Real Wage Cyclicality in the Euro zone before and during the Crisis: Evidence from micro-data

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Abstract

We estimate the response of real wages to the business cycle in major Euro zone countries before and during the crisis. Average real wages are found a-cyclical but this reflects in a large part the effect of changes in the composition of the labour force related to unemployment variations. Using individual level data from the ECHP and SILC panel, we estimate elasticities of real wages to unemployment increases between −0.9 and −1.4 over the period 1994-2008. We use this result to investigate whether real wages have been particularly rigid during the recent crisis. We first highlight that composition effects have been large after 2009 and explain most of the stagnation or increase in average wage observed in some countries from 2008 to 2011. In contrast, at constant composition of the labour force in terms of education and experience, the figures indicate a significant decrease in average wage during the downturn in countries most affected by the crisis. Nevertheless, in most cases, this decrease is more moderate than predictions based on the previously estimated elasticity in the 2008-2009 period but not in the 2009-2010 period. A potential explanation of this relatively higher wage rigidity is the strong decrease in inflation in 2009 which had prevented firms to adjust real wages by using inflation.

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I. Introduction

The evolution of real wages over the business cycle is observed with great attention by policy makers and forecasters. During periods of economic downturns, real wage adjustments are considered as being of first order importance to reequilibrate the labour market and adjust external imbalances. In particular, during the recent economic crisis in Europe, it has been argued that the observed downward rigidity of real wages can explain a significant part of the large unemployment increase that has been observed in some countries (see e.g. Schmitt-Grohé and Uribe, 2013).

Figures from quarterly aggregate wage data from national accounts, which are the only comparable cross-country data rapidly available on a regular basis, indicate that wages have not decreased much in most countries before 2011 in spite of sometimes very large unemployment increases. These development have put serious doubts on the long term viability of the Euro Zone since wage flexibility is crucial in a currency union where internal migrations have been until here too low to ensure a significant macroeconomic adjustment (Anderton et al. 2012 ; Krugman 2013).

We argue in this paper that these figures are partially misleading and that in practice wages have been more flexible than indicated by the aggregate data. We highlight that the evolution aggregate wage data is difficult to interpret, particularly during exceptional crisis periods, because the composition of the labour force also changes significantly over the cycle. In practice, large changes in composition explain most of the apparent real wage rigidity during the recent crisis period in major Euro zone countries. This implies that the true extend of wage rigidity can only be measured with individual level data which allows for controlling for composition effects.

Cyclical changes in the composition of the labour force reflect the fact that unemployment increases tend to affect disproportionately low wage workers. When unemployment increases, the labour force tends to become more skilled. This affects the average wage in a counter-cyclical way, the average wage increasing mechanically simply because the share of low wage workers in the population diminishes. If these composition effects are large, they may completely mask the response of wages to the cycle in the aggregate series.

Many studies have shown that composition biases are empirically important and, that, as a result, there is a large difference between real wage elasticities estimated with aggregate or individual level data. While this issue is relatively well known in the academic literature since the empirical studies on US data of Bils (1985) or Solon, Barsky and Parker (1994) [2] and is discussed in standard economic textbooks (see Romer 2006, p 264), this question has received relatively little attention during the recent period in Europe in spite of the fact that unemployment changes have been particularly dramatic. From 2007 to 2012, the unemployment increased by 16 p.p. in Spain and Greece, 7.8 p.p. in Portugal and 4.6 p.p. in Italy. The unemployment increase was particularly large for blue collar, unskilled and young workers which implies that the composition of the employees also changed dramatically. In Spain, for example, the share of low educated workers among employees decreased by 8 p.p. from 44% to 36% between 2007 and 2012, while the share of university graduate workers increased symmetrically by 8 p.p.[3] Such large changes in composition directly influenced the average wage paid in these countries. As a result, it is unclear how much the evolution of the aggregate wage series during the crisis in these countries reflected a change in wages or changes in composition effects.

An investigation on the cyclical behaviour of real wages in European labour markets appears also particularly useful to derive whether more generally wages are relatively more rigid in Europe, which might potentially explain the stronger persistence of unemployment there with respect to the U.S. and the exceptional difficulties experienced by European labour markets during the recent crisis. While there exists some important and recent work on several major European countries[4], the results are sometimes difficult to compare since the construction of the sample, the data source and the period used in the estimates vary in potentially important ways across studies. Moreover, these studies were published before the recent crisis and the relative importance of wage rigidity and composition effects

[2] For the US, see also Devereux (2000) and Devereux and Hart (2006) for the UK.
[3] Figures from aggregate LFS data from Eurostat.
[4] See Anger (2011) for Germany, Peng and Siebert (2008) for Italy, Martin (2007) and Carneiro, Guimarães and Portugal (2011) for Portugal.

in explaining the evolution of real wages in the Euro zone in the recent period remains an open question. In addition, as far as we know, there is currently no study including important countries such as Spain or France.

