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THE CYCLICALITY OF REAL WAGES AND THE ROLE OF HETEROGENEOUS FIRM DYNAMICS

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ABSTRACT

The objective of this Master's Thesis is to study the cyclical behaviour of real wages, using data from in Portugal, between 1986 and 2018. This study uses a disaggregated data set which allows to control for worker, firm and job title heterogeneity, and an iterative high-dimensional fixed effects procedure. A procyclical pattern of real wages throughout the cycle is obtained, with a slightly weaker pattern for workers who move from one job to another in two consecutive years. Furthermore, a firm level analysis is performed, by obtaining a different coefficient for each firm in the data set, which allows a further investigation of the heterogeneous behaviour of the different establishments. Almost one quarter of the total firms' wage policies were found to be countercyclical, whereas the degree of cyclicality varied considerably between sectors. [1]

Keywords: Business Cycles, Labour Economics, Fixed Effects, Real Wages, Labour Market Dynamics.

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1 Introduction

”Observed real wages are not constant over the cycle, but neither do they exhibit consistent pro- or counter-cyclical movements. This suggests that any attempt to assign systematic real wage movements a central role in an explanation of business cycles is doomed to failure.” Lucas Jr (1977).

Understanding the cyclical behaviour of real wages is a question that had interested economists for a long time and that has constituted a central pillar of numerous macroeconomic theories, from the real business cycle theory to Keynesian models. Historically, however, macroeconomic theories' predictions have often been contradictory among themselves, leaving some leading economists to state that real wages do not exhibit a consistent pattern throughout the cycle.

Benefiting from more and higher-quality data, economists in more recent studies started to address this question from a microeconometric perspective and to favor the employment of disaggregated data.

However, these studies also often do not achieve clear conclusions, and some face relevant challenges regarding the quality and the representativeness of the data used, while others fail to control for significant observed and unobserved characteristics that may bias the results. Furthermore, this question was historically often perceived as one of macroeconomic interest, and therefore most economists had not demonstrated much attention to understanding the heterogeneous cyclical behaviour of real wages between different firms.

That is why I have proposed to contribute to the existing literature, not only by using a very complete and disaggregated data set, which allows me to consider a wide set of worker characteristics and worker, firm and job title heterogeneity, but also to go one step further and understand the heterogeneous dynamics at the firm level, so as to obtain different results for each firm. By obtaining multiple slopes, I can then analyse the heterogeneous dynamics regarding different firm characteristics, namely their size and the economic sector in which they operate.

The structure of this study is as follows: Section 2 reviews the existing literature on the cyclicality of real wages, starting by the theoretical studies, moving to the analysis of empirical research (aggregated and disaggregated studies), and finalizing with some studies for the Portuguese econ-

omy; Section 3 describes the methodology used in this study; in Section 4, the data set used is presented; Section 5 presents the results obtained in the study; and Section 6 concludes.

2 Literature Review

In this section, firstly, I will present the most influential theoretical models that explain the cyclical behaviour of real wages and the economic mechanisms behind them, secondly, I will move to the empirical literature, explain the main limitations of using aggregated data to perform this analysis, and analyse the results of disaggregated studies, and thirdly, I will review some studies which also analyse the Portugal labour market.

The divergences regarding whether real wages move in a procyclical or countercyclical way in the business cycle are not new and there are several theories supporting each different hypothesis. Keynes (1936) predicts a countercyclical behaviour of real wages, due to the fact that nominal wages fail to adjust to the cycle, contrarily to prices. The reasoning is that nominal wages are rigid, and the labour demand schedule is therefore stable: when faced with an economic expansion (or recession), prices adjust by increasing (or decreasing), but because of nominal wage stickiness, real wages will evolve in a countercyclical way. Models of price-misperceptions also achieve similar conclusions, but the explanation is a stickiness in expectations.

In contrast, classical economic theories, including the real business cycle theory, predict real wages to evolve in a procyclical way (and prices to be countercyclical). According to the real business cycle theory, a positive (negative) technological shock, would lead to an increase (decrease) in the marginal productivity of the factor of production 'labour', and consequently to an increase (decrease) in the real wages of workers (clearing of the labour market). The new Keynesian model, which assumes sticky prices, also achieves a similar prediction of procyclical real wages.

Empirically, using aggregated data, economists often do not achieve conclusive results, although the general consensus is that real wages, in aggregate terms, are much less responsive than employment to the cyclical behaviour of the economy, showing only weak procyclicality. This idea is

well resumed in Blanchard et al. (1989), which states that "The correlation between changes in real wages and changes in output or employment is usually slightly positive but often statistically insignificant". Lucas Jr (1977) even argues that there is no concrete pattern regarding the behaviour of aggregate real wages in the business cycle, suggesting that 'any attempt to assign systematic real wage movements a central role in an explanation of business cycles is doomed to failure'.

However, aggregated data does not allow to examine the cyclical behaviour of wages of different workers or economic sectors and ignores the changes in the workforce composition throughout the cycle. That is why some papers started to use panel data to analyse the cyclicality of real wages.

Mitchell et al. (1985) acknowledges that studies which use macro-data ignore the composition changes that exist throughout the cycle, namely regarding the main demographic characteristics of the workforce, like sex, race or age, as well as the exogenous shocks that influence each of these groups in a different way, and therefore ultimately lead to biased results.

Keane et al. (1988) concludes that not accounting for the selectivity bias, derived from the fact that workers have unobserved characteristics which not only affect their wages, but also their likelihood to stay in the job market or not during different cycles, will lead to a procyclical bias in the estimations.

Furthermore, since low-skilled workers experience greater hours cyclicality than high-skilled workers, aggregate models give more weight to low-skilled workers during expansions than during recessions. This phenomenon generates a composition bias which affects the results in a countercyclical way, and which hides the real wage procyclicality that real wages typically experience, according to Solon et al. (1994), which studied real wages in the United States since the 1960s and found them to be substantially more procyclical than what aggregate time series previously indicated and macroeconomists assumed. The authors also notice that the evidence of greater hours cyclicality of low-skill workers extends to other time periods and possibly also to other countries, implying that other statistics are likely to be biased as well.

