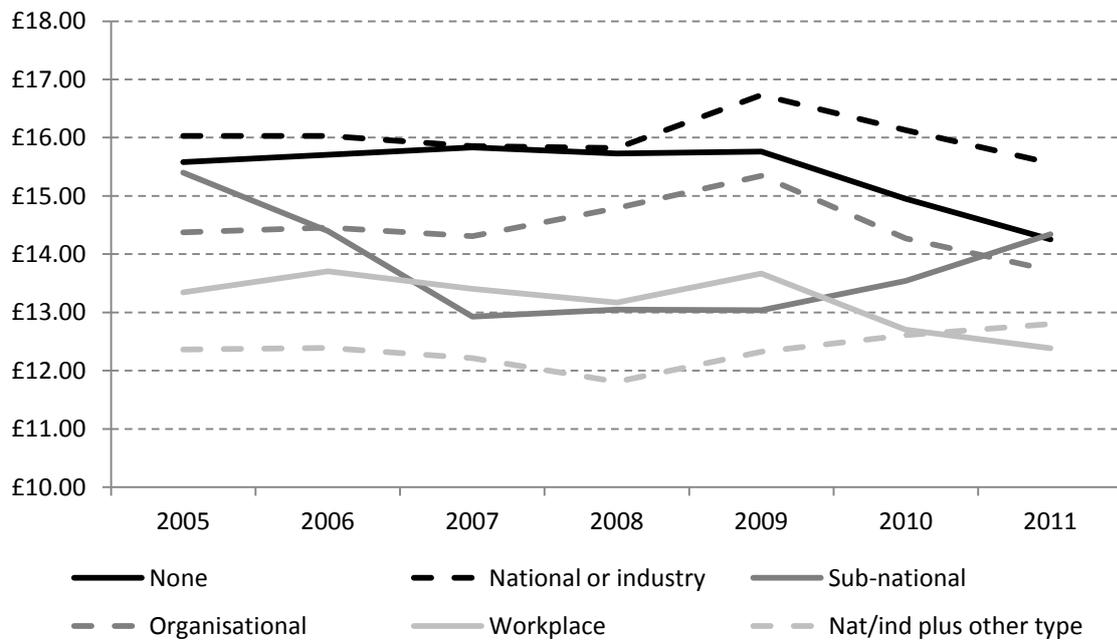http://www.neighbourhood.statistics.gov.uk/HTMLDocs/dvc1/UKPyramid.html for working age population.

[21] This may help to explain the differences between public and private sector pay shown in Figure 21.

Figure 23 Distribution of individuals' year-on-year nominal hourly wage growth by type of collective agreement, 2008-11

Source: New Earnings Survey Panel Dataset. Conditional on employees being in the same job as the preceding year. Each of the six distributions pool together observations from 2008 to 2011.

Figure 24 Average real hourly wages by type of collective agreement

Source: Annual Survey of Hours and Earnings 2005-2011 (unweighted). Conditional on the individual being in the same job as the preceding year. Main job (i.e. job that gives the highest weekly earnings) only. Wages are in April 2011 prices.

5   Conclusions and policy implications

This paper has used individual data on employment and wages to shed light on the UK's productivity puzzle. Overall, we have shown that there has been an increase in the supply of workers in this recession compared to previous recessions. However, despite the increase in supply occurring amongst groups towards the lower end of the jobs market, there is strong evidence against the composition or quality-of-labour hypothesis as a potential explanation for the reduction in wages and hence productivity that we observe. By contrast, we find significant real wage reductions amongst individuals who have stayed in the same job year-on-year, with around one third of workers experiencing nominal wage freezes or cuts between 2010 and 2011 and 70% experiencing real wage cuts (on the basis of the Retail Prices Index). So the real question is: why have wages for existing workers been able to fall so much in this recession compared to previous recessions?

Part of the explanation is the substantial increase in labour supply that we have observed in this recession. We show that a combination of policy changes and reductions in the value of household wealth have contributed to the rise in labour supply. This means that there are more individuals willing to work at any given wage and thus that there is likely to be greater competition for jobs. As a consequence workers have lower reservation wages than in the past and that they attach more weight to staying in work (because their expected time to find another job is longer than in the past) than on securing higher wages, and are thus willing to accept lower wages in exchange for holding onto their job. This is consistent with the findings of Gregg et al. (2013), who show that wages have become more responsive to local unemployment rates since the early 2000s.

Another likely factor is that the labour market is now substantially more flexible than it was in the 1980s or 1990s. There has been a dramatic decline in trade union membership over the last 30 years, which appears to have made it easier for employers to reduce insiders' wages: nominal wage freezes were more prevalent in jobs without collective agreements and average wages have fallen least amongst those covered by collective agreements at the national or industry level.

A final piece in the puzzle – discussed extensively in Van Reenen (2013) – is that the reduction in productivity might be driven by a reduction in the capital-labour ratio as a result of an increase in the cost of capital (particularly for small and medium sized firms) or the continuing misallocation of capital to less efficient firms or projects. There has certainly been a sharp reduction in business investment over the course of the recent recession, which has been significantly larger than in previous recessions (Benito et al., 2010) and amongst small and medium-sized firms (Crawford et al., 2013). While Crawford et al. (2013) provide some evidence that the reduction in investment can explain only a small proportion of the within-firm changes in productivity in 2008-09, it is plausible

that reductions in productivity resulting from a fall in the capital-labour ratio also contributed to reductions in real wages and hence labour costs, which Crawford et al. (2013) find to be the primary driver of productivity falls.

Thus, while it is impossible to tell the extent to which lower productivity is being driven by lower wages or lower wages are being driven by lower productivity, obtaining new insights into the drivers of the significant reductions in wages that we observe amongst those who remain in the same job year-on-year would seem to be at the heart of understanding the UK's productivity puzzle.

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Appendix 1   Data sources used

The **English Longitudinal Study of Ageing** (ELSA) is a longitudinal dataset of a representative sample of 50-year-olds and above in England. It contains a huge amount of information on wealth, health, pension schemes, employment, and other economic and social circumstances. ELSA began in 2002-03. This study uses linked ELSA 2006-7 (Wave3) and 2010-11 (Wave 5), and has a sample of more than 7,000 respondents.

The **Family Expenditure Survey** (FES) is a repeated cross-sectional survey focusing on expenditures and incomes of households in the UK. In 2001 the FES was merged with the National Food Survey(NFS) to create the Expenditure and Food Survey (EFS). At the individual level, the FES/EFS contains employment status, hours, incomes from different sources and some demographic information. There are 5,000-9,000 adult respondents every year.

The **Labour Force Survey** (LFS) is a survey of employment circumstances of households in the UK. It started as a bi-annual survey in 1975, becoming annual from 1983 to 1991 and quarterly since 1992 Q2. The survey contains detailed information on individual characteristics such as education, ethnicity, and household composition. Since the LFS became quarterly, each respondent is interviewed at five consecutive quarters and in each wave one-fifth of the households in the sample are replaced. The LFS contains around 100,000 individuals per quarter. Wages are surveyed in the first and the fifth interviews only, and from 1992 only.

The **New Earnings Survey Panel Dataset** (NESPD) is a large panel dataset of earnings of individuals in the UK. Broadly speaking, the sample frame contains all working individuals whose National Insurance number ends in a particular pair of digits, so the same individuals can be linked over time. The survey forms are sent to their employers and ask detailed questions about hours, wages and pensions arrangements. There is little information on individual characteristics. The NESPD combines the New Earnings Survey (1975-2003) with the Annual Survey of Hours and Earnings (ASHE, 2004-2011). The sample size is around 150,000 every year.