In this paper, we contribute to the literature on the relationship between wages and the business cycle in two important ways. First, we use harmonized panel microdata from ECHP and SILC covering the major countries of the Euro zone to examine the relationship between real wages and the business cycle in major Euro zone countries using data from the period 1994-2001 and 2004-2008.

As in previous work, we find that aggregate wage series are not cyclical. However, when we use individual level data to control for changes in composition of workers in the labour force over time, we find that most of this acyclicality reflect the effect of compositional changes of the labour force. In our preferred specification, we obtain statistically significant elasticities of real wages to unemployment increases between −0.9 and −1.4.

Using cross-country variations in inflation rates over the period, we also assess the role of inflation in real wage cyclicality. The effects of inflation on wage adjustments in the labour markets is an important issue to determine costs and benefits of different levels of inflations. If inflation "grease the wheels" of the labour market, as argued by Card and Hyslop (1994), we should find higher level of wage adjustment in period of relatively high-inflation in response to a given negative shock.

Our results confirm this hypothesis. We find evidence that the rate of wage adjustment is faster in higher inflation environment, with an elasticity of −1.3 when the inflation rate is superior to 2% but only −0.9 when the inflation rate is inferior to 2%.

In the second part of the paper, we explore the respective role of composition effect and wage rigidity in explaining the evolution of real wages from 2008 to 2011. Using standard decomposition techniques, we first decompose the evolution of the average wage by the part explained by changes in the composition in terms of education and experience of the labour force and the part explained by changes in wages across groups. We find that most of the increase or stagnation in real wages observed in the aggregate data can be explained by composition effects. When we keep the distribution of education and experience in the population constant, we find that real wages tend to decrease significantly.

Then, in order to assess whether wages have been particularly rigid during the recent crisis from 2008 to 2011, we compare observed and predicted wage change by the previously estimated elasticity keeping the composition of the labour force constant. We discuss the potential mechanisms explaining this higher level of rigidity. The most important explanation is the large and sudden decrease in inflation in the 2008-2009 period.

The rest of the paper proceeds as follows. In a first section, we present the econometric model evaluating the cyclicality of real wages and describe the data. We provide estimates of real wage elasticity taking into account composition effects using 11 countries from the Euro zone in the second section. In a third section, we study the importance of changes in the composition of the labour force and wages rigidity during the recent crisis between 2008 and 2011.

II. Theoretical Framework

To be written.

III. Methods

Econometric model

Our baseline empirical model is based on Solon et al. (1994) and Bils (1985). We estimate regression models which relate log real wages at the individual level with the unemployment rate at the country level. In order to get an average across country, and because we have a short panel of at most 12 years per country which does not allow to estimate a separate model per country, we estimate our baseline model by pooling countries in the sample as in Bellou and Kaymac (2012).

One difficulty in this context is that, while we are using individual level data, the regressor of interest varies only at the aggregate country by year level. This implies that conventional standard errors will be significantly downward biased since they do not take into account the potential correlations of the error term within country and year (see Card 1995 or Angrist and Pishke, 2009,

chapter 8). To deal with this issue, as in Solon et al. (1994), we estimate the model in two step.[5] In the first step, we start with a simple mincerian log wage model:

$$\ln w_{ikt} = X_{it}\beta + \alpha_i + \gamma_{kt} + \epsilon_{ikt}$$

where wages depend on observable individual characteristics which are varying over time X_{it}, a term constant over time α_i, which captures the effect of observable and unobservable characteristics of a worker such as education or ability, time by country FE. In practice, the vector X_{it} includes experience and experience squared.[6] The last term γ_{kt} aims to captures the effect of changes in labour demand on wages in a given country k and period t. Since the model includes an individual fixed effect α_i, these parameters are identified using deviations from the individual average and thus γ_{kt} captures the residual variations in average wages at the country level and over time which are not explained by changes in the composition of the labour force. This implies that average wage variations that are captured by the parameters γ_{kt} do not reflect the effect of changes in the distribution of observed or unobserved workers characteristics in the labour force such as education or experience on wage.

