The heterogenous cyclicality of real wages. Evidence from wage groups in economic expansions and recessions

María Cervini-Plá* Antonia López-Villavicencio† José I. Silva‡

June 27, 2013

Abstract

We investigate the cyclicality of real wages using individual data for the years 1991-2008 in the UK, . We pay special attention to heterogeneity among different wage groups during positive and negative shocks to the unemployment rate. We document that top wages are more cyclical than lower ones. Moreover, the estimated cyclicality is as high as 3% in recessions for top earners. We also show that real earnings are acyclical for low wage workers. Instead, their adjustment to the cycle take place through hours worked –in case of booms– or unemployment –in recessions–.

JEL Classification: E24, E32, J31.
Keywords: real wage, cyclicality, heterogeneity, recessions, expansions

*University of Girona, Spain. E-mail: maria.cervini@udg.edu

†*Corresponding author.* CEPN-CNRS, University of Paris Nord, France. E-mail:lopezvillavicencio@univ.paris13.fr. Phone: +33(0) 0149402087

‡Universitat de Girona, University of Kent, School of Economics, Keynes College, Canterbury, Kent. E-mail: J.I.Silva-Becerra@kent.ac.uk.

1 Introduction

Documenting and assessing real wage cyclicality (RWC) has been a central focus in economics for a very long time. However, there remain important theoretical and empirical disagreements about the direction and the magnitude of the relationship between changes in real wages and changes in standard measures of the business cycle. Indeed, real wages are suppose to be counter-cyclical under sticky wages but procyclical in theoretical models that assume sticky prices. More recently, a common view is that having both pricing and wage decisions staggered can generate procyclical, acyclical, or countercyclical real wages (e.g. Blanchard (1986) and Huang, et al. (2004)).

The extensive empirical literature on RWC is also inconclusive. In particular, macro studies usually find counter-cyclical real wages whereas most of the literature based on panel micro data document substantial procyclicality.[1] This discrepancy between aggregate time series and micro oriented studies is usually explained by a composition bias. For instance, Mitchell, Wallace, and Warner (1985) propose that aggregate statistics are constructed in a way that gives more weight to low skill workers during expansions than during recessions. The argument is that low-wage workers tend to have substantially more cyclical hours and employment than high-wage workers, so that in every recession, a large number of low-wage worker-hours are dropped from the aggregate wage statistic. In this way, changes in the composition of the labor force occurring over the course of the business cycle may lead to biased estimates of the cyclicality of manufacturing wages. The measurement of nominal wages, nominal prices and cyclical conditions, as well as the frequency, time period and empirical specification may also lead to biased estimates of cyclicality in aggregate studies (Abraham and Haltiwanger (1995)).

Moreover, even if a large number of micro studies find that wages change in a procyclical way, wage cyclicality is found to differ between alternative wage measures, demographic and personal characteristics as well as between job stayers and employees who change employers. For instance, Mitchell, Wallace, and Warner (1985) study heterogeneity according to age, sex and race, Bils (1985) analyzes differences between blacks and whites and Hart (2006) makes the distinctions for males and

[1] See, for instance, Mitchell, Wallace, and Warner (1985), Bils (1985), Hart (2006), Solon, Barsky, and Parker (1994), Devereux and Hart (2006), Shin and Solon (2007), Martins (2007), Swanson (2007), etc.

females. The consensus of these studies is that there is little heterogeneity in cyclical wage responses among these groups. However, Bils (1985), Solon, Barsky, and Parker (1994), Devereux and Hart (2006), Hart (2006) or Shin and Solon (2007) find differences among individuals who are moving between employers or in and out of the work force.

Although the previous studies outline the importance of controlling for composition bias, the fact that wage cyclicality may differ among workers throughout the wage distribution is not considered in the literature. Even more, the proposition that RWC may be different during recessions and expansions is also missing in the empirical investigations. In this paper, we propose that a heterogenous wage cyclicality may appear from two sources. The first one is linked to the fact that wage cyclicality can be a heterogeneous parameter depending on the composition of the labour force. In particular, we are interested in the heterogeneity that arises across high- and low-wage workers. The second source of heterogeneity describes the different responses that may elicited by positive or negative shocks to the unemployment rate.

We explore these two sources of heterogeneity by using wave 1 to 18 of the British Household Panel Survey (BHPS). Our analysis is motivated by the fact that, for many years, the predominant part of the literature was based on the idea that incomes of low-income households were more cyclical than those at the top. The common explanation was that unemployment falls primarily on low-wage workers, affecting thus their income (Clark and Summers (1981), Kydland (1984)). However, there is a recent literature suggesting the opposite effect. These topical studies suggest that during the past quarter century, the incomes of high-income households have become much more sensitive to aggregate fluctuations than previously. For instance, Parker and Vissing-Jorgensen (2010) document that the incomes of households in the top 1 percent have become more than twice as sensitive to aggregate income fluctuations as the income of the average household in the United States and Canada.