Another fact pointed out in the literature is that wages of new hires are more cyclical than those of workers who stay in the same job, not because the firms pay different wages to workers with

the same productivity, but rather because of the procyclicality of the job quality in new matches (workers changing jobs will have more opportunities to move to higher-paying jobs, within higher-paying firms and within higher-paying industries during expansions, and vice-versa), as Trigari et al. (2016) argues. Bils (1985) also concludes, using disaggregated data, that real wages of workers who change jobs (or move in or out of the work force) are more procyclical than those workers who stay in the same position.

Finally, firms are not homogeneous and behave differently along the cycle. Therefore, allowing for some decomposition is crucial. This is the conclusion of Merkl and Stüber (2017), which uses data for Germany, between 1975 and 2014, and conclude that, although the average establishment is indeed procyclical, more than 40% of establishments behave in a countercyclical way. The researchers also find that the establishments with more procyclical wages have a less procyclical (or even countercyclical) employment dynamics (i.e. during expansions, these establishments increase employment by less and wages by more than establishments which show a countercyclical wage behaviour). Therefore, this paper introduces a new notion to the existing literature, which is that a significant share of firms behave in line with traditional Keynesian theories and with the real business cycle theory. It is therefore important to examine the behaviour of different sectors, firms and job titles so as to see how each of these characteristics influences the cyclicality of real wages.

There are also other issues that must be considered when performing this analysis. Devereux (2001) notices that some studies exclude the parts of the wages of job stayers that are more procyclical. According to this paper, the procyclicality in the wages of job stayers is mainly driven by workers' commissions, bonuses or overtime earnings. Therefore, not accounting for these sources of earnings will bias the estimates in a countercyclical way. Bils (1985) also achieves similar conclusions.

Carneiro et al. (2012) is a very complete study which uses data from Portugal, between 1986 and 2007, and that already addresses some of the points mentioned above, as it includes non-regular sources of income and controls for worker, job title and firm heterogeneity. It concludes that real wages are indeed responsive to the business cycle, but that not accounting for worker, firm and job

title unobserved characteristics might lead to a countercyclical bias in the estimations. The paper also notices that real entry wages are more cyclical than real wages of job stayers.

Martins et al. (2012) also studies Portugal, and founds that real entry wages in this country, during the period 1982-2007, tended to be 1.8% lower when the unemployment rate is one percentage point higher, which leads to the conclusion that real entry wages in Portugal respond considerably to business cycle fluctuations, a pattern that was also reflected on the behaviour of employment.

This project's contribution to the literature is to build on the studies that already use micro-data, correct for the correct for possible sources of bias that exist, to analyse the heterogeneous behaviours of certain segments of the workforce, such as 'new hires' and to understand the behaviour of the different firms and economic sectors.

3 Methodology

The empirical model that I will use to test the real wage cyclicality controls for worker time-varying characteristics and for worker, job title and firm time-invariant heterogeneity, therefore using three fixed effects:

$$LogW_{ijft} = \alpha_i + \beta_j + \lambda_f + \theta_0 * t + \omega * X_{it} + \theta * Cycle_t + u_{ijft}, \quad (1)$$

where W_{ijft} is the total real hourly wage of worker i, in job title j, in firm f, at time t; α_i is the worker fixed effect; β_j is the job title fixed effect; λ_f is the firm fixed effect; t is the time trend; X_{it} is a vector of time-varying worker controls, such as age, schooling and tenure; $Cycle_t$ is the variable of interest, which is an indicator of the business cycle (we use the unemployment rate from the previous year); and u_{ijft} is the error term.

This specification uses a three high-dimensional fixed effects model, which is an iterative procedure which can be applied in large data-sets with one or more fixed effect, explained in Guimaraes and Portugal (2010).

Previous literature, including studies from Portugal, namely Carneiro et al. (2012), have supported the idea that real entry wages are more responsive to the economic cycle than the real wages of those workers who are already in the firm for more than one year. Therefore, to evaluate and control for the differences between workers who were newly hired by a given firm, I add $Hire_{it}$, which is a dummy variable that indicates if a worker is in the firm for less than 1 year, therefore distinguishing 'new hires' from stayers, and $Hire_{it} * Cycle_t$, which is an interaction between this dummy and the cyclical variable of the model,

$$LogW_{ijft} = \alpha_i + \beta_j + \lambda_f + \theta_0 * t + \omega * X_{it} + \theta * Cycle_t + \eta * Hire_{it} + \rho * Hire_{it} * Cycle_t + u_{ijft} \quad (2)$$

However, inside this group of 'new hires', there are workers who came from another firm (poaching) and those who did not. To check the cyclicality of real wages of the particular sub-group of 'new hires' which came from another firm, I include a dummy variable, $JobtoJob_{it}$, that identifies if a given worker has moved from one job to a different one from one year to the other ("mover") and an interaction between this dummy and the cyclical variable of the model, $JobtoJob_{it} * Cycle_t$. This variable distinguishes the 'new hires' who came from another job (therefore from a different firm) from those that were previously out of the workforce (or at least were not considered in the data set for the previous year), and therefore the model will be:

$$LogW_{ijft} = \alpha_i + \beta_j + \lambda_f + \theta_0 * t + \omega * X_{it} + \theta * Cycle_t + \eta * Hire_{it} + \rho * Hire_{it} * Cycle_t +$$

$$+ \delta * JobtoJob_{it} + \mu * JobtoJob_{it} * Cycle_t + u_{ijft} \quad (3)$$

However, firms do not behave uniformly among themselves and do not have equal wage policies. Merkl and Stüber (2017) notes that there is 'a substantial cross-sectional heterogeneity of establishments' average real wages over the business cycle', further explaining that 'While the median establishments' real wages are procyclical, there is a large fraction of establishments with countercyclical real wages'.

