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

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Abstract

In this paper we analyze the cyclicality of real wages. Using the BHPS over the 1991-2008 period, we distinguish individuals according to their wage level and study their wage cyclicality during recessions and expansion. Our results show that the cyclicality depends on the position of the workers in the wage distribution. In particular, top salaried workers are more procyclical than lower ones. A one-point increase in the unemployment rate decreases wages of the top 10% male workers by around 2.5% and by just 1.5% for all individuals in the sample. Moreover, the estimated cyclicality can be as high as 4% in recessions for top earners. We provide evidence that real earnings are acyclical for low wages and we conclude that an important portion of that acyclicality probably is due to the reduction of hours worked during labor market downturns.

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

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1 Introduction

The behavior of real wages over the cycle has captured the interest of both policy-makers and economists for several reasons. Indeed, how unemployment and other real disturbances affect wages is important for the understanding of the labour market adjustment, the sluggishness in firms' marginal cost or their price setting behavior, etc. Therefore, the way in which real wages fluctuate over the business cycle has important implications for both households and firms.

Even if it is well accepted that real wages are not constant over the cycle, there are 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 movement. Theoretically, real wages are suppose to be counter-cyclical under sticky wages but procyclical under sticky prices. More precisely, Keynesian models with sticky nominal wages that predict counter-cyclical real wages have been criticized and rejected in favor of Real Business Cycle (RBC) or New Keynesian (NK) models that, based on price stickiness and imperfect competition, yield pro-cyclical wages.[1] However, given the inability of the previous models to be reconciled with observed data in some cases, 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)). More recently, Cervini-Plá et al. (2012) propose a model with adjustment costs in the form of labor disruption charges that can generate counter-cyclical or even acyclical real wages.

The empirical literature is no less conclusive. Indeed, macro studies usually find counter-cyclical real wages whereas most of the literature based on panel micro data document substantial procyclicality.[2] 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. For example, low-wage workers tend to have substantially more cyclical hours and employment than high-wage workers, so that in every re-

[1] See Abraham and Haltiwanger (1995) for a discussion of alternative hypotheses concerning the cyclicality of real wages.

[2] 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.

cession, 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. In addition, the choice of the time period analysis, price deflator, and cyclical indicator may substantially affect the estimates of real wage cyclicality in aggregate studies (Abraham and Haltiwanger (1995)).

A number of micro studies find that wages in fact change in a procyclical way. However, 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, whereas Mitchell, Wallace, and Warner (1985) study heterogeneity according to age, sex and race; Bils (1985) centers on differences between blacks and whites and Hart (2006) makes the distinctions for males and females. The consensus of these studies is that there is little heterogeneity in cyclical wage responses for any of these groups. However, Bils (1985), Solon, Barsky, and Parker (1994), Devereux and Hart (2006), Hart (2006) or Shin and Solon (2007) do find differences among individuals who are moving between employers or in and out of the work force. Recently, Hart and Roberts (????) find significant differences between pieceworkers and timeworkers in the UK.

Even though all the previous studies questioned the validity of the average measure of wages and stressed the importance of controlling for composition bias in obtaining accurate measurements of wage cyclicality, the possibility that cyclically may differ among different workers in the wage distribution is largely neglected in the literature. In this paper we explore this possibility using wave 1 to 18 of the British Household Panel Survey. In addition to exploring the heterogeneity among wage groups we formally study if economic recessions and expansions affects workers at the upper or at the lower tail of the distribution in the same way. We finally look at hours worked during booms and busts for the different wage groups.

Our main contribution to the wage cyclicality literature is to provide evidence of two types of heterogeneity that have been largely ignored in micro studies. Indeed, our results show that wages are procyclical. Nonetheless, cyclicality is considerably higher in economic recessions. This implies that wages fall when the unemployment rate increases. However, the response of wages in economic expansions is mild or even non-existent. Moreover, we show that this cyclicality is different for different wage groups. In particular, cyclicality is stronger 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. These results contradict previous studies that suggest that individual wages in the United States tend to be pushed upwards during boom years but not pushed downwards during slumps (e.g. Beaudry and DiNardo (1991),). Finally, we propose that an important portion of that acyclicality for low wages probably is due to the reduction of hours worked during labor market downturns.

