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Abstract

We investigate the cyclicality of real wages and income using individual data for the UK over the 1991-2008 period. By paying special attention to heterogeneity among different income groups, we document that top incomes and wages are more cyclical than lower ones. Moreover, the estimated cyclicality is considerably higher in recessions than in expansions for top-incomes. We also show that real wages and income are acyclical for low income workers. Instead, their adjustment to the cycle takes place through transitions to and from unemployment.

JEL Classification: E24, E32, J31.
Keywords: real wage, cyclicality, heterogeneity, income groups

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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 countercyclical 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 oc-

[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.

curring 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 the job. 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 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 income distribution has not received enough attention in the literature. In this paper, we propose that wage and income 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-income workers.

We explore this source 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] This literature, however, disregards low-income individuals and, therefore, do not adequately address the relationship between the business cycle and income distribution.

[2]Based on data for the US, 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. 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.

We go beyond the previous literature by analysing how the business cycle affects income and wages at different points of the income distribution. This allows us to report the differences between the bottom and the top income groups. Moreover, our database avoids some drawbacks of the previous studies. First, contrary to Parker and Vissing-Jorgensen (2010), our unit of observation is an individual and not a tax unit. This is an important advantage because the steady downward trend in the number of individuals per tax unit over time implies that relying on this units possess a problem for measurement of trends if this ratio changes unevenly across income groups. Second, instead of working with repeated cross sections, we rely on a panel of observations. As such, we are able to track income changes for a constant population of individuals and not for groups of households that overlap but are not completely identical across years.

We demonstrate that there is a type of heterogeneity that has been largely ignored in micro oriented studies. Indeed, our results show that income and wages are procyclical. Nonetheless, we show that this cyclicality differs across income groups. In particular, cyclicality is stronger for workers who are at the top of the income distribution. On the contrary, moving to the lower tail of the distribution provides acyclical income and wages. We also provide evidence that income and wage cyclicality are not the same during economic expansions and recessions. Indeed, income of top-income individuals is more cyclical in expansions, contrary to wages that react stronger during recessions. However, income and wages of low-income individuals are acyclical in both expansions

and recessions. We reconcile our findings by showing that an important portion of the acyclicality for low wages is due to the loss of jobs. Another possible explanation for acyclical income and real wages among low income individuals is the role that benefits and transfers play in these individuals total income.

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 concludes.

2 Empirical framework

The starting point of our empirical strategy consists on analysing the cyclical exposure of the different income groups. We follow the literature on wage cyclicality and regress, for each percentile, the (log) real wages or income (x) for the i^{th} worker in year t in the whole sample and by wage groups as follows:

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

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):

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

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

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

where t is a linear time trend, Y_t is the GDP in year t and υ_t is the error term. The quadratic in time is included to account for secular trends. Taking the first difference of Eq. (3) and substituting in Equation (2) yields:

$$\Delta \ln x_{it} = \gamma_2 + 2\gamma_3 t + \gamma_y \Delta \ln Y_t + \beta' Z_{it} + (\Delta\epsilon_{it} + \Delta\upsilon_t) \tag{4}$$

Equation (4) represents the standard wage cyclicality relationship where γ_y captures the cyclical elasticity of income or real wage's with respect to GDP growth. Alternatively to the GDP growth, we used the output gap $(y - y_t^*)$ as indicator of the business cycle. This measure allows us to differentiate between economic expansions and recessions with enough observations in both regimes.[3]

As noticed by Solon, Whatley, and Stevens (1997), one way to estimate the cyclical 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

[3]In the case where the growth rates of time series of interest are predominantly positive (negative), this may result in a situation where the number of effective observations in the negative (positive) regime is insufficient for the OLS estimator to be well determined.

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]

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 household head males between 21 and 60 years old. 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 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 income and real wage.

[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.

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

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 variables are the logarithmic change between two consecutive waves in total income and the logarithmic change between two consecutive waves in the average gross hourly wage, both variables are deflated by the aggregate consumer price index.

The key explanatory variables are the the change in gross domestic product and the output gap, which are intended to reflect movements in the business cycle. We calculate the first variable as the change in the log in GDP from year t to year $t-1$.