This simple model implies that changes in average wage in a given country between two periods can be written:

$$\Delta\overline{w_{kt}} = \Delta\overline{X_{it}}\beta + \Delta\overline{\alpha_{kt}} + \Delta\gamma_{kt}$$

The first two terms capture the effect of changes in the distribution of observable and unobservable characteristics in the labour force. The last term is the effect of changes in economic conditions.

[5] Notice that in this context, the simple solution of using cluster standard errors at the country/year level might not be valid in some specifications in which we have relatively few clusters since the estimator is consistent as the number of cluster gets large (Angrist and Pishke 2009, chapter 8).

[6] We follow the existing empirical literature which treats the returns to observable and unobservable characteristics as constant over time. This implies that all cyclical changes in the wage distribution are captured by the country fixed effects. See Chay and Lee (2000) for a more general model allowing for changes in the returns to observed and unobserved characteristics over time.

During a downturn, we expect the quality of the labour force to increase such that $\Delta\overline{\alpha_{kt}} > 0$ while, if negative labour demand shocks affect wages, $\Delta\gamma_{kt}$ is expected to be negatively corrected to the shock.

To account for workers FE, the fixed effect estimator instead of a first-difference estimator will be used in order to avoid restricting the sample to only employed workers over two consecutive period. This is important since we are obliged to focus on full time full year workers in some survey.

In the second step, we use changes in national unemployment rates as proxies for changes in labour demand during the cycle. We use a first difference regression of our 'residual' average wage changes on unemployment rate changes:

$$\Delta\hat{\gamma}_{kt} = \pi_t + \rho\Delta U_{kt} + u_{kt}$$

To control for potential common trends in wages across countries, the model includes time fixed effects π_t in some specifications. This implies that the parameter ρ is identified by using deviations from average changes in unemployment rate across countries.

However, even if the model is identified by using within-individual variations in wages, changes in the characteristics of individuals in the sample might affect our estimates if the effect of labour demand shock is heterogeneous across workers and the share of workers with a different level of wage cyclicality endogenously varies over the cycle.[7] A partial solution to this issue is to estimate the model using a balanced panel which keeps the composition of the sample constant over the entire estimation period. However, using a balanced sample implies that the estimates are made on a selected subgroup of individuals with strong attachment to the labour force which might not be representative.

[7] If the coefficients are heterogeneous, the regression estimates, under some additional assumptions, what Wooldridge (2002) calls the average partial effect.

In order to explore the importance of this issue, we provide below both estimates from a balanced sample and from standard unbalanced estimates.[8]

The Data

To estimate the model outlined above, we need data in which an individual is observed at least twice. We use two large nationally representative samples covering the same set of countries but different time period. The first dataset we use is the ECHP panel, where information on real wages is available from 1994 to 2001.[9] The ECHP panel is a harmonised cross-national longitudinal survey focusing on household income and living conditions. We use information on net current monthly wage and salary earnings (*pi211m*) to estimate wages. We also construct use an hourly wage rate where the number of hours is obtained using the number of hours worked at main job (*pe005a*). We define full time workers are those that declare having a full time job (*pe005c*).

We also use data from the SILC longitudinal panel (denoted LG-SILC) collected from 2004 to 2011 which contains retrospective information on total annual income over the period from 2003 to 2010 and on monthly income for a selected subgroup of countries from 2004-2011. The construction of LG-SILC is quite different from the ECHP. First, unlike ECHP, it is based on a rotating panel in which an individual is interrogated at most fourth time. More importantly, the information on income included in the LG-SILC is very different than the one in ECHP. In particular, there is not information on current monthly wages and the only information on annual "employee cash or near cash income" in the year previous the survey (*py010n*).[10] In addition, only retrospective information on the number of month worked full or part time during the previous year is available (*pl210a-pl210f*). Because there is no precise distinction between income received from full time or part time work and no information on the number of annual hours, it is difficult to separate changes in wage coming from the number of

[8] In practice, Solon et al. (1994) found relatively negligible differences between standard estimates and estimates obtained from a balanced sample.
[9] The ECHP panel has been used in many recent studies: see e.g. Olivetti and Petrongolo (2008) or Bellou and Kaymac (2012).
[10] An exception is Ireland which uses as a reference period the 12 month preceding the interview.

days worked or the wage rate if an individual did not work full time full year in both periods. As a result, when we use LG-SILC, we make the strong restrictions of focusing on workers who report to have worked full time full year during the previous year. For this selected subgroup of the population, we are sure that annual wage variations reflect changes in the wage rate and not changes in the number of hours worked.[11]

In the last section of the paper, we also use data from the cross-sectional SILC (noted CS-SILC below) to document the evolution of wages during the most recent crisis period. While CS-SILC does not enable us to follow individuals, it includes information on current monthly wages (*py200g*) and the number of hours worked (*pl060*) which are conceptually quite similar to what ECHP provides. Unfortunately, this information is only available for a restricted set of countries.[12] In addition, information on annual income is available for a more extensive number of countries than in the LG-SILC.