Therefore, I use a specification which allows every firm to have a different slope for our variable of interest (the cyclical behaviour of the economy), which will then allow not only to understand the distribution of firms among different cyclical behaviours (from the more countercyclical ones to the ones with more procyclical policies), but also to see analyse the specific behaviour of the different industries and sectors.

The data set was, however, restricted to firms whose presence is of at least 10 years and which have employed 500 or more employees during this period. Therefore, the model would look like:

$$LogW_{ijft} = \alpha_i + \beta_j + \lambda_f + \theta_0 * t + \omega * X_{it} + \pi_f * Cycle_t + u_{ijft}, \tag{4}$$

where π_f corresponds to the heterogeneous slopes of the unemployment rate for each firm.

4 Data

The data that will be used comes from Quadros de Pessoal, which is an annual compulsory employment survey conducted by the Portuguese Ministry of Labour, Solidarity and Social Security, that covers all establishments with wage earners. The information is now collected in October, but prior to 2007 it was collected in March.

On a yearly basis, every establishment with wage earners has to fill a set of standardized questions, which include both firm's information, including its size, location, economic activity, employment, sales, among others, and worker's information, namely its gender, age, skills, occupation, tenure, earnings and duration of work. The information on earnings includes the worker's base wage, as well as benefits, overtime pay and also the mechanisms of wage bargaining.

In this study, I will use data from 1986 to 2018.

As each worker and firm are assigned a number that is constant throughout time, this data set allows for their tracking over the years. Furthermore, it covers almost all wage earners and firms in Portugal and includes a wide set of variables that are useful to control for each worker and therefore obtain more precise estimators.

My data set includes all observations from workers aged between 18 and 65 years old, with some restrictions, which aim to reduce the influence of outliers in the results. Therefore, the data set only includes workers who earn more than 80% of the minimum wage established for that year, have less than or equal to 50 years of experience and benefit from more than or equal to 120 remunerated hours per month. To estimate models with various fixed effects, I restricted the sample to the observations which belonged to the largest connected set.

It consists of 54,427,743 observations, which correspond to 7,578,333 different workers (matched by an identification number), 885,266 firms (also matched by an identification number), 165,115 occupational categories ("job titles", matched by the code of the collective agreement and occupational category) and 11 educational levels.

From all these observations, 45,302,685 (83.23%) correspond to stayers, meaning workers which are in the same employer for two consecutive years (defined as the workers whose tenure in the current employer is higher or equal to 1 year), and the remaining 9,125,058 (16,77%) correspond to new hires, which are workers who come from non-employment or from another firm (which implies that their tenure in the current firm is lower than 1 year).

It is also important to mention that 2,711,017 observations (4,98%) correspond to workers who moved from one job to a different one in two consecutive years, which is computed as the workers whose current firm is different from the one they were working in the year before, excluding those who came out of the labour force (or else that were excluded from the data set because of the restrictions made (namely on wages)).

5 Descriptive Analysis and Empirical Results

The focus of this analysis is to establish relations between the real wages in Portugal, between 1986 and 2018, and the economic cycle at that time.

Real wages are represented by the natural log of real hourly earnings, which correspond to the ratio between regular earnings (including overtime payments) and the total number of hours worked (including extra hours), deflated by the Portuguese Consumer Price Index (CPI) of the base year 1986.

Since the effect of the economic cycle does not have an instantaneous impact on the agents' decisions, even more when considering that annual wages are set by firms before the beginning of each year, I chose to use the unemployment rate of the previous year, precisely to try to capture this delayed effect.

Table 1 presents the first estimations of the paper, which correspond to regressions without fixed effects. In the first equation estimated, some covariates were included so as to control for worker specific characteristics that are likely to have an impact on their real hourly wages. The controls used in these specifications were: age, age square (to capture a non-linear behaviour of the life cycle of earnings), tenure, tenure square (for the same reason as age squared), gender, a time trend and a set of dummies for the different educational levels (11 categories, from less than primary education to PhD).

It is already possible to understand from the first equation estimated the impact of the different controls added on the dependant variable. According to this estimation, there are positive but diminishing returns of both age and tenure on the real hourly wages of a worker, as well as a positive impact of being male on this variable. One can also see that the coefficient for the time trend is not significant at conventional levels. Regarding scholarity, the results are predictable, as there are positive effects of having higher levels of scholarity on real wages, and negative effects of low levels of scholarity on this variable, with the impacts increasing in size as the level of education gets lower or higher, respectively.