In order to estimate the income and wage cyclicality for different income groups, we calculate the percentile in which the individual is placed on the entire distribution of income in each wave and consider the percentile to which the individual belongs at time t. High-income individuals are defined to be those with incomes in the top percentile, and low-income individuals those in the bottom percentile. We drop the observations placed at the lowest and higher 1% in the income distribution in order to avoide the extremes of the distribution that are usually reported with more errors.

We also analyse the cyclicality of hours worked for the different income groups. The hypothesis behind this exercise is that the adjustment in the labour mar-

ket might be 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 (i.e. the intensive margin). However, in the second case we extend the sample to all men in the restricted age group that ever worked (extensive margin). 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 income group: i) the percentage of workers with temporary contracts are higher among low income groups, ii) analyzing income percentiles we observe that probably individuals from lower income percentiles are below the poverty line and iii) wages remain close to the minimum established real wage in the UK for the bottom income group. Indeed, about 8 percent of low income individuals have temporary contracts, compared to just 3% for the top income. 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 to the minimum wage. In particular, the mean of the real hourly wage for the bottom 10% reached 6.3 pounds in 2008, almost equal to the established minimum wage (6.2). Yet 6.3 pounds is the mean wage, which implies that many individuals in this group receive wages below the 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

Furthermore, in table 5 we show the main sources of annual individual income by income group. This table documents two main points. First, pensions and benefits account for roughly fifty percent of total income for low income individuals. On the contrary, these sources of income account for only a low share of total income for the top 10 percent. This implies that a main part of the income of low income individuals is, in principle, counter-cyclical or acyclical. Indeed, while government subsidies tend to be counter-cyclical, social security transfers do not react to the cycle probably because they include large components, such as health and pension payments that are acyclical and that dominate the cyclical component, which includes unemployment benefits (Égert (2010)).[7]

Second, whereas pensions are steadily decreasing as a source of total income for the poorest groups since 1991, labour income is increasing. On the contrary, whereas the share of pension, benefits and, in particular, interests, are increasing for top income individuals, income labours has slightly decrease for these individuals.

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.

[7]Note that we exclude from our sample individuals who do not earn any income from labor and do not receive any benefit from Social Security transfers (i.e. pensions or other benefits) nor from unemployment insurance or assistance payments. In the bulk of the literature, poverty rates are calculated as the proportion of households in the population of a particular region at a given moment in time who do not earn any income from these sources.

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 income groups. In accordance with previous studies based on micro data, the symmetric business cycle variable (γ_y) indicates procyclical income and wages. Indeed, a percentage point rise in the GDP is associated with an increase of real income and wages of about 0.8% and 0.6%, respectively. The results with the output gap confirm this cyclicality for the whole sample.

However, our first main contribution is in terms of heterogeneity regarding cyclicality among the different the income groups. At this respect, our results show that real wages and income of the top income workers –particularly the top 10% in the income distribution– are much more responsive to the cycle than lower income groups. In fact, income and wages of the bottom-income individuals –the lowest 10% and 25%– are not influenced by movements in the GDP or the output gap. 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 for bottom wage percentiles. We present evidence –without precedent to the best of our knowledge–that income and earnings of low-income units are roughly acyclical.

Table 1: **Cyclicality of real income and wages by income group**

Elasticity	All units	Lowest 10%	Lowest 25%	Top 25%	Top 10%
		INCOME			
$\widehat{\gamma_y}$	0.767	−0.386	−0.156	0.700	0.720
	(3.18)	(−0.70)	(−0.87)	(2.95)	(1.87)
$\widehat{\gamma_{y-y*}}$	2.514	−0.814	−0.426	2.274	2.431
	(6.15)	(−0.86)	(−1.28)	(5.53)	(3.69)
		WAGES			
$\widehat{\gamma_y}$	0.584	0.409	1.673	0.377	0.120
	(4.83)	(1.38)	(1.63)	(2.18)	(4.41)
$\widehat{\gamma_{y-y*}}$	1.575	0.986	2.458	1.675	1.697
	(8.50)	(0.22)	(1.65)	(5.89)	(4.02)

Notes: (1) $\widehat{\gamma_y}$ and $\widehat{\gamma_{y-y*}}$ are the estimated coefficient for cyclicality according to GDP growth and output gap, respectively; (2) t-values in parenthesis

So far, we have estimated the global effect of the business cycle. However, these effects might differ during expansions and contractions. For instance, Hines, Hoynes, and Krueger (2002) document that the effects of changes in unemployment rates on earnings are larger in recessions for the United States. Shin and Shin (2008), in turn, provide evidence that real wage cyclicality 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.