In addition, Swanson (2007), Parker and Vissing-Jorgensen (2010) or Piketty and Saez (2012) propose that the evolution of top incomes is not exclusively due to capital or entrepreneurial income. In fact, given that wages and salaries represent the main share of total income, it follows that wages are also a major source of the change in cyclicality of top incomes.[2] We contribute to this literature by focusing in

[2]Based on data for the US, Parker and Vissing-Jorgensen (2010) show that income cyclicality of

wage cyclicality along the wage distribution. However, we add two new dimensions by analysing the differences between the bottom and the top wage salaried workers during expansions and recessions.

The empirical micro literature that explores RWC distinguishing between booms and busts is very scarce. An important exception is Shin and Shin (2008), who provide evidence that real procyclicality among job stayers in the United States is mainly explained by large wage adjustments during the period when the unemployment rate reaches a historical minimum level from the start of the employee's current job. More recently, Martins (2007) finds evidence that real wages are considerably more procyclical during recessions than during expansions in Portugal.[3] We consider that the contrast between the UK case and that of other countries with parallel or different institutional setups for which similar research has already been conducted (e.g. the US and Portugal) is important. Moreover, a greater understanding of the underpinnings of the flexibility of the UK labour market in booms and busts is also useful from a policy perspective at these challenging times in the business cycle.

We demonstrate that there are two types of heterogeneity that have been largely ignored in micro oriented studies. Indeed, our results show that wages are procyclical. Nonetheless, cyclicality is considerably higher in economic recessions. This implies that gross wages fall when the unemployment rate increases but their response is mild or even non-existent in economic expansions. Moreover, we show that this cyclicality differs across wage groups. In particular, cyclicality is stronger during recessions for workers who are at the top of the wage distribution. On the contrary, moving to the lower tail of the distribution provides acyclical wages. We reconcile our findings by showing that an important portion of the acyclicality for low wages is due to the loss of jobs during labor market downturns. These loss are not compensated by the gains in economic booms.

This paper is organized as follows. Section 2 presents the empirical methodology. Section 3 explains the dataset used. Section 4 presents the results and Section 5

households in the top 1 percent is roughly similar if one leaves out households with stock options. Similarly, Piketty and Saez (2012) propose that in 2007, one needs to enter into the top 0.1% for capital income to dominate wage income. Moreover, if one takes away capital gains, then wage income dominates capital income at the very top

[3]Martins' specification contains both the change in the unemployment rate and an interaction between the change in the unemployment rate and a dummy for periods in which the unemployment rate increases.

concludes.

2 Empirical framework

The starting point of our empirical analysis consists of regressing for each percentile the (log) real wages for the i^{th} worker in year t in the whole sample and by wage groups as follows:

$$\ln w_{it} = \alpha_t + \delta_1^{'} Z_i + \delta_2 A_{it} + \delta_3 A_{it}^2 + \epsilon_{it} \tag{1}$$

where α_t is the time-variant coefficient (the time-effect), Z is a vector of time-invariant worker characteristics such as race, gender, years of education, ability, and motivation; A is the worker's age as of year t and ϵ_{it} is the transitory worker-specific error term. Following Solon, Whatley, and Stevens (1997), we control for both the observable and unobservable elements of Z by taking the first-difference in Equation (1):

$$\Delta \ln w_{it} = \Delta\alpha_t + \beta^{'} X_{it} + \Delta\epsilon_{it} \tag{2}$$

where the vector X contains the worker's age. To characterize the cyclicality of the year effects in real wages we write the time-variant coefficient as follows:

$$\alpha_t = \gamma_1 + \gamma_2 t + \gamma_3 t^2 + \gamma_u U_t + \upsilon_t \tag{3}$$

where t is a linear time trend, U_t is the national unemployment rate in year t and υ_t is the error term. The quadratic in time is included to account for secular trends. In Eq. (3), γ_u represents the cyclical elasticity of real wage's with respect to the unemployment rate (i.e γ_u captures wage cyclicality). Taking the first difference of Eq. (3) and substituting in Equation (2) yields:

$$\Delta \ln w_{it} = \gamma_2 + 2\gamma_3 t + \gamma_u \Delta U_t + \beta^{'} X_{it} + (\Delta\epsilon_{it} + \Delta\upsilon_t) \tag{4}$$

As noticed by Solon, Whatley, and Stevens (1997), one way to estimate the cyclical wage elasticity is to apply ordinary least squares (OLS) to equation (4). However, if the error terms of different workers in the same percentile are cross-sectionally correlated, the associated standard error of the OLS estimates would be biased. We treat the cross-sectional correlation of the error term in equation (4) by applying generalized least squares (GLS) to Eq. (4), which provides efficient

coefficient estimates and consistent standard error estimates.[4]