This paper is organized as follows: Section 2 explore the literature review on heterogeneity in wage cyclicality; Section 3 presents the empirical methodology. Section 4 explains the dataset used. Section 5 presents the results and Section 6 concludes.

2 Heterogenous wage cyclicality

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 different characteristics in workers. In particular, we are interested in the heterogeneity that arises across high- and low-wage individuals. The second source of heterogeneity describes the different responses that may be elicited between the phases of the economic cycle.

Regarding the first type of heterogeneity, 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 recently a literature suggesting quite the opposite effect. Indeed, this 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 high-income households in the United States and Canada have become more than twice as sensitive to aggregate income fluctuations as the income of the average household. Moreover, they show that there is a link between increased income inequality and increased income cyclicality at the top.[3]

In addition, Swanson (2007), Parker and Vissing-Jorgensen (2010) or Piketi and

[3]Parker and Vissing-Jorgensen (2010) show that income cyclicality of households in the top 1 percent is roughly similar if one leaves out households with stock options.

Saez (2012) propose that the evolution of top incomes is not exclusively due to capital or entrepreneurial income. In effect, 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.[4] In this context, we should expect higher cyclicality of wages at the top when compared to the lower percentiles.

With respect to the second type of heterogeneity, there is a substantial body of literature stressesing that various economic variables, such as output, employment and wages, often exhibit asymmetry. In particular, one of the key findings is that wages increases are stronger and faster than wages decreases. This literature relates to the downward wage rigidity hypothesis going back at least to the times of Keynes, who emphasized, for instance, that workers were so concerned about their wages relative to those at other firms that no company dared to cut pays.

Several theories have been developed to explain why firms may find it optimal to refrain from cutting wages in recessions, even though wage reductions would decrease labor costs. The most prominent of these theories are contract theory, implicit contract theory, efficiency wage theory, and insider-outsider theory.

For instance, efficiency wages models postulate that in order too maintain the wage premium, firms may be willing to adjust wages promptly when competitors' wages rise but delay adjustment when competitors' pay declines. Downward rigidity in the labor market can also be rationalized through the presence of labor contracts that specify in advance the nominal wage that prevails for the contract duration. In this scenario, it is possible that nominal wage rigidity may be asymmetric in response to positive and negative demand shocks (Magda (1996)). The idea is as follows. Usually contracts stipulate an indexing parameter that allows for an additional adjustment of the nominal wage in response to unexpected changes in the price level that are realized after contract negotiation. According to Magda (1996), the degree of indexation may be larger in response to positive demand shocks compared to negative shocks because of institutional settings that differentiate wage and salary negotiations in the upward and downward directions. Also, firms may be reluctant to adjust wages in the downward direction during recessionary periods

[4]Based on data for the US, Parker and Vissing-Jorgensen (2010) shows that income cyclicality of households in the top 1 percent is roughly similar if one leaves out households with stock options. In the same line, Piketi 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

because the search and training cost of hiring new workers may actually exceed the perceived loss of retaining workers at wages that exceed the marginal physical product of labor during recessionary periods.

Downward rigidity might apply to nominal values if people care about nominal wages, if contracts are written using nominal terms, or if inflation serves as a vehicle for a coordinated reduction in real wages(Holden and Wulfsberg (2009)). However, it is real, not nominal wages, that rational agents are supposed to care about. Downward real wage rigidity is defined on the basis of wage indexation. Firms that have an automatic link between nominal base wages and past or expected inflation are subject to downward real wage rigidity. As in the case of nominal wages, efficiency wage or bargaining models also provide numerous explanations as to why, in a situation of high unemployment, real wages do not fall in order to clear the labour market.

More recently, the behavioral justification for downward wage rigidity it that agents specifically dislike negative changes in their income more than they value additional gains (Holden and Wulfsberg (2009)). A number of studies have documented the existence of loss aversion, meaning that people are more averse to losses relative to their reference level than they are attracted to the same-sized gains (e.g. Kahneman and Tversky (1979)). Falk, Fehr, and Fischbacher (2005) show in experiments that employers refrain from cutting prevailing wages, out of fear that lower wages may have an unfavorable effect on work efforts.