We follow the this previous literature by allowing real income and wages to react differently. We capture 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 values of the output gap, respectively, and 0 otherwise. We then identify two asymmetric variables defined as $(y-y^*)_t^+ = (y-y^*)_t \times D_1$ and $(y-y^*)_t^- = (y-y^*)_t \times D_2$, such that $(y-y^*)_t^+$ captures the positive component of the output gap and, therefore, expansions and $(y-y^*)_t^-$ captures the negative output gap.[8] Replacing $(y-y^*)_t$ in Equation (4) by its decomposition into positive and negative components, we get to the following asymmetric extension of the real wage cyclicality equation:

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

where all the variables were previously defined and $(y-y^*)_t^+ + (y-y^*)_t^- = (y-y^*)_t$ by definition. Note that $(y-y^*)_t^+$ (resp. $(y-y^*)_t^-$) takes positive (negative) values for the positive (negative) component of the output gap, and 0 otherwise. Hence, the coefficient $(y-y^*)_t^+$ in Equation (5) will be positive and significant if we expect wages or income to increase in periods of expansions. Equally, the coefficient $(y-y^*)_t^-$ will be also positive they decrease in periods of recessions. We verify the reaction symmetry of the wage cyclicality can be verified with a Wald statistic testing the null hypothesis assumption that $\gamma_{(y-y^*)^+} = \gamma_{(y-y^*)^-}$. If the estimated coefficient for $\gamma_{(y-y^*)^+}$ is higher than the estimated $\gamma_{(y-y^*)^-}$, then there is an asymmetry where expansions have higher impact on real wages than contractions. We estimate equation Eq. (5)

[8] In order to capture asymmetric effects during expansions and recessions, we rely on the output gap instead of the GDP growth. We do so in order to have enough variation to identify this split. Decomposing the GDP growth would result on most of the observations belonging to economic expansions.

for all the individuals of our sample and for each wage group.

Table 2 presents the results of the previous asymmetric specification. As seen, the Wald statistic testing the null hypothesis that the estimated rise of wages/income in booms is equal to the fall in recessions cannot be accepted at a 5% critical level for high-income individuals. Interestingly, the results show that whereas income increases particularly in expansions, recessions are particularly harmful for real wages in the top incomes. Note, however, that adding asymmetric effects over the business cycle does not change the acyclicality in lower income groups. This findings imply that economic growth can produce significant changes in a country's income distribution. Certainly, economic downturns are associated with decreasing income for top incomes. However, the increase in income for these individuals during economic expansions more than offset the losses during negative economic conditions. In other words, while leaving the bottom income individual's income unchanged, periods of strong aggregate growth contribute to increase the share of income that receive rich individuals. This probably produces a significant change in a country's income distribution.

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.

Table 2: **Asymmetric cyclicality of real income and wages by income group**

Elasticity	All units	Lowest 10%	Lowest 25%	Top 25%	Top 10%
INCOME					
Expansions: $\widehat{\gamma^{+}_{y-y*}}$	1.739 (3.25)	−4.240 (−0.54)	−5.624 (−1.65)	2.675 (5.41)	3.163 (4.26)
Recessions: $\widehat{\gamma^{-}_{y-y*}}$	2.413 (5.49)	−3.230 (−0.35)	3.719 (1.07)	1.514 (3.17)	1.388 (1.69)
Symmetry test	0.274	0.928	0.041	0.045	0.044
WAGES					
Expansions: $\widehat{\gamma^{+}_{y-y*}}$	0.851 (3.21)	2.028 (0.32)	1.300 (0.61)	0.902 (2.34)	0.798 (1.42)
Recessions: $\widehat{\gamma^{-}_{y-y*}}$	2.263 (10.76)	−0.346 (−0.06)	4.076 (1.70)	2.411 (7.21)	2.536 (4.78)
Symmetry test	0.000	0.775	0.413	0.000	0.012