To focus on worker groups with substantial attachment to the labour force, our final sample uses workers aged between 18 and 60, who declare to be working full time, and are not self-employed (*pe001*) and are working in the private sector (*pe009*).[13] We focus on observations with valid information on wage and exclude imputed observations. To eliminate the influence of outliers, we trim the top and bottom 1% of wage observations within each country and years. We compute real wages using the national HICP index obtained from the OECD website.

We focus initially on 11 countries available both in ECHP and SILC: Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, Netherland, and Portugal. A typical year contains about

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[11] Another important issue is that LG-SILC is less homogenous than the ECHP because it is not based on a harmonized questionnaire but instead define a set of 'target variables' specified by EU regulations. This implies that data collection procedures often differ widely across countries and that comparison might be problematic. In particular, in some countries, information on income is collected from administrative records while other countries rely on surveys. See appendix for details.

[12] The collection of these variables was compulsory only for member states which have no other source to calculate the "gender pay gap". In our sample, this includes 6 countries: Austria, Spain, Greece, Ireland, Italy and Portugal.

[13] The same restrictions are used in the ECHP, LG-SILC and CS-SILC with the important exception that we cannot exclude workers from the public sector in the LG-SILC.

25,000 individuals for ECHP and 80,000 for SILC for which we have at least two individual observations to estimate the first stage model.

An important issue is that the coverage of the ECHP and SILC sample varies over time. For ECHP, data is available over the period 1994-2001 for all countries, with the exception of Austria and Finland for which the data is available during the period 1995-2002 and 1996-2001, respectively. For SILC, limitations in data availability are more important and tend to vary, particularly in the recent period.[14] Additional details on the construction of the sample are given in the data appendix.

IV. Estimates of the Elasticity of Real Wages in the pre-Crisis period

In this section, we present our estimates of the elasticity of real wages to changes in unemployment rate. We estimate the model using data on income from 1994-2001 in the ECHP and 2003-2007 in LG-SILC.[15] We do not include data for years after 2007 in order to derive how much the evolution of wages during the current crisis differs with respect to previous episodes.

In order to guarantee that our dependant variable capture changes in the wage rate and not changes in labour supply, for most of the analysis, we restrict our attention to employees working full time in the sample during the reference month in ECHP. As stated before, in LG-SILC, we have to make the stronger restrictions of focusing on workers who have worked full time full year during the previous year.

For comparison purposes, we first start with estimates of the model of equation (2) using uncorrected aggregate wage data as a dependant variable instead of our two step estimate based on individual level data. In Columns 1 and 2 of Table 1, we use changes in the real labour compensation from the national accounts obtained from the Eurostat website. To ensure comparability, we match the

[14] For LG-SILC, the data includes 2004-2011, except for Germany where it only covers 2005-2006, France where it covers, 2004-2010 and Greece and Ireland for which the sample cover 2004-2009. For CS-SILC, we have information on annual income for all countries for years 2004 to 2010 except for France the sample stops at 2010. We have information on monthly income over the period 2005-2011 for Austria, Spain, Italy, Portugal, 2005-2010 for Ireland, 2005-2009 for Greece.

[15] This imply that we use the 2004-2011 releases of LG-SILC since LG-SILC only contains retrospective information on annual income in the previous year.

number of countries and years in the sample across regressions with the one of regressions using ECHP-SILC that we perform next. Column 1 provides a simple bivariate regression while column 2 includes a time fixed effect which absorbs nonparametrically the impact of common trends across countries.

Consistent with previous studies using aggregate data, the results in Column 1 and 2 point to no evidence of cyclicality of the real unit labour cost on this panel. The point estimates are very small and statistically insignificant.

In column 3 and 4, we construct an aggregate wage series using our micro-data. To do this, we simply estimate the parameters γ_{kt} without including individual fixed effects or additional covariates in the first step. As a result, these country fixed effects reflect simply changes in average wage over time, as changes in the unit labour cost. Using these averages, we find some weak evidence of wage cyclicality, with elasticities between − 0.3 and −0.13, which are measured rather imprecisely.