The scarce literature tends to give some support to an asymmetric feature of wages according to different types of employees. Distinguishing between recessions and expansions, Shin and Shin (2008) provide evidence that real wages are procyclical for those who stay with the same employer. More precisely, they find that the wage procyclicality among job stayers is mainly explain 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. Their finding explains how real wages of job stayers behave asymmetrically over the cycle providing support to the theoretical prediction of implicit contracts that consider that employer shields the worker from changes in economic conditions. More recently, Martins (2007) finds evidence that most wage cyclicality estimates are driven by wage increases in periods of expansion, and not by wage cuts or lower wage growth in periods of recession. Since his specifications contain both the change in the unemployment rate and and a dummy for periods in which the unemployment rate increases his findings may be

subject to collinearity. Moreover, Martins (2007) fails to provide any formal test of asymmetries over the business cycle.

3 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:

$$\ln w_{it} = \alpha_t + \delta_1^{'} Z_i + \delta_2 A_{it} + \delta_3 A_{it}^2 + \delta_4 T_{it} + \delta_5 T_{it}^2 + \epsilon_{it} \tag{1}$$

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), in order to control for both the observable and unobservable elements of Z, we first- difference equation (1) to obtain:

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

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:

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

where t is a linear time trend, U_t is the unemployment rate in year t and υ_t is the error term. The quadratic in time is included to account for secular trends, and γ_4 is the cyclical elasticity of real wage's with respect to the unemployment rate, (i.e γ_4 captures the wage cyclicality). Taking the first difference of Eq. (3) gives:

$$\Delta\alpha_t = (\gamma_2 - \gamma_3) + 2\gamma_3 t + \Delta\upsilon_t \tag{4}$$

Substituting (4) in Equation (2) yields:

$$\Delta \ln w_{it} = (\gamma_2 - \gamma_3) + 2\gamma_3 t + \gamma_4 \Delta U_t + \beta^{'} X_{it} + (\Delta\epsilon_{it} + \Delta\upsilon_t) \tag{5}$$

As noticed by Solon, Whatley, and Stevens (1997) one way to estimate the cyclical wage elasticity is to to apply ordinary least squares (OLS) to equation (5). 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 (5) by applying generalized least squares (GLS) to Eq. (5), which provides efficient coefficient estimates and consistent standard error estimates.[5]

Equation (5) represents the standard wage cyclicality relationship which is based on the assumption that real wages are pushed upwards during boom years in the same magnitude that they are pushed downwards during slumps. 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:

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

Such that U_t^+ captures recessions and U_t^- expansions. Replacing ΔU_t in Equation (5) by its decomposition into positive and negative components, we get to the following asymmetric extension of the real wage cyclicality equation:

$$\Delta \ln w_{it} = (\gamma_2 - \gamma_3) + 2\gamma_3 t + \gamma_4^+ \Delta U_t^+ + \gamma_4^- \Delta U_t^- + \beta' X_{it} + (\Delta \epsilon_{it} + \Delta \upsilon_t) \qquad (6)$$

where all the variables were previously defined and $\Delta U_t^+ + \Delta U_t^- = \Delta U_t$ by definition. Note that ΔU_t^+ (ΔU_t^-) takes positive (negative) values for a positive (negative) variation of the unemployment rate, and 0 otherwise. Hence, the coefficient δ^+ in Equation (7) will be negative and significant if we expect wages to decrease in periods of recession (i.e when the unemployment rate increases). Equally, the coefficient δ^- will be also negative if wages increase in periods of expansion (or for reductions of the unemployment rate).

The reaction symmetry of the wage cyclicality can be verified with a Wald statistic testing the null hypothesis assumption that $\gamma_4^+ = \gamma_4^-$. If γ_4^+ is higher to γ_4^-, then

[5]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.

there is an asymmetry where positive changes of the unemployment rate (i.e recessions) have higher impact on real wage contractions than negative changes.