Equation (4) represents the standard wage cyclicality relationship which is based on the assumption of symmetry between the movements in expansions and contractions. We challenge this assumption by allowing real wages to change differently during different parts of the business cycle. This asymmetric reaction can be captured by defining two dummy variables, D_1 and D_2, that take the value of 1 for positive or negative changes of the unemployment rate, respectively, and 0 otherwise. We then identify two asymmetric variables in the following way:

$$U_t^+ = \Delta U_t \times D_1$$
$$U_t^- = \Delta U_t \times D_2$$

Such that U_t^+ captures increases in the unemployment rate and therefore recessions and U_t^- captures decreases in the unemployment rate. Replacing ΔU_t in Equation (4) by its decomposition into positive and negative components, we get to the following asymmetric extension of the real wage cyclicality equation:

$$\Delta \ln w_{it} = \gamma_2 + 2\gamma_3 t + \gamma_u^+ U_t^+ + \gamma_u^- U_t^- + \beta' X_{it} + (\Delta\epsilon_{it} + \Delta\upsilon_t) \tag{5}$$

where all the variables were previously defined and $U_t^+ + U_t^- = \Delta U_t$ by definition. Note that U_t^+ (U_t^-) takes positive (negative) values for a positive (negative) variation of the unemployment rate, and 0 otherwise. Hence, the coefficient γ_u^+ in Equation (5) will be negative and significant if we expect wages to decrease in periods of recession. Equally, the coefficient γ_u^- will be also negative if wages increase in periods of expansion.

The reaction symmetry of the wage cyclicality can be verified with a Wald statistic testing the null hypothesis assumption that $\gamma_u^+ = \gamma_u^-$. If the estimated coefficient for γ_u^+ is higher than the estimated γ_u^-, then there is an asymmetry where positive changes of the unemployment rate (i.e recessions) have higher impact on real wages than negative changes. We estimate equation Eq. (5) for all the individuals of our sample and for each wage group.

[4]Note that it is also possible to use a two-stage procedure, which is a close substitute for single-stage GLS. However, the two-stage procedure can yield serially correlated or heteroskedastic error terms. See Solon, Whatley, and Stevens (1997) for a discussion.

3 Data and descriptive statistics

Our analysis is based on waves 1 to 18 (years 1991-2008) of the British Household Panel Survey (BHPS). The BHPS is a nationally representative sample consisting of around 5500 households across Great Britain. The panel starts in 1991 with 13840 individuals interviewed. The same individuals were follow, as far as possible, for the subsequent waves of the survey.[5]

The sample is restricted to males between 25 and 55 years old. Specifically, we select males who declared paid employment to be their main activity. We use this restricted sample to avoid several mis-specification issues. First, we restrict our sample only to males in order to mitigate issues of endogenous female labour market participation. Second, individuals are allowed to enter the panel at any wave and to re-enter the panel if they exit in previous waves. Such a sample selection produces an unbalanced panel since not all individuals are present for all eighteen waves. Movements into and out of the sample may be due to unemployment, retirement, mobility to or from self-employment and attrition. An individual has to be present in the sample at least two consecutive years in order to be consider in our sample since we work with the first difference of real wage. Third, our chosen age range excludes the extremes of the earnings life cycle, where volatility arising just after labour market entry or before retirement may be confounded with volatility due to structural labour market changes.

Our main dependent variable is the logarithmic change between two consecutive waves in average gross hourly wage deflated by the aggregate consumer price index. Alternatively, we also consider net wages as the dependent variable. This distinction is important since there is evidence (Parker and Vissing-Jorgensen (2010)) that taxes, and especially transfers, significantly reduce the cyclicality at the bottom of the income and wage distribution while making less difference to the cyclicality of the very top. Therefore, we compare differences in the cyclicality of gross and net earnings.

The key explanatory variable is the change in the unemployment rate, which is intended to reflect movements in the business cycle. We calculate this variable as the change in the average national unemployment rate from year t to year $t-1$. For the asymmetric estimation, we decompose the unemployment rate as in Eq.(6).

[5]The BHPS data is available from the Data Archive at Essex University.

In order to estimate the wage cyclicality of different wage groups, we calculate the percentile in which the individual is placed on the entire distribution of earnings in each wave and consider the percentile to which the individual belongs at time t. High-wage individuals are defined to be those with wages in the top decile, and low-income earners those in the bottom percentile.

We also analyse the cyclicality of hours worked for the different wage groups. The hypothesis behind this exercise is that during recessions, the adjustment in the labour market is through changes in the hours worked rather than by reductions in wages at the bottom wage distribution. In this case, we work with two samples. In the first case, we use the same sample used to study wage cyclicality. However, in the second case we extend the sample to all men in the restricted age group that ever worked. This allows us to capture movements from and to unemployment by constructing a balanced panel with 0 hours in the case an individual is unemployed.