In columns 5 and 6, we show our baseline estimates from the two step model including individual fixed effects and controls for experience and experience squared in the first step. The estimated wage elasticity is between 4 to 10 times larger than the previous specifications and is statistically significant. The results in column 5 indicate an elasticity of −1.2 and an elasticity of −1 in column 6 where time fixed effects are included. These elasticities imply that a 1 p.p. increase of the unemployment rate is correlated with a decrease of between 1.2 and 1 p.p. of the average log wage in the country.

In order to more clearly document the underlying source of variations of these estimates, we represent in Figure 1 the "*Yulized residuals*" of the estimate of the parameter ρ in column 6. The figure provides a graphical representation of the variations underlying the parameter estimate using the residuals of regression of $\Delta\gamma_{kt}$ on time fixed-effects on the y-axis and a separate regression of ΔU_{kt} on time fixed effects on the x-axis.

Overall, the Figure indicates that no particular outlier seems to be driving the estimates even if the observation for Greece in 1999, which is the farther point at the right, is quite far from the regression line. In practice, excluding this point from the sample provides a higher level of wage cyclicality with a parameter estimate (standard error) of −1.524 (0.316).

Similarly, from the Figure it can be seen that no particular country seems to drive the results. To derive more formally the influence of a particular country, we have estimated the same models but excluding each country sequentially. The largest change was obtained when excluding Ireland from the sample, with a parameter estimate of −0.847 (0.302).

In column 7 and 8, we estimate separately the model with either ECHP or LG-SILC. There are several reasons why the results might differ between these two samples: first, the wage concept is different between the two surveys, with full time workers in the reference month in ECHP and full time full year workers in LG-SILC. Second the cyclicality might also have changed between the two periods, particularly if the implementation of the Euro had a strong impact on wage evolutions in some countries.[16] However, for both periods, we obtain relatively strong and similar negative correlations for both samples with an elasticity of −1.5 for ECHP and −1.3 for LG-SILC.

In Table 2 and 3, we estimate whether the measured elasticity differ in an important ways across several subgroup of the population. In column 1 of Table 2, we first investigate how much the fact that the composition of individuals included the sample changes over time influences the results. In practice, such changes may matter only if the response of wages to the cycle is heterogeneous across individuals and if the share of individuals from different groups varies endogenously during the cycle. In column 1, the model is estimated by using a balanced sample with individuals observed over the whole sample period in ECHP.[17] Restricting the estimate to a balanced sample solved the problem of changes in the composition of the labour force at the price of an important selection of individuals in the sample, focusing on individuals with relatively strong attachment to the labour force. When using a balanced sample, we obtain an elasticity of −1.which is lower than the one of −1.5 obtained with ECHP only column 7 of the Table 1.

[16] Measurement errors might also differ between ECHP and CS-SILC on the one side which uses current monthly income, and LG-SILC on the other side which report retrospective annual total income (Moore et al. 2000).

[17] We focus on ECHP since LG-SILC being a rotating panel, it is only possible to follow a fourth of the sample over at most four year which decreases the sample size dramatically.

In column 4 and 5, we estimate whether there exist important differences in wage cyclicality between sexes by estimating our baseline model separately for men and women. We find somewhat similar elasticities of −1 for both sexes.

A limitation of the previous results is that they do not include account part time workers in the sample or the effect of changes in the number of hours worked. In column 4 and 5, we estimate the model using monthly hourly wages that can be estimated with ECHP and include part time workers in the sample. We find statistically significant but slightly lower elasticities with respect to the one obtained in column 7 of Table 1, with a value of −1.1 for both male and female.

The more important cyclicality of wages of jobs changers is well known in the empirical literature (see e.g. Beaudry and DiNardo 1991, Barlevy 2001). In Column 6 and 7, we estimate a separate model in ECHP distinguishing between workers who never changed employers during the period they are observed (stayers) and those who changed at least once (shifters). Unsurprisingly, the estimated elasticity of stayers is significantly lower −0.85. In contrast, in column 7, we find a much larger elasticity for job shifters with a coefficient of −1.4.

In Table 3, we estimate separate wage elasticity depending on the initial rank in the wage distribution of an individual when she is observed for the first time. We find that the wage elasticity is much larger at the first decile (−2.4), the first quartile (−1.9) than for the last quartile or the last decile (−0.8).

Comparison with elasticities from other studies

Our estimated elasticities might seem large but they are remarkably in line with existing estimates from the literature obtained using individual level data.[18] Existing studies report elasticities between −0.7 to −1.7 for the US (Solon et al. 1994) and −1.7 to −2.0 for the UK (Devereux and Hart, 2006).