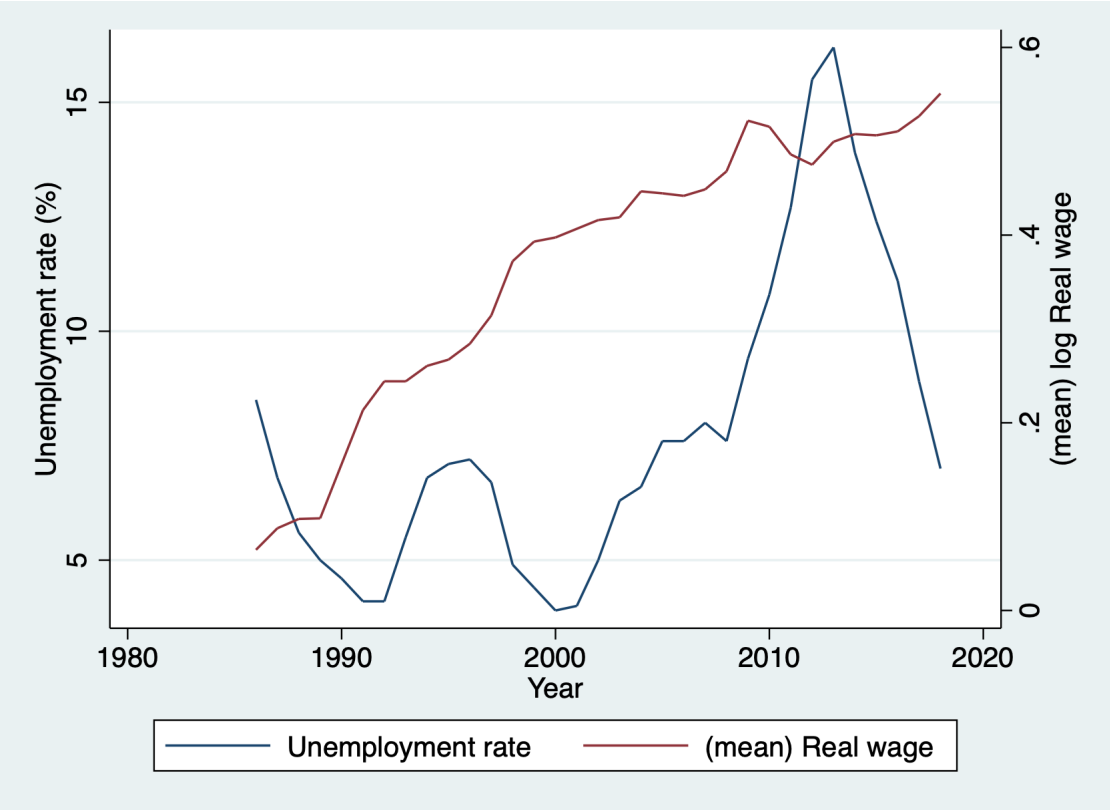

Figure 1: Real wages and the unemployment rate in Portugal

The estimated coefficient for our variable of interest indicates that, other things equal, an additional percentage point of unemployment decreases, on average, real hourly wages by 1.79% in the following year. This result is already a sign of a significant procyclical behaviour of real wages throughout the cycle, although it does not control for specific unobserved heterogeneity.

There is no additional significant impact of being a new hire in a given firm, nor of being a new hire which came from another firm (poaching). Although this result contradicts previous literature, it is worth noting that they do not control yet for individual, job title and firm time-invariant unobserved characteristics.

Table 1: Real wage sensitivity to the unemployment rate with no fixed effects

	(1)	(2)	(3)
Age	0.0401***	0.0401***	0.0394***
	(0.000)	(0.000)	(0.000)
Age squared	-0.000371***	-0.000371***	-0.000363***
	(0.000)	(0.000)	(0.000)
Tenure	0.0213***	0.0210***	0.0212***
	(0.000)	(0.000)	(0.000)
Tenure squared	-0.000196***	-0.000191***	-0.000194***
	(0.000)	(0.000)	(0.000)
Male	0.273***	0.273***	0.273***
	(0.000)	(0.000)	(0.000)
Time trend	0.00306	0.00306	0.00307
	(0.086)	(0.086)	(0.086)
$Educ_0$	0	0	0
	(.)	(.)	(.)
$Educ_1$	-0.744***	-0.745***	-0.743***
	(0.000)	(0.000)	(0.000)
$Educ_2$	-0.583***	-0.583***	-0.582***
	(0.000)	(0.000)	(0.000)
$Educ_3$	-0.414***	-0.414***	-0.413***
	(0.000)	(0.000)	(0.000)
$Educ_4$	-0.224***	-0.225***	-0.224***
	(0.000)	(0.000)	(0.000)
$Educ_5$	-0.0147	-0.0155	-0.0152
	(0.459)	(0.430)	(0.446)
$Educ_6$	0.0460*	0.0453*	0.0463*
	(0.023)	(0.023)	(0.023)
$Educ_7$	0.415***	0.414***	0.414***
	(0.000)	(0.000)	(0.000)
$Educ_8$	0.553***	0.552***	0.552***
	(0.000)	(0.000)	(0.000)
$Educ_9$	0.540***	0.539***	0.538***
	(0.000)	(0.000)	(0.000)
$Educ_{10}$	0.703***	0.702***	0.705***
	(0.000)	(0.000)	(0.000)
Lag Unemployment rate	-0.0179***	-0.0179***	-0.0177***
	(0.000)	(0.000)	(0.000)
'New hire'		-0.00503	-0.0207**
		(0.404)	(0.002)
'New hire' * Lag Unemployment rate		0.000195	-0.000668
		(0.790)	(0.358)
Job to Job			0.108***
			(0.000)
Job to Job * Unemployment rate			-0.000359
			(0.829)
R_sq	12 0.460	0.460	0.461

N = 53342348

p-values in parentheses: *p<0.05, **p<0.01, ***p<0.001

In this new model, I try to correct for the existing heterogeneity derived from unobservable time-invariant characteristics of different job positions, aiming to avoid the composition bias that exists in previous studies.

First of all, there are constant flows of individuals entering and exiting the workforce, who have different skills and inherited ability. It is reasonable to assume that these set of time-invariant, individual-specific characteristics influence the workers outcomes throughout their life and furthermore that there is no random selection among these workers in each period and cycle. Therefore, while this heterogeneity inside the workforce was disregarded in the previous model, a worker fixed effect was included here to correct for this source of bias.

Table 2: Real wage sensitivity to the unemployment rate with worker, firm, job title and education fixed effects

	(1)	(2)	(3)
Age	0.0370***	0.0372***	0.0370***
	(0.000)	(0.000)	(0.000)
Age squared	-0.000224***	-0.000226***	-0.000224***
	(0.000)	(0.000)	(0.000)
Tenure	0.00816***	0.00688***	0.00695***
	(0.000)	(0.000)	(0.000)
Tenure squared	-0.000154***	-0.000123***	-0.000124***
	(0.000)	(0.000)	(0.000)
Lag Unemployment rate	-0.0108***	-0.0107***	-0.0107***
	(0.000)	(0.001)	(0.001)
'New hire'		-0.0210***	-0.0224***
		(0.000)	(0.000)
'New hire' * Lag Unemployment rate		0.000123	-0.000370
		(0.816)	(0.503)
Job to Job			0.00980*
			(0.022)
Job to Job * Lag Unemployment rate			0.00131**
			(0.004)
R-sq	0.887	0.887	0.887

N = 53342348
p-values in parentheses: *p<0.05, **p<0.01, ***p<0.001

A firm fixed effect is also included since, following a similar reasoning, the set of firms in the market is constantly changing between the different periods. As each establishment has its own wage policy, not accounting for the firm-specific characteristics would bias the estimations.