Table 4 shows two important characteristics by wage group: i) the percentage of workers with temporary contracts are higher among low wage workers and ii) wages remain close to the minimum established real wage in the UK for the bottom wage workers. Indeed, about 25 percent of low wage workers have temporary contracts, compared to just 3% for the top wages. Moreover, according to our data, there is evidence of non-compliance regarding the minimum wage, with the real hourly wage for the lowest-paid workers remaining very close, or even below, to the minimum wage. For instance, the real hourly wage for the bottom 10% reached 4.2 pounds in 2008, two pounds below the established minimum wage. At a first glance, this non-compliance evidences that there is little or no scope for variation in wage adjustments in bad labour market conditions for this type of workers. It also suggest that low paid workers are easier to fire.[6]

[6]The Low Pay Commission Report 2012 provides evidence that 1% of employees in 2008 where paid less than the national minimum wage in the UK. The evidence of of non-compliance is even more striking for jobs paid less than the then forthcoming minimum wage, representing 5.2% of total employees for the same year. By occupations, around 48 per cent of jobs in the cleaning industry, 47 per cent in hospitality, 37 per cent in hairdressing and 34 per cent in childcare were paid less than the minimum wage.

4 Results

The top panel of table 1 presents our main findings in terms of cyclicality for all the individuals in our sample and for selected wage groups. In accordance with previous studies based on micro data, the symmetric business cycle variable (γ_u) indicates highly procyclical wages. Indeed, a percentage point rise in the unemployment rate is associated with a decrease of real wages of about 1.2%, which is close to the estimated cyclicality in the literature.[7]

However, our first main contribution is in terms of heterogeneity regarding cyclicality on the wage distribution. At this respect, our results show that real wages of the top wage salaried workers –particularly the top 10% in the wage distribution– are more affected by the business cycle than the rest. In fact, wages of the bottom wage earners –the lowest 10% and 25%– are not influenced by movements in the unemployment rate. Striking though these results are, they remain partly consistent with the limited previous literature. Indeed, Parker and Vissing-Jorgensen (2010) document that, since 1982, the wage and salary income of the top 1 percent in the United States has a cyclicality of 2.4 and that of the top 0.01 percent a cyclicality of 6.2, compared with a cyclicality of less than 1 for all tax units. Unfortunately, Parker and Vissing-Jorgensen (2010) do not provide the cyclicality of wages and salaries for bottom wage percentiles. We present evidence –without precedent to the best of our knowledge–that earnings of low-wage units are roughly acyclical.

A second important finding relates to the asymmetric reaction of wages during a positive or negative shock to the unemployment rate. Table 1 also shows that the Wald statistic testing the null hypothesis that $\widehat{\gamma_u^+} = \widehat{\gamma_u^-}$ (i.e. the estimated rise of wages in booms is equal to the fall in recessions) cannot be accepted at a 10% critical level. This lead us to turn our attention to the asymmetric cycle indicators in the second panel of the table. The results in this case are even more outstanding. Certainly, we document that RWC is mainly the result of real wages decreasing in recessions –when the unemployment rate increases- but not expanding during economic expansions; $\widehat{\gamma_u^-}$ being not significant for all individuals. Moreover, wages are considerably more cyclical in recessions that in the symmetric case, indicating that a percentage point rise in the unemployment rate is actually related to a decrease

[7]For instance, Bils (1985) or Devereux and Hart (2006) find a cyclicality of about -1.6 for job stayers. Based on more recent data, Parker and Vissing-Jorgensen (2010) estimate a value of -2.4 for all tax units in their sample of USA households.

of wages of almost 2%.

The proposition that real wages can be downward flexible but upward rigid is not without precedent. For instance, investigating the extent of nominal rigidity in aggregate time series for the UK labour market in the 1990s, Smith (2000) finds substantial downward flexibility. Similarly, Lopez-Villavicencio and Saglio (2013) investigate asymmetries over the cycle in aggregate time series for OECD countries. They find that real wages decrease more in recessions but are acyclic in expansions in the UK. At the micro level, our findings are consistent with those in Martins (2007) for the case of Portugal.[8] This is interesting since the UK and Portugal have very different labour market institutions and regulations, yet real wages fall significantly during recessions in both countries. Indeed, Portugal is characterised by its stringent employment protection legislation (EPL). The UK, on the contrary, has very low employment protection and relatively flexible labour market institutions.[9] This confirms that flexible labor market institutions do not necessary lead to higher wage flexibility (e.g Lopez-Villavicencio and Saglio (2013)).

More importantly, failing to properly capture asymmetries hides important rigidities in top wages. Indeed, the symmetric model indicates that a 1% increase (decrease) in the unemployment rate is associated with a decrease (increase) of about 1.3% of the real wage. Thus, both unemployment expansions and contractions have the same effect –in absolute value– on real wages. Our results show, however, that this is not the case: whereas a 1% increase in the unemployment rate reduces real wages of the top 25 and 10 percent wage groups by 2.5 and 3.2 percent, respectively, a fall in the unemployment rate leaves real wages unchanged. The symmetry hypothesis, in turn, cannot be rejected for the bottom 10 and 25 percent in the wage distribution, indicating that wages for these workers are indeed acyclic.