[18] Most papers use a model similar to the one of Eq. (1) but there are sometimes important differences in the sample construction and the unemployment measure used to estimate the model which must be taken into account to interpret the results. See Anger (2011) for a good summary of the existing empirical estimates. In spite of these differences, we find that our results are remarkably in line with the one obtained for the U.S. or Italy. See Anger (2011) for a detailed comparison of the existing cross-country empirical estimates.

For Euro Zone countries, Anger (2011) reports elasticities from -0.8 to -1.7 for Germany, Verdugo (2013) finds -1.5 for France, Carneiro et al. (2012) find -1.6 to -2.5 for Portugal, while Peng and Siebert (2008) find -1.4 to -3 for Italy.

Inflation and real wage elasticity

In Table 4, we attempt to assess whether the real wage elasticity depends on the inflation rate. In a low inflation environment, firms might find difficult to adjust wages downward because it implies to decrease the nominal wage which is deemed to be particularly rigid (Card and Hyslop 1997). Resistance to nominal wage cuts can constraint the reponse of real wages in a low inflation environment.

In a low inflation environment, firms might find difficult to adjust wages downward since that implies to decrease the nominal wage which is deemed to be particularly rigid (Card and Hyslop 1997). To evaluate this question, we estimate the following model:

$$\Delta\hat{\gamma}_{kt} = \pi_t + \rho_1 \Delta U_{kt} \times e_{\Delta IPC<1\%} + \rho_2 \Delta U_{kt} \times e_{\Delta IPC\in[1\%;2\%[} + \rho_3 \Delta U_{kt} \times e_{\Delta IPC\in[2\%;3\%[} + \rho_4 \Delta U_{kt} \times e_{\Delta IPC>3\%} + u_{kt}$$

where $e_{\Delta IPC\in[x,y]}$ is a dummy variable equals to one if the inflation rate is comprised in the indicated interval and zero instead. Each parameter ρ_k indicates how much the elasticity to unemployment rates differs across periods with different inflation levels.

Results in Table 4 point to a strong evidence that wage cyclicality differs across inflation levels. While the elasticity is small and positive when inflation is inferior to 1%, it is negative and statistically significant when inflation is superior to 1%. In addition, the elasticity appears to be much larger when inflation is superior to 3%, with an elasticity of −1.5

In sum, the results of this section indicates somewhat similar levels of elasticity across groups in the population, either when the sample only uses ECHP or LG-SILC, when hourly or monthly wages are used. In addition, the results are somewhat similar for males and females. The most important differences are observed between stayers and shifters, for workers the bottom of the wage distribution which seem to experience a much larger wage cyclicality, and between periods of low inflation compared with periods of high inflation.

V. Wage adjustments during the Recent Crisis

We now turn to an investigation of the evolution of real wages during the recent crisis focusing on the 2008-2010 period for which data at the individual level is available. An important point is the remarkable heterogeneity of changes in unemployment rates across Euro zone countries in this period. Table 5 shows that unemployment increases were particularly large in Spain or Portugal, and more moderate for countries such as France or Italy. Another important factor is that inflation levels differed widely across countries. Inflation was on average much lower in 2008-2009 than in 2009-2010 but there are noticeable differences across countries, particularly in the 2008-2009 period.

Over the two periods, changes in real labour compensation reported in column 3 also varied in an important way across countries. In 2008-2009, in spite of the large increase in unemployment in Spain, Ireland or Portugal, real wage increased widely in these countries by respectively 4%, 2.2% and 3.6%. Real wage growth was more moderate in 2009-2010, with most countries in our sample experiencing negative real wage change.

As discussed previously, a difficulty in interpreting these evolutions is that the unadjusted evolution of real wages may both reflect underlying changes in the price of labour and composition effects that confound changes in the wage structure. As data from LG-SILC is not yet available for a sufficient number of countries, we use data from CS-SILC which are reasonably exhaustive.[19] In this sample, we cannot track individuals over time and thus cannot keep constant the composition of the labour force as in the previous section. Instead, we estimate the respective contribution of changes in composition and changes in the price of labour using a simple wage decomposition method that is described in the Appendix.

In column 5, we show changes in real average wage estimated with CS-SILC. Over the two periods, changes in real labour compensation and changes in real average wage estimated with CS-SILC are correlated but tend to differ sometimes in an important ways. These differences are not

[19] Data from Ireland and France data are missing for the 2011 SILC sample (which contains restrospective informtion on 2010 income). Data from Greece is missing over the whole period.

surprising since in CS-SILC the sample is restricted to full-time full-year workers while real labour compensation includes the entire labour force.