Furthermore, as a worker's job is not solely defined by the firm in which it works, but also by the role that the worker performs in that given firm, a job title fixed effect is also added.

Finally, I also include a set of dummies to account for the 11 educational levels described above.

This model uses a three high-dimensional fixed effects procedure and the results can be seen in Table 2.

The first regression's estimates contrast with the ones on Table 1 as all estimates are weaker after the introduction of the three fixed effects described above, pointing to a possible bias in the previous estimations.

Most importantly, the estimate for our variable of interest is now -0.0108, which is, in absolute terms, lower than the one previously estimated, indicating a behaviour less flexible than initially predicted.

Therefore, not accounting for worker, firm and job title fixed effects leads to a procyclical bias in the estimates. This would lead us to conclude that well-payed workers and high-paying firms/job titles were over-represented during periods of economic expansion and under-represented during periods of economic contraction.

This conclusion goes against the one from Carneiro et al. (2012). This study only uses data from 1986 until 2007, which might explain the differences in the results, as it excludes the period just of the great recession of 2008 and the European sovereign debt crisis.

However, despite showing a weaker cyclicality than in the previous model, firms appear to be able to adjust their policies to the economic circumstances that they face, as wages prove to be still reasonably flexible. This is particularly interesting in a country known for its rigid labour market, primarily regarding its legal constrains on downward nominal wage adjustments.

As a side note, in Table 3, one can also see the influence of our cyclical variable on the different fixed effects used. Whereas the impact of the lagged unemployment rate is negative on the worker, firm and job title fixed effect, it is positive for education. The negative sign for the worker fixed effect corresponds to a lower influence of higher levels of skills/ability during recessions. There is a lower influence of higher-paying firms and job titles during economic contractions.

Table 3: Fixed effects regressions

	(W)	(F)	(J)	(E)
Lag Unemployment rate	-0.000750	-0.000299	-0.00344**	0.000406***
	(0.317)	(0.523)	(0.002)	(0.000)

N = 53342348
p-values in parentheses: *p<0.05, **p<0.01, ***p<0.001

Furthermore, Table 2 also presents the regression results of the specifications which include the dummies for 'new hires' and of workers who move from 'job to job'.

The additional cyclical impact of entry wages when compared to the other workers is not significant. This result goes against the estimations from other papers which identify an incremental procyclicality in the wages of 'new hires'.

On the contrary, we find a countercyclical impact of moving from one firm to a different one on the cyclicality of real wages.

One may therefore conclude that, during recessions, workers who move from one firm to a different one will not face, on average, a reduction in their wages as significant as that of the overall population, nor as a significant increase during a period of economic expansion, reflecting a lower vulnerability and less flexible behaviour of real wages for this segment of the workforce.

These facts underline the importance of distinguishing these two groups of new workers: according to these results, 'new hires' real wages do not evolve differently from those of the entire economy, although workers who are recruited from a different firm are less vulnerable to the cyclical conditions of the economy, being therefore more protected from its impact and showing a more smooth pattern of real wages.

Until here, we were only estimating one single coefficient for the entire economy, with only the differentiation between 'new hires' and workers who moved from 'job to job'. However, economies are constituted by heterogeneous firms who are affected differently by each cycle, which will translate in distinctive real wage behaviours.

That is why, lastly, a model which allows each firm to have a different cyclical coefficient was created. Some restrictions were, however, imposed: I dropped the firms which operated for less than 10 years throughout this period (around 17% of the total) and those which employed, during this period, less than a total of 500 workers (around 44.6% of the total), so as not to obtain the establishment-specific cyclicality of a firm with a very irrelevant presence in the Portuguese market during these years.

With this model, I obtained a total of 13.477 different coefficients, which correspond to the different firms that exist in the data set throughout this period. The distribution of the total coefficients (for each observation in the data set, therefore more than one by company) is shown in Figure 2.

The median level of cyclicality is found to be of -0.010525, which, as expected, goes in line with our previous estimations in Table 2, since the controls and fixed effects used were the same and the distribution is close to a normal one.

Additionally, one observes a countercyclical behaviour of real wages in almost 24% of the observations, reinforcing Merkl and Stüber (2017) hypothesis that a large fraction of establishments' policies went against the cycle.

Therefore, it is possible to conclude that, although the majority of the establishments' wage policies are procyclical, there is a significant share of firms whose wage policy goes in line with the traditional Keynesian predictions, where nominal wages are inflexible, and due to price adjustments, real wages evolve against the business cycle.

One can also see in Figure 3, that the distribution of the firms' different coefficients is similar to the one presented above, with a median point of -0.010881 and almost 23% of the firms implementing countercyclical real wage policies throughout this period. Despite the overall similarity, this corresponds to a slightly more procyclical pattern, suggesting that establishments with more