Finally, we estimate the following first-difference wage equation:

$$\Delta \ln w_{ijt} = (\gamma_2 - \gamma_3) + 2\gamma_3 t + \gamma_4^+ \Delta U_t^+ + \gamma_4^- \Delta U_t^- + \beta' X_{ijt} + (\Delta \epsilon_{ijt} + \Delta \upsilon_t) \quad (7)$$

in which j concerns the wage group, defined in terms of net or gross real hourly wage. For each of the subgroups, an employment equation of the following form was estimated using annual data for the same period:

$$\Delta s_{it} = \alpha_{0i} + \alpha_1 \Delta UR_t + \alpha_2 t + \epsilon_{it} \quad (8)$$

In Equation 8, Δs_{it}, measures the yearly change in the hors worked of each group i and the rest of the variables are defined as before. We include t, a linear trend as a proxy for any other variables that systemically affect hours worked.

and:

$$\Delta s_{it} = \alpha_{0i} + \alpha_1^+ \Delta U_t^+ + \alpha_1^- \Delta U_t^- + \alpha_2 t + \epsilon_{it} \quad (9)$$

ΔU_t^+ (ΔU_t^-) measures the rate at which the unemployment rate is is currently expanding (declining). As such, the estimated coefficient tells by how much real wages decrease (increase) in economic recessions (expansions).

4 Data and descriptive statistics

Our empirical 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 across Great Britain consisting of around 5500 households. 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.[6]

Our sample is restricted to include only full-time working males between 25 and 55 years old. Specifically, we select males who declared paid employment to be their main activity and who work at least 35 hours a week. We use this restricted sample to avoid several potential erogeneity problems. First, we restrict our sample only

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

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 do exit. Such a sample selection produces an unbalanced panel since not all persons 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 estimation since we work with the log difference of wages. 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 in average gross hourly wage between two consecutive waves, deflated by the consumer price index. Alternatively, we also consider the net wages as the dependent variable. This distinction is important since there is evidence (**?**) 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 study if there are different patterns in the cyclicality of the gross or net earnings.

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. As the individual can vary the percentile between two consecutive waves, we consider two alternative ways of defining wage groups. The first one consider the percentile the individual belongs in time t. The second alternative considers that an individual belongs to a certain percentile when he remains two consecutive waves in the same percentile. Individual who earn zero earnings in one of the two consecutive waves are not counted. High-wage individuals are defined to be those with wages in the top decile, and low-income earners those in the bottom percentile. Note that by considering these two definitions of percentiles, we remove acyclical biases. Indeed, selecting workers who remain in the same percentile for the different waves implies selecting only a sample which is reasonably acyclical or at least has the average cyclicality and throw out household that are either very cyclical and so move up and down through percentiles or very noncyclical or even countercyclical who also will move across percentiles.

Table 3 shows the real gross wage by wage group and the minimum gross real wage in the whole economy for the different years of the sample. As seen, the mean

hourly real wage for the lowest 10% in the wage distribution was less than 4.04 pounds in 1991 whereas workers at the top percentile earn in real terms at least 10.9 pounds in 1991. By 2008, real wage for bottom earners was less than 5.64 pounds, far below the 7.7 pounds established by the minimum wage. For top earners, wage in real terms was at least 14.5 pounds per hour.

The key explanatory variable is the change in the unemployment rate. We calculate this variable as the change in the average national unemployment rate from year t to year $t-1$ and is intended to reflect movements in the business cycle. For the asymmetric estimation, we decompose the unemployment rate as in Eq.(6). The rest of the explanatory variables are age, age square and time fixed effects.

Finally, we 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 via hours worked rather wages at the bottom wage distribution. In this case, we consider all men between 25 and 55 years old who have ever worked and calculate the change in their declared hours worked. As seen in Table 4, the number of hours worked decreases in each recession –which corresponds to an unemployment rate increase– for all the units and each percentile. However, this change is stronger for lower percentiles than for higher ones. As it is shown in the table, for the year 1992 for example, the fall in hours worked is 16.8% for the 10% of lower wages compared to a decrease of 9.2% in the highest percentile. Similar differences are observed in 1993, 2002, 2006 and 2008. The link between hours worked and economic expansions (i.e. decreases in the unemployment rate) is less clear.