Comparing gross and net real wages provides interesting results. Indeed, as seen in table 5 in the appendix, net real wages –wages after taxes and transfers– are less

[8]Martins (2007) estimates a cyclicality in downturns of 1.8 for the whole sample of Portuguese employees and about 3.0 when controling for workers characteristics. Our estimated 1.9 coefficient for unemployment expansions for all individuals are then in line with Martins findings.

[9]The EPL index is an indicator provided by the OECD. The OECD index is based primarily on (i) the strength of protection of permanent workers against individual dismissal, (ii) the specific requirements for collective worker dismissal, and (iii) regulations on temporary employment contracts. Between 1990 and 2008 the mean value was 3.6 in Portugal compared to a 0.6 in the UK.

Table 1: **Cyclicality of real wages by wage group**

	All units	Lowest 10%	Lowest 25%	Top 25%	Top 10%
Symmetric					
Cyclicality ($\widehat{\gamma_u}$)	−1.226	−0.812	−1.127	−0.832	−1.354
	(−4.50)	(−0.31)	(−1.01)	(−2.14)	(−2.21)
Asymmetric					
Expansions ($\widehat{\gamma_u^-}$)	−0.570	−7.281	−4.600	0.666	0.397
	(−0.80)	(−1.15)	(−1.57)	(0.68)	(0.24)
Recessions ($\widehat{\gamma_u^+}$)	−1.906	5.772	2.042	−2.439	−3.243
	(−2.74)	(0.93)	(0.76)	(−2.42)	(−2.08)
Symmetry test	0.006	0.249	0.186	0.016	0.048

Notes: (1) $\widehat{\gamma_u}$ is the estimated coefficient for cyclicality in Eq. (5); (2) $\widehat{\gamma_u}^-$ and $\widehat{\gamma_u}^+$ indicates cyclicality in economic expansions and recessions, respectively; (3) The symmetry test is the probability of the Wald test for the null that $\widehat{\gamma_u}^+ = \widehat{\gamma_u}^-$ in Eq. (6).; (4) t-values in parenthesis

cyclical than gross wages for all units. Nonetheless, for the top 25 and 10 percent wages, real net wages are cyclic but symmetric, indicating that an increase (decrease) on the unemployment rate, decreases (increases) net real wages about 1.3%, the same cyclicality observed in gross real wages. As in Parker and Vissing-Jorgensen (2010), this implies that considering taxes and transfers in a linear symmetric model makes no difference for the top wages. However, once considering the asymmetric models, it is important to note that taxes and transfers represent an important share of the cyclicality of high wages during recessions. On the contrary, taxes and transfers do not affect the cyclicality at the bottom of the wage distribution which are in any case acyclic.

What explains the acyclicality of individuals at the bottom wage distribution? The literature emphasizes job mobility as one reason for the different cyclicality among workers (e.g. Beaudry and DiNardo (1991)). However, Pavlopoulos, et. al. (2007) conclude that the probability of job mobility does not appear to be different for the low and the high paid worker, the driving forces of a job change being similar along the wage distribution.

We explore an alternative explanation by looking at the adjustments in the hours worked in each percentile during booms and busts. In particular, given the constraints to reduce wages of low wage workers, we analyse if bottom wage per-

centiles are pushed to work less hours during recessions than in normal or boom periods. The proposition is as follows. Individuals at the bottom percentile are close to the minimum wage. Contrary to high wages, this means that, in case of positive shocks to the unemployment rate, wages for this group cannot decrease. Therefore, one could infer that adverse shocks eventuate in hours worked –or even job losses– rather than wage adjustments for lower wages.

There are a few studies supporting the proposition that working hours could be the adjustment mechanism for some wage groups. For instance, Clark and Summers (1981) and Kydland (1984) advance that low income households are the most affected by booms and recessions and that this greater sensitivity is due to higher cyclicality of hours worked among this group. On the contrary, Parker and Vissing-Jorgensen (2010) show that hours cyclicality plays only a minor role for the cyclicality of the top 1 percent.

In order to investigate to what extent the adjustment to the cycle is through employment (hours), we regress the change in average weakly hours on the change in the unemployment rate. The cyclicality of hours is shown in table 2. As seen, the estimated cyclicality is 0.22 for the whole sample and just 0.02 for the top 10 percent. Simmilarly to our results, Parker and Vissing-Jorgensen (2010) find significant cyclicality of hours worked of all families but non-significant cyclicality for the top 1% income in the case of the United States. In contrast, Castro and Coen-Pirani (2008) find that aggregate hours worked by individuals with a college degree –which are usually the highest salaried workers– have become much more procyclical and volatile relative to aggregate output since the late 1980s.

Our results also show that hours worked are highly cyclic for the lowest 10 and 25 percent. The asymmetric specification indicates that the lowest percentile increases hours worked in times of expansions. This finding may explain why wages are not cyclic during economic booms for these workers. Indeed, producers may react to the cycle by offering more working hours to their low wage workers rather than higher wages when the unemployment rate is low. Note, however, that the cyclicality of hours worked does not explain the acyclicality of wages for the bottom tenth of the earnings distribution during recessions, the estimated coefficient of hours worked being not significant in this case.