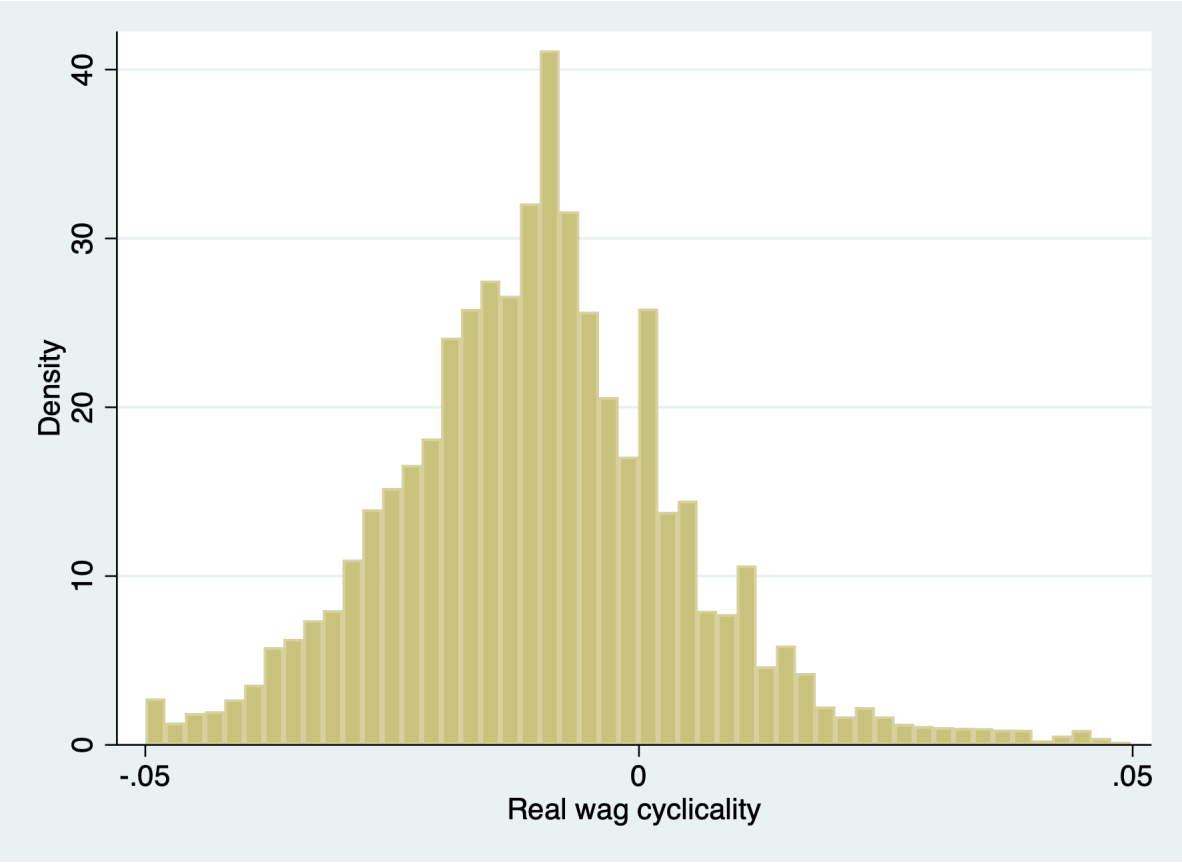

Figure 2: Distribution of the cyclicality among observations

employees and/or present in the Portuguese market for a longer period of time have slightly less procyclical wage policies.

This fact is corroborated by the nonexistence of clear differences in the cyclicality of real wages among firms by their total number of employees throughout their period of activity. As it can be seen in Figure 4 and in Table 4, there are no evident differences between the different groups of firms according to the total number of employees they have employed, although the group of very large firms (over 100000 workers employed during this period) has indeed a modestly less procyclical wage policy.

Regarding the total number of years in which each establishment was operating in Portugal, no relevant differences can be seen in Table 6, in the sense that there is no clear trend of increasing or decreasing procyclicality from firms present during less years to those present during more years in

the period studies.

Table 4: Real wage cyclicality by total number of employees

Less than 1000 employees	0
	(.)
Total employees between 1000 and 1500	-0.0115***
	(0.000)
Total employees between 1500 and 2000	-0.0114***
	(0.000)
Total employees between 2000 and 2500	-0.0109***
	(0.000)
Total employees between 2500 and 3000	-0.0119***
	(0.000)
Total employees between 3000 and 5000	-0.0113***
	(0.000)
Total employees between 5000 and 10000	-0.0101***
	(0.000)
Total employees between 10000 and 20000	-0.0148***
	(0.000)
Total employees between 20000 and 30000	-0.0131***
	(0.000)
Total employees between 30000 and 50000	-0.00920***
	(0.000)
Total employees between 50000 and 100000	-0.0151***
	(0.000)
Total employees higher than 100000	-0.00728***
	(0.000)

N = 27613297
p-values in parentheses: *p<0.05, **p<0.01, ***p<0.001

Lastly, the heterogeneous behaviour between the different sectors of activity is analysed, by regressing the different slopes obtained for the various firms on their specific sector. The sectors are defined having the 'Classificação Nacional de Actividades Económicas' as their basis, and were clustered in 31 sectors.

From Table 5 one can see that the sectors indeed behave differently, which may result from being hit differently by the economic shocks and/or facing different labour market conditions and regulations which influence their wage policies.

The strongest procyclical influences can be found on extractive industries, as well as the manu-

facturing of mineral non-metallic products or the hospitality sector, implying that these sectors have some specificites which make them more volatile to the economic conditions of the country, which might be the case namely on the extraction of energy products.

Furthermore, it can be noted that the wage policy of the government regarding its civil service also shows a relevant procyclical influence. This could be seen in the period analysed in this project, namely on the strong pay cuts imposed on the public employees following the economic crisis of 2008 and the European debt crisis, and their reversal once the economy started to show signs of recovery, in 2014.

On the contrary, in agriculture, animal production, hunting and forestry, and fisheries, the real wages appear to be less flexible and show less procyclicality. One possible explanation for this result in the agriculture and fisheries sector is their higher degree of protection (when compared to the industry sector), namely derived from the common European agricultural and fisheries policies which may help the workers from these activities to smooth their earnings between the cycles. Furthermore, some of the most common goods described as essential (meaning that the pattern of consumer demand is more stable) are related, at least partially, with these sectors, which may make them and their respective workers less vulnerable to the different economic cycles, while being on the other hand more subject to other kind of shocks (related to environmental and climacteric conditions).