5 Results

The top panel of table 1 presents our main findings on cyclicality for all the individuals in our sample and for the different wage groups. In accordance with previous studies based on micro data, the symmetric business cycle variable (γ_4) indicates highly procyclical wages for employed individuals of our sample. Indeed, a percentage point rise in the unemployment rate is associated with a decrease of wages of about 1%.[7]

[7]For instance, Bils (1985) find a cyclicality of -1.5 and -1.6 for male and female job stayers, respectively. In Devereux and Hart (2006) the results are quite similar (-1.7 and -1.7 for male and female job stayers). Based on more recent date, Parker and Vissing-Jorgensen (2010) estimate a

Our main contribution is, however, to explore two types of heterogeneity. First of all, we analyse cyclicality on the wage distribution. Second, we test asymmetric reaction of wages during a positive or negative shock to the unemployment rate (i.e. recession and expansions).

Related to the first type of heterogeneity, 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, as the results show, 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 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, they 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.

Regarding the second type of heterogeneity, the Wald statistic testing the null hypothesis assumption that $\widehat{\gamma_4^+} = \widehat{\gamma_4^-}$ (i.e. the 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 out attention to the asymmetric cycle indicators in the second panel of table 1. The findings in this case are even more outstanding. In effect, our results indicate that for the whole sample the cyclicality of real wages is mainly the result of real wages decreasing in recessions –when the unemployment rate increases- but not expanding during economic booms –when the unemployment rate decreases-; $\widehat{\gamma_4^-}$ being not significant. 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 of wages of more than 2%.

The fact that real wages can be downward flexible but upward rigid is novel in micro data but not without precedent at the aggregate level. For instance, Smith (2000) investigates the extent of nominal rigidity in the UK labour market in the 1990s. She finds substantial downward flexibility. Similarly, Lopez-Villavicencio and Saglio (2012) investigate asymmetries over the cycle in aggregate time series for

value of 2.4 for all tax units in their sample of USA households.

OECD countries. They find that real wages decrease more in recessions than their increase in expansions in the UK.

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 1.4%. That is, 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% wage groups by 2.5% and 4.1%, respectively, cuts in the unemployment rate do not affect real wages. This finding may indicate upward real wage rigidity for top wages. The symmetry hypothesis, in turn, cannot be rejected for the bottom 10% in the wage distribution, indicating that wages are acyclic as indicated by the symmetric model.

So far, our analysis considers wage groups that are defined according to wages of employed workers in each wave. This means that each wage group of the distribution contains somewhat different people from year to year. The table 1 also presents the results for units that remain in the same percentile for two consecutive waves (for instance, they start at the top 10% and they remain there for two years). Note that, since we are removing part of the cyclicality in this case –we are throwing out some workers that are very cyclical and so move up and down through percentiles– the levels of cyclicality are lower than in the previous cases. In this case, wages are cyclic also during expansions for the whole sample of individuals but the estimated coefficient remains statistically lower than in recessions (at the 10% level). What is important though is that our results are quite similar than before, outlining the robustness of our findings.

Moreover, we emphasize that the increase in top income cyclicality is robust to alternative measures of wages. Indeed, as seen in table 5 in the appendix, net real wages –wages after taxes and transfers– are less cyclical than gross wages for all the individuals in the sample and for the top percentile of the wage distribution. As it is the case for gross wages, cyclicality for the lowest percentiles is not significant. This means that, contrary to the findings in Parker and Vissing-Jorgensen (2010), taxes and transfers do not affect the cyclicality at the bottom of the wage distribution, with wages not being significant in either case. Even when considering taxes and transfers, there is a very important difference among wages groups.