We explore a further possibility by extending the sample to all men in the re-

Table 2: **Cyclicality of hours worked by wage group**

	All units	Lowest 10%	Lowest 25%	Top 25%	Top 10%
Symmetric					
Cyclicality ($\widehat{\gamma_u}$)	−0.219	−1.221	−0.992	−0.183	−0.022
	(−7.54)	(−2.42)	(−3.90)	(−2.52)	(−0.18)
Asymmetric					
Expansions ($\widehat{\gamma_u^-}$)	−0.253	−1.856	−1.754	−.176	−0.079
	(−2.69)	(−2.05)	(−3.85)	(−1.36)	(−0.37)
Recessions ($\widehat{\gamma_u^+}$)	−0.134	−0.403	−0.022	−.193	0.054
	(−1.18)	(−0.37)	(−0.04)	(−1.23)	(0.21)
Symmetry test	0.503	0.400	0.044	0.945	0.747

Notes: (1) Notes: The symmetry test is the probability of the Wald test for the null that the estimated cyclicality of hours worked is equal in expansions and recessions; (2) t-values in parenthesis

stricted age group that ever worked. If he does not work in the following periods, we impute 0 hours worked, constructing a balanced panel. This allow us as to capture switches from employment to unemployment as well as reductions in the hours worked by workers who remain in the labour force. The results in this case are presented in table 3. As seen, the cyclicality for working hours is highly significant and negative for the whole sample and for the different wage groups. For instance, a 1% increase in the aggregate unemployment rate implies a decrease of about 2.1 in the hours worked per week, the decline being more important for the lowest percentile (about 3 hours). Turning to the asymmetric estimation, it is very important to note that working hours decrease more in recessions than expansions for bottom wage earners. Remember that there is a high percentage of these workers with temporary contracts and, therefore, easy to fire in case of recessions.

Together, our results for hours worked considering the intensive and the extensive labour margins indicate that recessions affect low wage workers mainly through transitions to unemployment, rather than hours worked or wages. Note that we are treating the intensive and extensive margins differently when studying RWC, hours cyclicality and hours cyclicality allowing for transitions to unemployment. In the first two cases, joblessness is treated as a missing observation in the data and ignored. In the third case, joblessness is imputed as zero. As such, these workers disappear from our original sample, which explains why wages are not cyclic.

Table 3: **Cyclicality of hours worked by wage group. Includes transition to unemployment (zero working hours)**

	All units	Lowest 10%	Lowest 25%	Top 25%	Top 10%
Symmetric					
Cyclicality ($\widehat{\gamma_u}$)	−2.113	−3.201	−3.685	−1.143	−0.935
	(−15.94)	(−5.33)	(−9.42)	(−5.80)	(−3.15)
Asymmetric					
Expansions ($\widehat{\gamma_u^-}$)	−2.647	−2.185	−4.630	−1.278	−1.794
	(−11.31)	(−2.12)	(−6.83)	(−3.66)	(−3.41)
Recessions ($\widehat{\gamma_u^+}$)	−1.407	−4.644	−2.387	−0.967	0.186
	(−4.90)	(−3.48)	(−2.79)	(−2.28)	(0.29)
Symmetry test	0.005	0.066	0.088	0.639	0.048

Notes: (1) Notes: The symmetry test is the probability of the Wald test for the null that the estimated cyclicality in hours worked is equal in expansions and recessions; (2) t-values in parenthesis

5 Final remarks

Micro studies in real wage cyclicality have shed light on several important questions in the macro-labour literature over the last 20 years or so (e.g. the role of composition bias). This paper presents additional evidence of this type, by analysing the differences in real wage cyclicality (RWC) across worker groups and over the business cycle. Using the British Household Panel Survey (BHPS) data sets from 1991 to 2008, we conclude that the wages at the top of the wage distribution are more procyclical than those at the bottom of the distribution.

We also show that most of the RWC documented is derived from real gross wage decreases during recessions, particularly for top wages. Our different results for gross and net real wages regarding asymmetries imply that taxes and transfers accruing to those in the very top of the wage distribution move substantially more than the overall average. Moreover, for the top percentile, wages after taxes are cyclic but symmetric, indicating that taxes and transfer account for a good part of wages decreases in recessions for these workers.

We also demonstrate that gross and net wages are equally acyclic for those at the bottom of the wage distribution. The large share of workers in the lowest wage groups that are paid minimum wages (or below) explains in part the lack of real wage cyclicality amongst these groups. However, there is also considerable cyclicality in hours of worked. Indeed, when considering the intensive margin, there are important increases in hours worked during expansions. When the extensive margin is taken into account, recessions result in transitions to unemployment rather than decreases in real wages. A high proportion of low paid workers with temporary contracts helps also to explain why the adjustment to the cycle is likely to be through employment or hours for workers at the lower tail of the wage distribution.