Notes: (1) $\widehat{\gamma^{+}_{y}}$ and $\widehat{\gamma^{+}_{y-y*}}$ capture expansions according to the GDP growth and output gap, respectively; (1) $\widehat{\gamma^{-}_{y}}$ and $\widehat{\gamma^{-}_{y-y*}}$ capture recessions according to the GDP growth and output gap, respectively; (3) Symmetry test is the probability associated to the null hypothesis that the estimated coefficient is the same in expansions and recessions; (4) t-values in parenthesis

We explore an alternative explanation by looking at the adjustments in the hours worked in each percentile. In particular, given the constraints to reduce wages –which are already low– of low wage workers, we analyse if hours worked of bottom income percentiles are more sensitive to the cycle. The proposition is as follows. Individuals at the bottom percentile are close to the minimum wage. Contrary to high wages, this means that wages for this group cannot decrease –or decrease very little– in adverse conditions. Therefore, one could infer that adverse shocks eventuate in hours worked –or even job losses– rather than wage adjustments for lower wages. Regarding income, the main source

are pensions and benefits which are, as said before, acyclic or counter-cyclical. This should explain, in part, the acyclicality observed for low income individuals.

There are a few studies supporting the proposition that working hours could be 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.

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 GDP and the output gap. The cyclicality of hours is shown in the first panel of table 3. As seen, the estimated cyclicality is non-significant for the whole sample as well as for the different percentiles. This results contradict some previous investigations that find a significant cyclicality of hours worked of all families but non-significant cyclicality for the top 1% income in the case of the United States (e.g. Parker and Vissing-Jorgensen (2010)). On the contrary, 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.

We explore a further possibility by extending the sample to all men, in the restricted 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. We refer to this sample as the extensive margin. The results, presented in table 3, show that the cyclicality for working hours is significant and positive for the whole sample and for the different wage groups. For instance, a 1% decrease in the GDP implies a decrease of about 0.3 hours worked per week, the cyclicality being more important for the lowest percentile (about 0.7 hours). Remember that there is a high percentage of these workers with temporary contracts and, therefore, relatively easy to hire and fire. This finding may explain why wages are not cyclic for these workers. Indeed, according to the economic conditions, employers may react to the cycle by offering more or less working hours to their low income workers rather than higher or lower wages. We also observe acyclicality of hours worked for top-incomes (at least respect to the GDP growth), implying that adjustments for this group of individuals is mainly on the wage/income side rather than hours worked.

Together, our results for hours worked considering the intensive and the extensive labour margins indicate that negative economic conditions 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 income or wage and hours worked cyclicality. In the first case, joblessness is treated as a missing observation in the data

and ignored. In the second case, joblessness is imputed as zero. As such, these workers disappear from our original sample, which explains why wages are not cyclic for the lowest percentiles. The acyclicality of income, in turn, is probably explained by the acyclicality of benefits and transfers, its main components.

Table 3: **Cyclicality of hours worked by income group**

Elasticity	All units	Lowest 10%	Lowest 25%	Top 25%	Top 10%
INTENSIVE MARGIN					
$\widehat{\gamma_y}$	0.022	−0.688	0.076	0.013	0.013
	(0.95)	(−1.04)	(0.38)	(0.40)	(0.23)
$\widehat{\gamma_{y-y*}}$	0.009	0.171	0.206	−0.011	0.001
	(0.24)	(0.16)	(0.61)	(−0.19)	(0.10)
EXTENSIVE MARGIN					
$\widehat{\gamma_y}$	0.319	0.716	0.501	0.068	0.032
	(5.81)	(3.81)	(2.54)	(0.80)	(0.23)
$\widehat{\gamma_{y-y*}}$	1.341	1.163	1.195	1.088	0.779
	(14.39)	(2.95)	(3.60)	(7.52)	(4.08)

Notes: (1) $\widehat{\gamma_u}$ is the estimated coefficient for cyclicality in Eq. (5); (2) t-values in parenthesis, (2) The extensive margin includes transition to unemployment (zero working hours)

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 income and real wage cyclicality across income groups. Using the British Household Panel Survey from 1991 to 2008, we conclude that the wages and income at the top of the income distribution are more procyclical than those at the bottom.

We also show that most income reacts symmetrically during recessions and expansions for the whole population. However, contrary to wages, income for high-income individuals increases more in economic expansions than what it decreases in recessions. Indeed, for this group of individuals, the harmful effects of a one percentage point decrease in the GDP during a downturn is more than compensated by the helpful effect of an increase during an upturn.