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

	All units	Lowest 10%	Lowest 25%	Top 25%	Top 10%
			WHOLE SAMPLE		
Symmetric					
Cyclicality ($\widehat{\gamma_4}$)	−1.037	0.121	−0.623	−0.792	−1.346
	(−4.02)	(0.06)	(−0.68)	(−4.06)	(−3.98)
Asymmetric					
Recessions ($\widehat{\gamma_4^+}$)	−2.138	5.401	1.349	−2.554	−4.163
	(−3.16)	(1.12)	(0.60)	(−2.42)	(−2.61)
Expansions ($\widehat{\gamma_4^-}$)	0.021	−5.157	−2.531	0.842	1.466
	(0.03)	(−1.00)	(−1.14)	(0.84)	(0.88)
Symmetry test	0.043	0.238	0.340	0.075	0.048
			INDIVIDUALS LINKED ACROSS 2 WAVES		
Symmetric					
Cyclicality ($\widehat{\gamma_4}$)	−0.436	−0.660	−1.429	−1.247	−1.387
	(−3.70)	(−0.39)	(−1.78)	(−3.80)	(−3.75)
Asymmetric					
Recessions ($\widehat{\gamma_4}^+$)	−1.143	−0.699	−1.489	−1.903	−3.149
	(−2.43)	(−0.16)	(−0.69)	(−4.30)	(−3.37)
Expansions ($\widehat{\gamma_4^-}$)	0.845	−0.620	−1.371	0.567	0.266
	(1.71)	(−0.14)	(−0.67)	(0.64)	(0.28)
Symmetry test	0.077	0.992	0.976	0.002	0.039

Notes: (1) $\widehat{\gamma_4}$ is the estimated coefficients for cyclicality in Eq. (5); (2) $\widehat{\gamma_4}^+$ and $\widehat{\gamma_4}^-$ indicate cyclicality in economic recessions and expansions, respectively; (3) The symmetry test is a Wald test for the null that $\widehat{\gamma_4}^+ = \widehat{\gamma_4}^-$ in Eq. (6).

How to explain this acyclicality of individuals at the bottom wage distribution and the high cyclicality at the top?. The literature has emphasize 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.

In this paper, we explore an alternative explanation by looking at the adjustments in the hours worked in each percentile during booms and busts. In particular,

we propose that in case of labor market downturns, bottom wage percentiles are pushed to work less hours than in normal of boom periods. The idea is as follows. Individuals at the bottom percentile are close to the minimum wage. Even more, as seen in table 3, since 2005 wages at the 10% are even lower than the national real hourly wage. This means that, in case of positive shocks to the unemployment rate, that wages for this group of workers cannot decrease as it would be the standard mechanism in the labour market. Therefore, one could infer that adverse shocks eventuate in hours worked –or even job losses– rather than wage adjustments for lower wages.

The literature tends to give some support to the proposition that working hours are the adjustment mechanism in some cases. 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.

We investigate to what extent hours cyclicality represent an adjustment mechanism in the labour market. To this end, we extend the sample to all men in the restricted age group that ever worked in the sample. If he does not work in the following periods, we impute 0 hours worked. This allow us as to capture switches from employment to unemployment as well as reductions in the hours work for workers who remain in the labour force. We use the average usual hours worked per week in each year for each individual belonging to each different wage groups. For each group we regress the change in average hours on the change in unemployment for the same period.

The results for hours worked are presented in table 2. With the exception of the top 10% wage salaried workers, the variable $\widehat{\gamma_4}$ –the cyclicality for working hours– is 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 1.6 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 in recessions but do not increasing during expansions for bottom wage earners. On the contrary, hours worked at the top 10% are not sensitive to the economic cycle, as measured by changes in the

unemployment rate.[8].

Our previous results do not entirely support the proposition of a counter-cyclical bias in aggregated data caused by persons with lower wages entering the work force in good times (Stockman (1983), Bils (1985), etc.). Indeed, Stockman (1983) suggests that during an expansion, average aggregate real wages should not rise as much –should be more countercyclical– if more low-waged, unskilled workers gain jobs compared to highly skilled, high-waged workers. However, our results clearly show that in economic booms, individuals with low wages do not work more hours. Moreover, given the non significance of hours worked –a measure that increases with individuals entering the labour force– for lower percentiles in expansions, there is no reason to believe that in good times low-waged workers gain jobs. Nonetheless, during a recession, average aggregate real wages should not fall as much –also being more countercyclical– because more low-waged workers lose jobs compared to high-waged workers. In fact, from our results we could infer that the bias can arise only in recessions.

6 Final remarks

The aim of this paper is to investigate the cyclicality of real wages by paying a particular attention to heterogeneity among different wage groups due to positive and negative shocks to the unemployment rate. Relying on micro data from the British Household Panel Survey covering the 1991-2008 period allows us to drop the assumption that the relationship between real wages and the business cycle is the same for all individuals, a feature that is supposed to cause a bias in aggregate data.