In this context, we provide additional channels through which aggregation might affect the estimated relation between real wages and the business cycle. First, given that high-wage workers tend to experience more wage cyclicality in economic downturns than their low-wage counterparts, i.e given the disparity in RWC across the wage distribution, there is no such thing as a typical worker in this context. Second, the average, aggregate real wage might be affected by cyclical changes in hours worked or transitions to unemployment by low pay workers in times of recession.

6 Appendix

Table 4: **percentage of workers with temporary contract and real gross mean wage by wage group and minimum gross real wage whole economy**

	Workers with temporary contract				**Real mean Wage**								**Minimum Wage**
	Lowest	Lowest	Top	Top	Lowest 10%		Lowest 25%		Top 25%		Top 10%		
Year	10%	25%	25%	10%	Mean	Min/Max.	Mean	Min/Max.	Mean	Min/Max.	Mean	Min/Max.	
1991	20.3	21.0	4.0	6.1	2.7	1.6/3.5	3.6	1.6/4.7	15.1	10.1/65.6	19.3	14.2/65.6	n.a
1992	26.5	19.5	3.0	3.0	2.7	1.5/3.6	3.7	1.5/4.8	15.8	10.4/83.9	20.5	14.6/83.9	n.a
1993	30.4	22.9	4.3	3.0	2.8	1.5/3.7	3.7	1.5/4.8	15.5	10.6/73.7	19.2	14.6/73.7	n.a
1994	37.4	32.6	3.9	3.2	2.8	1.5/3.6	3.6	1.5/4.8	16.0	10.4/112.7	21.1	15.0/112.7	n.a
1995	26.4	27.9	3.3	4.9	2.9	1.5/3.7	3.8	1.5/4.9	16.2	10.7/76.3	21.2	15.1/76.3	n.a
1996	39.1	28.9	3.0	2.8	2.8	1.5/3.7	3.8	1.5/4.9	16.4	10.6/195.0	21.8	15.1/195.0	n.a
1997	34.3	27.1	3.4	4.6	3.0	1.5/3.8	3.8	1.5/5.0	16.1	10.5/90.8	21.0	14.8/90.8	n.a
1998	39.5	29.8	3.2	4.2	3.1	1.5/3.9	4.0	1.5/5.1	16.5	10.8/127.7	21.5	15.2/127.7	n.a
1999	25.0	19.7	2.9	2.9	3.3	1.6/4.1	4.2	1.6/ 5.3	17.1	11.0/262.6	22.4	15.4/262.6	n.a
2000	20.6	15.4	2.7	2.9	3.5	1.7/4.3	4.5	1.7/5.6	17.4	11.5/225.1	22.6	16.0/225.1	4.7
2001	20.3	17.1	2.8	2.4	3.6	1.5/4.4	4.6	1.5/5.7	17.9	11.8/110.5	23.1	16.5/110.5	4.8
2002	27.4	17.2	2.7	2.9	3.6	1.6/4.6	4.7	1.6/6.0	19.2	12.5/167.3	25.4	17.4/167.3	5.2
2003	23.8	17.4	2.5	2.0	3.8	1.6/4.7	4.8	1.6/6.1	19.2	12.6/247.1	25.3	17.7/247.1	5.3
2004	21.6	15.7	1.6	1.7	3.9	1.5/4.9	5.0	1.5/6.3	19.7	12.8/175.2	25.6	17.9/175.2	5.6
2005	23.1	18.4	2.4	2.7	4.0	1.5/5.0	4.9	1.5/6.3	19.5	13.2/104.8	25.3	18.2/104.8	5.9
2006	16.6	14.1	3.0	3.3	3.9	1.6/5.1	5.0	1.6/6.4	20.3	13.4/147.5	26.5	18.5/147.5	6.0
2007	17.4	13.1	1.2	1.6	4.0	1.5/5.2	5.2	1.5/6.5	20.8	13.5/146.1	27.2	19.1/146.1	6.2
2008	20.7	14.7	1.7	1.9	4.2	1.7/5.2	5.1	1.7/6.5	21.1	13.6/93.6	27.3	19.2/93.6	6.2
Mean	**26.1**	**20.7**	**2.9**	**3.1**	3.4	1.6/4.3	4.3	**1.6/5.5**	**17.8**	**11.7/139.2**	**23.1**	**16.3/139.2**	**5.5**

Notes: (1) n.a. means not available. The National Minimum Wage (NMW) was established in the UK in April 1999; (2) Minimum hourly real wages are provided by the OECD. Real hourly wages are statutory minimum wages converted into a common hourly pay period. The resulting estimates are deflated by national Consumer Price Indices (CPI). Real hourly are calculated first by deflating the series using the consumer price index taking 2011 as the base year.