On the contrary, we present evidence that income and wages are acyclic for those at the bottom of the distribution. There are several possible explanations for this acyclicality. First, the large share of workers in the lowest income groups that are paid close to the minimum wage explains in part the lack of real wage cyclicality amongst these groups. Second, there is also considerable cyclicality in hours of worked when allowing for transitions to and from unemployment. Indeed, when considering the intensive margin, hours work are not cyclic. However, when the extensive margin is taken into account, changes in

the GDP result in transitions to of from unemployment rather than decreases in real wages. The high proportion of low paid workers with temporary contracts probably facilitates the adjustment to the cycle to be through employment for these workers. Finally, and contrary to the case of rich individuals, the main sources of income for low income workers are benefits and transfers, which are basically counter or acyclic. In this sense, the improvement and strengthen of the social security is important to mitigate the negative effects of crisis.

Finally, our results tend to emphasize that economic growth can produce significant changes in a country's income distribution. Certainly, changes in the cycle are not directly associated with high income and real wage cyclicality for low-income workers but the increase in inequality can be originated through higher unemployment among these workers. Indeed, if increases in unemployment result in higher poverty rates, then the cycle increases the share of poor individuals in the total population. Moreover, whereas income of low-income individuals is not directly sensitive to the cycle, the gains in terms of income during economic expansions of high-income individuals offset their loses during recessions. This surely represents a source of income inequality in the log-term.

6 Appendix

Table 4: **Percentage of workers with temporary contract, real income and real gross wage by income group and minimum gross real wage of the whole economy**

	Workers with temporary contract				**Mean of annual Real Income**				**Mean of Hourly Real Wage**				**Minimum Real Wage**
Year	Lowest 10%	Lowest 25%	Top 25%	Top 10%	Lowest 10%	Lowest 25%	Top 25%	Top 10%	Lowest 10%	Lowest 25%	Top 25%	Top 10%	
1991	8.47	6.73	5.12	4.21	1352.7	3425.7	27582.3	35686.6	5.65	6.11	14.77	17.52	n.a
2000	9.57	5.39	3.83	3.04	2000.5	4108.4	30787.7	39318.5	6.17	6.54	16.31	20.79	4.7
2008	6.13	4.43	2.5	1.91	2940.8	5560.1	36156.3	45759.3	6.33	7.20	18.8	23.48	6.2
Mean	**7.82**	**5.90**	**3.34**	**3.18**	**2216.6**	**4587.5**	**31646.6**	**40692.6**	**6.37**	**6.52**	**16.58**	**20.66**	**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: **Composition of annual income by income group**

	Annual income					
Year	Labour income	Pensions	Benefits	Transfers	Interest	Total income
			Lowest 10%			
1991	27.94%	0.00%	48.42%	4.21%	19.43%	100.00%
2000	43.33%	7.55%	34.65%	5.53%	8.94%	100.00%
2008	41.74%	2.44%	42.85%	8.77%	4.22%	100.00%
Mean	**39.58%**	**3.00%**	**43.41%**	**6.69%**	**7.32%**	**100.00%**
			Lowest 25%			
1991	33.52%	1.70%	51.60%	6.47%	6.72%	100.00%
2000	42.60%	3.60%	46.76%	3.54%	3.50%	100.00%
2008	42.64%	3.72%	47.51%	2.87%	3.27%	100.00%
Mean	**41.89%**	**3.43%**	**48.02%**	**3.19%**	**3.46%**	**100.00%**
			Top 25%			
1991	95.85%	0.86%	0.65%	0.08%	2.56%	100.00%
2000	94.89%	1.73%	0.71%	0.23%	2.45%	100.00%
2008	94.43%	1.70%	0.88%	0.12%	2.86%	100.00%
Mean	**94.68%**	**1.64%**	**0.75%**	**0.16%**	**2.76%**	**100.00%**
			Top 10%			
1991	96.17%	0.58%	0.41%	0.11%	2.74%	100.00%
2000	95.04%	1.27%	0.58%	0.22%	2.88%	100.00%
2008	94.82%	1.34%	0.45%	0.12%	3.27%	100.00%
Mean	**94.75%**	**1.30%**	**0.43%**	**0.18%**	**3.34%**	**100.00%**

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