We decompose the unemployment rate in to its positive and negative components and formally test if the estimated coefficient in the recessions and expansions is symmetric. Our results show that the cyclicality is considerably different when comparing bottom and top wages. Moreover, we provide evidence of acyclicity or rigidity for the lower wage- earners. However, top wages are characterized by a strong cyclycality in recessions, implying that when the unemployment rate increases real

[8]Close to our estimates, Parker and Vissing-Jorgensen (2010) find a non-significant cyclicality of hours worked 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.

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

	All units	Lowest 10%	Lowest 25%	Top 25%	Top 10%
			WHOLE SAMPLE		
Symmetric					
Cyclicality $\widehat{\alpha_1}$	−1.637	−2.981	−2.397	−0.777	−0.259
	(−11.78)	(−4.39)	(−5.88)	(−3.75)	(−0.81)
Asymmetric					
Recessions $\widehat{\alpha_1^+}$	−3.120	−5.541	−3.91	−2.245	−0.585
	(−9.95)	(−3.53)	(−4.27)	(−4.65)	(−0.79)
Expansions $\widehat{\alpha_1^-}$	−0.247	−0.565	−0.976	0.580	0.045
	(−0.78)	(−0.37)	(−1.97)	(1.24)	(0.06)
Symmetry test	0.000	0.070	0.001		0.630
			INDIVIDUALS LINKED ACROSS 2 WAVES		
Symmetric					
Asymmetric					

Notes: (1) Notes: (1) $\widehat{\alpha_1}$ is the estimated coefficients for hours worked cyclicality in Eq. (8); (2) $\widehat{\alpha_1}^+$ and $\widehat{\alpha_1}^-$ indicate cyclicality in economic recessions and expansions, respectively; (3) The symmetry test is a Wald test for the null that $\widehat{\alpha_1}^+ = \widehat{\alpha_1}^-$ in Eq. (6).

wages decrease. Not a symmetric effect is found in expansions. This result tend to indicate that real wages are downward flexibility but upward sticky for the top 10% on the wage distribution. These characteristic can not be captured by a static linear model, suggesting that the rich flexibility embedded in our proposed model may prove highly beneficial.

In addition, we show that hours worked for the low wage percentile react strongly to increase in the unemployment rate than to decreases. This is coherent with the fact that, given that wages of workers in this group are close –or even lower– than the minimum real wage, workers are unable to work for a lower pay in order to keep their jobs. Instead, adjustments in the labour market take place via employment.

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, the aggregate statistic will be a poor mea-

sure of the experience of typical worker. Second, the average, aggregate real wage might be affected by cyclical changes in hours worked by low pay workers in times of recession.

Finally, the conventional wisdom suggesting that low-income (wage) households experience the greatest changes in response to macroeconomic conditions – their income (wage) falls the most when the economy weakens, and it picks up the most when the economy recovers– does not hold for individuals in our sample.

7 Appendix

Table 3: **Real gross wage by wage group and minimum gross real wage whole economy.**

	Lowest 10%	Lowest 25%	Top 25%	Top 10%	Minimum wage
1991	4.04≤	5.43≤	≥7.57	≥10.9	n.a
1992	4.12≤	5.59≤	≥7.80	≥11.19	n.a
1993	4.09≤	5.65≤	≥7.87	≥11.31	n.a
1994	4.06≤	5.61≤	≥7.93	≥11.38	n.a
1995	4.23≤	5.68≤	≥8.04	≥11.51	n.a
1996	4.21≤	5.65≤	≥7.96	≥11.42	n.a
1997	4.25≤	5.63≤	≥7.95	≥11.27	n.a
1998	4.42≤	5.86≤	≥8.03	≥11.62	n.a
1999	4.54≤	5.99≤	≥8.19	≥11.72	n.a
2000	4.84≤	6.25≤	≥8.57	≥12.16	4.72
2001	4.98≤	6.46≤	≥8.82	≥12.62	4.79
2002	5.21≤	6.65≤	≥9.23	≥13.19	4.82
2003	5.34≤	6.83≤	≥9.26	≥13.31	4.85
2004	5.42≤	6.99≤	≥9.56	≥13.60	5.31
2005	5.54≤	7.16≤	≥9.77	≥13.95	6.19
2006	5.68≤	7.27≤	≥9.85	≥14.22	5.63
2007	5.67≤	7.27≤	≥9.91	≥14.23	6.15
2008	5.64≤	7.25≤	≥10.03	≥14.50	7.71