In columns 6 and 7, we decompose changes in real average wage in CS-SILC by a part explained by changes in composition and a part related by changes in the price of labour. These decompositions are graphically depicted in Figure 2 and 3. As expected, composition effects tend to be positive across all countries over the period. However, an important result is that composition effects are usually small in countries in which unemployment did not change much such as Germany or Austria, while they are quite large in countries which experienced a large increase in unemployment. Indeed, the importance of composition effects appears to be strongly proportional to the change in unemployment. From 2008 to 2009, composition effects explain more than half the increase in average wage observed in France, Ireland, Italy and in the Netherlands. During the period 2009-2010, composition effects are also substantial in Italy, Portugal or Belgium where they have increased wages by about 1.5% over the period.

An important issue is whether the evolution of real wages net of composition effects during this period is consistent with the elasticities estimated in the previous section. An important point is that inflation was very low in 2008-2009 and increased substantially in 2009-2010. As a result, we report in column 7 the expected change in real wage using elasticities from the more flexible model where elasticities are allowed to vary with inflation. During the 2008-2009 period, the model predicts very little change in wages in most countries since the elasticity of real wages to unemployment is close to zero in a low inflation regime. Clearly, this is not what has happened as relatively substantial wage increases were observed.

In contrast, in 2009-2010, inflation levels tend to be above the 1% threshold, which imply an elasticity of −0.8. For this period, the differences between the predicted and the observed values are much smaller. In Spain, Portugal or Belgium, we even find larger adjustments net of composition effects than those predicted by the model.

VI. Discussion

Using individual level data for the Euro zone, we have investigated the relationship between real wages and change in unemployment rate. We found that while aggregate real wage series are weakly procyclical, composition effects related to changes in employment probability across workers during the cycle are sufficiently important to hide the significant correlation between real wage changes at the individual level and the business cycle. With individual level data, we estimate that the elasticity with respect to unemployment rate between −0.9 and −1.4.

During the recent crisis period, we also found that large composition effects have influenced the evolution of the observed real average wage.

Composition effects have been large and explain a large share of the stagnation or increases in average wage observed in some countries from 2008 to 2010. At constant composition of the labour force in terms of education and experience, the data indicates much larger wage adjustments during the downturn in countries most affected by the crisis. Most of average real wage increase or stagnation in France of Italy from 2008 to 2011 is explained by changes in the composition of the labour force. Using the elasticity estimated, we find strong evidence that real wages have been particularly rigid in the recent period but not so rigid than what would be indicated by the aggregate series.

Nevertheless, and in contrast with the 2009-2010 period, wages did not adjust much in 2008-2009 even after adjusting for composition effects. There is overwhelming evidence that this relatively larger level of wage rigidity at the beginning of the crisis is related to the strong decrease in inflation in 2008-2009 which had prevented firms to adjust real wages using inflation.

The results in this paper have several implications. First, our results confirm that the evolution of the aggregate real wage series is partially misleading and must be interpreted with caution when there are simultaneously large unemployment variations.

The difficulties related to the interpretation aggregate wage data over time suggests that the availability of better wage index taking into account composition effect would have a substantial payoff. Obviously, such index to be useful for policy making, it would have to be available in a reasonable delay and be sufficiently homogenous across countries.

Finally, the fact that wage adjustment where particularly slow during low inflation period confirms previous evidence that adjustment are difficult to make during periods of low inflation. These results confirm it is important for the Euro Zone to avoid deflationary low inflation during periods in which wages have to be adjusted significantly.

VII. References

Anderton R. et al., (2012), Euro area labour markets and the crisis, No 138, Occasional Paper Series, European Central Bank.

Angrist, Joshua D and Pischke, Jörn-Steffen, 2008, Mostly harmless econometrics: An empiricist's companion, Princeton University Press

Joseph G. Altonji & Paul J. Devereux, 1999. "The Extent and Consequences of Downward Nominal Wage Rigidity," NBER Working Papers 7236

Ammermüller, A., C. , F.O. Lucifora, T. Zwick, 2010. Wage flexibility in regional labour markets: Evidence from Italy and Germany. Regional Studies 44, 401-421.

Anger, S., 2011. The Cylicality of Effective Wages within Employer-Employee Matches in a Rigid Labor Market. *Labour Economics* 18, 786-797.