Table 5: **Cyclicality of net real wages by wage group.**

	All units	Lowest 10%	Lowest 25%	Top 25%	Top 10%
Symmetric					
Cyclicality ($\widehat{\gamma_u}$)	−0.867	0.370	0.147	−0.987	−1.334
	(−3.49)	(0.18)	(0.15)	(−2.40)	(−2.05)
Asymmetric					
Expansions ($\widehat{\gamma_u^-}$)	−0.715	−4.516	−2.625	−0.238	−1.388
	(−1.08)	(−0.90)	(−1.16)	(−0.29)	(−0.83)
Recessions ($\widehat{\gamma_u^+}$)	−1.025	2.170	2.938	−1.785	−1.274
	(−1.58)	(−0.90)	(1.29)	(−1.78)	(−0.79)
Symmetry test	0.797	0.274	0.176	0.394	0.969

Notes: Notes: (1) $\widehat{\gamma_u}$ is the estimated coefficients for cyclicality in Eq. (5); (2) $\widehat{\gamma_u}^+$ and $\widehat{\gamma_u}^-$ indicate cyclicality in economic recessions and expansions, respectively; (3) The symmetry test is the probability of the Wald test for the null that $\widehat{\gamma_u}^+ = \widehat{\gamma_u}^-$ in Eq. (6); (4) t-values in parenthesis

References

Abraham, K. G., and J. C. Haltiwanger (1995): "Real Wages and the Business Cycle," *Journal of Economic Literature*, 33(3), pp. 1215–1264.

Beaudry, P., and J. DiNardo (1991): "The Effect of Implicit Contracts on the Movement of Wages over the Business Cycle: Evidence from Micro Data," *Journal of Political Economy*, 99(4), 665–88.

Bils, M. J. (1985): "Real Wages over the Business Cycle: Evidence from Panel Data," *Journal of Political Economy*, 93(4), 666–89.

Blanchard, O. J. (1986): "The Wage Price Spiral," *The Quarterly Journal of Economics*, 101(3), 543–65.

Castro, R., and D. Coen-Pirani (2008): "Why have aggregate skilled hours become so cyclical since the mid-1980s?," *International Economic Review*, 49(1), 135–185.

Clark, K. B., and L. H. Summers (1981): "Demographic Differences in Cyclical Employment Variation," *Journal of Human Resources*, 16(1), 61–79.

Devereux, P. J., and R. A. Hart (2006): "Real wage cyclicality of job stayers, within-company job movers, and between-company job movers," *Industrial and Labor Relations Review*, 60(1), 105–119.

Hart, R. A. (2006): "Worker-Job Matches, Job Mobility and Real Wage Cyclicality," *Economica*, 73(290), 287–298.

Kydland, F. E. (1984): "Labor-force heterogeneity and the business cycle," *Carnegie-Rochester Conference Series on Public Policy*, 21(1), 173–208.

Lopez-Villavicencio, A., and S. Saglio (2013): "Modelling downward and upward wage flexibility at the macroeconomic level," *Munich Personal RePEc Archive Working Paper*.

Martins, P. S. (2007): "Heterogeneity in Real Wage Cyclicality," *Scottish Journal of Political Economy*, 54(5), 684–698.

Mitchell, M., M. Wallace, and J. Warner (1985): "Real Wages over the Business Cycle: Some Further Evidence," *Southern Economic Journal*, 51, 1162–1173.

Parker, J. A., and A. Vissing-Jorgensen (2010): "The Increase in Income Cyclicality of High-Income Households and Its Relation to the Rise in Top Income Shares," *Brookings Papers on Economic Activity*, 41(2 (Fall)), 1–70.

Pavlopoulos, D., D. Fouarge, R. Muffels, and J. K. Vermunt (2007): "Who benefits from a job change: The dwarfs or the giants?," IRISS Working Paper Series 2007-16, IRISS at CEPS/INSTEAD.

Piketty, T., and E. Saez (2012): "Top Incomes and the Great Recession: Recent Evolutions and Policy Implications," *IMF, 13th Jacques Polak annual research conference*.

Shin, D., and K. Shin (2008): "Why Are The Wages Of Job Stayers Procyclical?," *Macroeconomic Dynamics*, 12(01), 1–21.

Shin, D., and G. Solon (2007): "New Evidence On Real Wage Cyclicality Within Employer-Employee Matches," *Scottish Journal of Political Economy*, 54(5), 648–660.

Smith, J. C. (2000): "Nominal Wage Rigidity in the United Kingdom," *Economic Journal*, 110(462), C176–95.

Solon, G., R. Barsky, and J. A. Parker (1994): "Measuring the Cyclicality of Real Wages: How Important Is Composition Bias?," *The Quarterly Journal of Economics*, 109(1), 1–25.

Solon, G., W. Whatley, and A. H. Stevens (1997): "Wage Changes and Intrafirm Job Mobility over the Business Cycle: Two Case Studies," *Industrial and Labor Relations Review*, 50(3), pp. 402–415.

Swanson, E. T. (2007): "Real wage cyclicality in the PSID," Discussion paper.