Notes: (1) n.a. means not available. The National Minimum Wage (NMW) was established in the UK in April 1999; (2) Minimum real wages are provided by the OECD

Table 4: **Percentage change in hours worked by wage group.**

	All units	Lowest 10%	Lowest 25%	Top 25%	Top 10%	Unemployment Variation
1992	-11.7	-16.8	-10.2	-10.8	-9.0	positive
1993	-9.4	-10.0	-10.3	-8.4	-8.8	positive
1994	-0.5	11.4	0.5	0.5	-0.8	negative
1995	-3.7	-15.4	-3.0	-2.6	-3.5	negative
1996	2.5	4.4	-2.5	2.4	5.0	negative
1997	16.4	16.1	19.6	14.9	15.4	negative
1998	-3.0	-7.7	-3.9	-2.4	-0.7	negative
1999	31.3	21.5	24.2	31.1	26.4	negative
2000	0.4	-5.2	2.9	2.8	2.9	negative
2001	12.6	13.9	4.7	10.2	9.8	negative
2002	-12.1	-27.2	-15.5	-11.1	-10.7	positive
2003	-3.8	6.7	-3.0	-1.4	-1.7	negative
2004	-3.3	0.8	-3.2	-5.1	-6.5	negative
2005	-2.3	1.8	-2.6	-2.0	-5.3	positive
2006	-3.4	-10.5	-5.4	-3.2	1.0	positive
2007	-2.2	-6.5	-5.0	0.2	-0.8	negative
2008	-4.4	-5.2	-4.7	-4.7	-4.8	positive

Notes: (1) All numbers are percentage change with respect to the previous year; (2) A positive (negative) unemployment variation ir related to a recession (expansion).

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

	All units	Lowest 10%	Lowest 25%	Top 25%	Top 10%
			WHOLE SAMPLE		
Symmetric					
Cyclicality ($\widehat{\gamma_4}$)	−0.750	1.933	1.302	−0.962	−0.898
	(−3.23)	(0.97)	(1.51)	(3.44)	(−4.51)
Asymmetric					
Recessions ($\widehat{\gamma_4^+}$)	−1.272	2.366	3.836	−1.724	−3.597
	(3.17)	(1.56)	(1.70)	(3.75)	(−2.61)
Expansions ($\widehat{\gamma_4^-}$)	−0.247	−3.523	−1.136	−0.247	1.725
	(0.39)	(−0.72)	(0.53)	(−0.29)	(1.20)
Symmetry test	0.383	0.213	0.220	0.038	0.036
			INDIVIDUALS LINKED ACROSS 2 WAVES		
Symmetric					
Cyclicality ($\widehat{\gamma_4}$)	−0.329	0.876	0.056	−1.317	−1.342
	(−4.68)	(0.57)	(0.08)	(−4.04)	(3.62)
Asymmetric					
Recessions ($\widehat{\gamma_4^+}$)	−0.345	1.365	0.995	−2.400	−2.924
	(−4.70)	(0.36)	(0.48)	(−4.49)	(−3.63)
Expansions ($\widehat{\gamma_4^-}$)	0.093	0.393	−0.843	−0.236	1.635
	(0.19)	(0.10)	(−0.45)	(−0.29)	(2.95)
Symmetry test	0.631	0.889	0.616	0.007	0.014

Notes: Notes: (1) $\widehat{\gamma_4}$ is the estimated coefficients for cyclicality in Eq. (5); (2) $\widehat{\gamma_4}^+$ and $\widehat{\gamma_4}^-$ indicate cyclicality in economic recessions and expansions, respectively; (3) The symmetry test is a Wald test for the null that $\widehat{\gamma_4}^+ = \widehat{\gamma_4}^-$ in Eq. (6).

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