Overall, these results reinforce the need to use disaggregated data and understand the heterogeneous dynamics at the firm level. Although these study's estimations go in line with most predictions of procyclical real wages, the firm-level decomposition illustrated a very differentiated image of the Portuguese labour market and economic structure.

Table 5: Real wage cyclicality by economic activity

Agriculture, animal production, hunting and forestry	-0.00730***
	(0.000)
Fisheries	-0.00603***
	(0.000)
Extraction of energy products	-0.0464***
	(0.000)
Other extractive industries	-0.0181***
	(0.000)
Food, drinking and tobacco industries	-0.0112***
	(0.000)
Textile industry	-0.00979***
	(0.000)
Leather industry	-0.00264***
	(0.000)
Wood and cork industry	-0.0128***
	(0.000)
Pulp and paper industry, edition and printing	-0.0123***
	(0.000)
Manufacturing of coke, refined petroleum products and nuclear fuel	-0.00686***
	(0.000)
Manufacturing of chemical products and fibers	-0.00923***
	(0.000)
Manufacturing of rubber products and plastic materials	-0.00945***
	(0.000)
Manufacturing of mineral non-metallic products	-0.0180***
	(0.000)
Basic metallurgic and metallic products industry	-0.0134***
	(0.000)
Manufacturing of machinery and equipment	-0.00982***
	(0.000)
Manufacturing of electric and optical materials	-0.00789***
	(0.000)
Manufacturing of transportation materials	-0.0106***
	(0.000)
Manufacturing industry	-0.0123***
	(0.000)
Production and distribution of electricity, gas and water	-0.0129***
	(0.000)
Construction	-0.0114***
	(0.000)
Wholesale and retail trade, automotive repair services and similar activities	-0.0136***
	(0.000)
Hospitality industry (including restaurants)	-0.0121***
	(0.000)
Transportation, storage and communications	-0.0129***
	(0.000)
Financial activities	-0.00584***
	(0.000)
Real estate, rentals and services provided to businesses	-0.0130***
	(0.000)
Public administration, defense and mandatory social security	-0.0174***
	(0.000)
Education	-0.0102***
	(0.000)
Health and social services	-0.00961***
	(0.000)
Other activities of collective, social and individual services	-0.0117***
	(0.000)

6 Conclusion

The objective of this study was to analyse the cyclical behaviour of real wages in Portugal throughout the period of 1986 and 2018. We concluded, contrarily to previous literature, that controlling for worker, firm, and job title time-invariant heterogeneity reduced the procyclicality of real wages in the economy, implying that there was a procyclical bias in the first estimations of the study. This study estimates that, on average, a 1 percentage point increase in unemployment leads to a 1.08% decrease in real wages, therefore showing a procyclical behaviour throughout the cycle, in line with previous literature for this country.

Furthermore, different models were estimated to control for specific groups of individuals: the newly hired workers, and the newly hired workers who came from a different firm. A countercyclical impact was identified for the latter group, while no additional impact was identified for the former, when compared to the entire workforce. Real wages were found to be reasonably responsive to the economic cycle, mainly for a country with a rigid labour market and subject to significant restrictions, namely regarding nominal wage reductions.

Additionally, this study contributes to the literature by obtaining a different slope for each firm, therefore allowing for a firm and sector level analysis. Although most firms wage policies indeed behave in a procyclical way, around one quarter of the total show a countercyclical wage behaviour: going back to the initial question, although the majority of establishments policies go in line with classical predictions, a relevant share of them go in line with Keynesian expectations.

Furthermore, it was possible to conclude that sectors behave differently and show different degrees of procyclicality: whereas real wages in some sectors are very vulnerable to the domestic economic conditions, in other activities real wages are more smoothed throughout time.

The firm level analysis that was employed in this project has a great potential of analysing other types of heterogeneity that distinguish firms' behaviours apart from the ones evaluated in this study, paving the way for further research. It would therefore be interesting to build on this study and analyse other sources of heterogeneous firm dynamics, as well as the mechanisms and explanations behind them, also from a theoretical viewpoint.

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7 Appendix

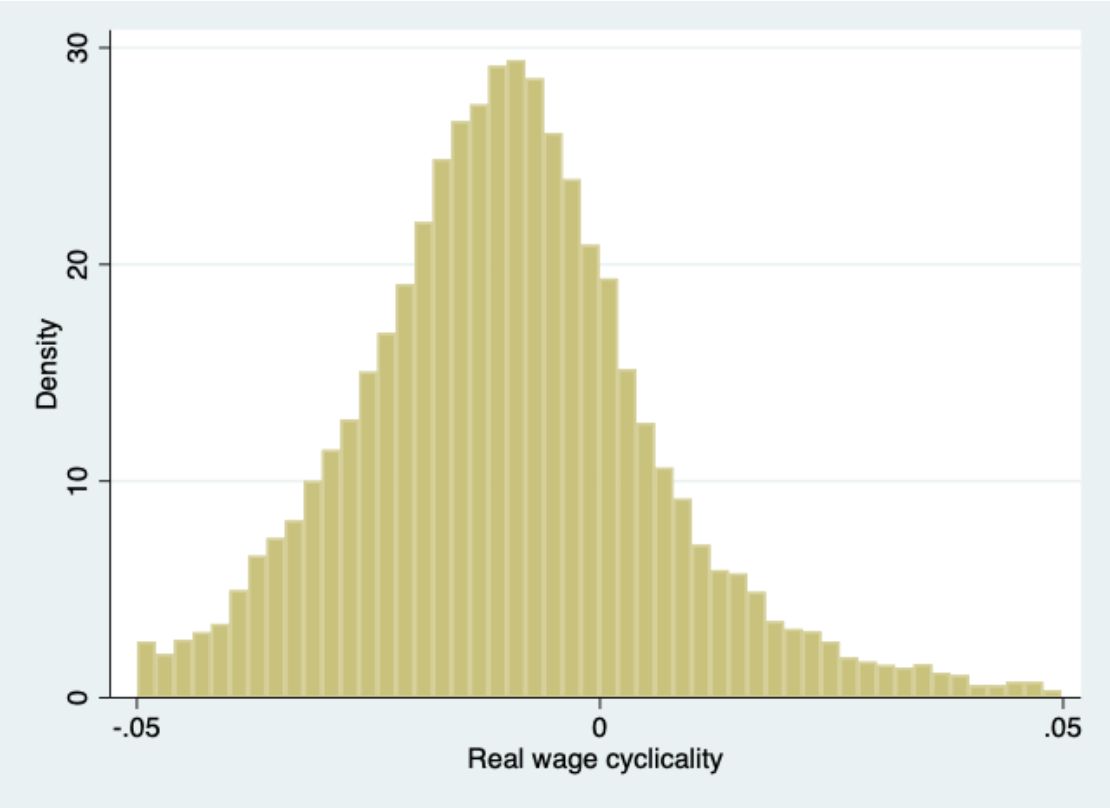

Figure 3: Distribution of the cyclicality among firms

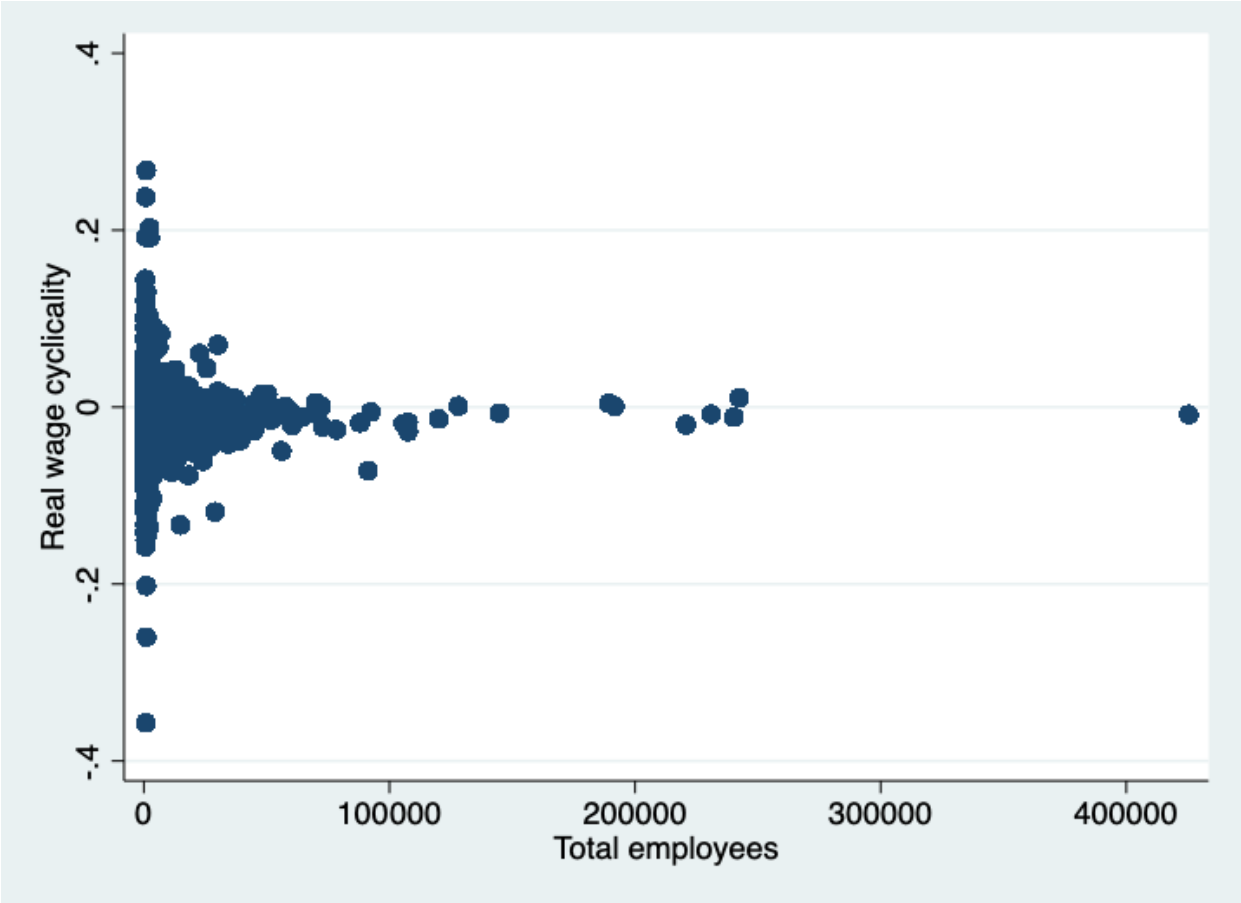

Figure 4: Number of employees and firms' real wage cyclicality

Table 6: Real wage cyclicality by total number of years of presence

10	0
	(.)
11	-0.0143***
	(0.000)
12	-0.00995***
	(0.000)
13	-0.0164***
	(0.000)
14	-0.0100***
	(0.000)
15	-0.0133***
	(0.000)
16	-0.0109***
	(0.000)
17	-0.0102***
	(0.000)
18	-0.0116***
	(0.000)
19	-0.0114***
	(0.000)
20	-0.00722***
	(0.000)
21	-0.0170***
	(0.000)
22	-0.0151***
	(0.000)
23	-0.0135***
	(0.000)
24	-0.0102***
	(0.000)
25	-0.0144***
	(0.000)
26	-0.0104***
	(0.000)
27	-0.0106***
	(0.000)
28	-0.00753***
	(0.000)
29	-0.0121***
	(0.000)
30	-0.0109***
	(0.000)
31	-0.00982***
	(0.000)

N = 27613297
p-values in parentheses: *p<0.05, **p<0.01, ***p<0.001