Beaudry, Paul and DiNardo, John, 1991, The effect of implicit contracts on the movement of wages over the business cycle: Evidence from micro data,Journal of Political Economy , 665--688

Bellou, Andriana and Kaymak, Baris, (2012), Wages, implicit contracts, and the business cycle: Evidence from a European panel, *Labour Economics*, 19, issue 6, p. 898-907

Bils, M.J., 1985. Real Wages over the Business Cycle: Evidence from Panel Data. *The Journal of Political Economy* 93, 666-689.

Borjas, G. J. (1980). The relationship between wages and weekly hours of work: The role of division bias. *The Journal of Human Resources*, *15*(3), 409-423.

Anabela Carneiro & Paulo Guimarães & Pedro Portugal, 2012. "Real Wages and the Business Cycle: Accounting for Worker, Firm, and Job Title Heterogeneity," American Economic Journal: Macroeconomics, vol. 4(2), pages 133-52, April.

Card, David E, 1995, The Wage Curve: A Review Journal of Economic Literature 33 2 285--299
Romer, David, 2006, Advanced macroeconomics

Card, David and Hyslop, Dean , 1997, Does Inflation "Grease the Wheels of the Labor Market"?, in: Reducing inflation: Motivation and strategy, 71—122, University of Chicago Press

Devereux, P. J. (2000). Cyclicality of Real Wages within Employer-Employee Matches, The. *Indus. & Lab. Rel. Rev.*, *54*, 835.

Devereux, P.J., R.A. Hart, 2006. Real Wage Cyclicality of Job Stayers, Within-Company Job Movers, and Between-Company Job Movers. *Industrial and Labor Relations Review* 60, 105-119.

DiNardo, John and Fortin, Nicole M and Lemieux, Thomas, Labor Market Institutions and the Distribution of Wages, 1973-1992: A Semiparametric Approach, Econometrica, 64(5)

Fortin, Nicole and Lemieux, Thomas and Firpo, Sergio, 2011, Decomposition methods in economics, Handbook of labor economics, 4, 1--102

Gobillon, L. (2001). Emploi, logement et mobilité résidentielle. *Economie et statistique*, *349*(1), 77-98.

Kline, Patrick, 2011, Oaxaca-Blinder as a reweighting estimator, American Economic Review, 101 (3), 532—37

Krugman, P. (2013). Revenge of the Optimum Currency Area, *NBER Macroeconomic Annual*

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

Moore, Jeffrey C and Stinson, Linda L and Welniak Jr, Edward J, 2000, Income Measurement Error in Surveys: A Review, Journal of Official Statistics, 16 (4), 331-361

Peng, F., W.S. Siebert (2008): Real Wage Cyclicality in Italy, *Labour*, 22 (4), 569-591.

Peng, F., W.S. Siebert (2007): Real Wage Cyclicality in Germany and the UK: New Results Using Panel Data, IZA Discussion Paper No. 2688.

Schmitt-Grohe S, Uribe M., Downward Nominal Wage Rigidity and the Case for Temporary Inflation in the Eurozone, Journal of Economic Perspectives, 27, Summer 2013, 193-212.

Solon, G., R. Barsky, J.A. Parker, 1994. Measuring the Cyclicality of Real Wages: How Important Is Composition Bias? *Quarterly Journal of Economics* 109, 1-26.

Data Appendix

Construction of LG-SILC sample: We combine the longitudinal files. For observations that are included in several files, we keep the observation of the most recent panel version. Rotation panel: France 9 years.

Table 1: Real Wage Elasticity: Aggregate versus Individual level Estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Specification	Real aggregate Labour Compensation		No individual FE		Include indiv. FE		ECHP	LG-SILC
$\Delta Unemp_{kt}$	-0.094	0.001	-0.320	-0.135	-1.223***	-1.054**	-1.515***	-1.316**
	(0.239)	(0.261)	(0.321)	(0.353)	(0.370)	(0.367)	(0.434)	(0.626)
Sample	National Accounts		ECHP / LG-SILC				ECHP	LG-SILC
Time period	1994-2001 // 2003-2008						1994-2001	2003-2008
Time FE	No	Yes	No	Yes	No	Yes	Yes	Yes
Individual FE (First Step)	na	na	No	No	Yes	Yes	Yes	Yes
N	101	101	101	101	101	101	63	38

Robust SE.

Table 2: Differences in Wage Elasticity across groups in the population

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Balanced Sample	Men	Women	Men: Hourly Wage	Women: Hourly Wage	Job Stayers	Job Shifters
$\Delta Unemp_{kt}$	-1.014**	-1.024**	-1.063**	-1.143***	-1.127**	-0.849*	-1.402**
	(0.353)	(0.339)	(0.440)	(0.339)	(0.434)	(0.351)	(0.537)
Sample	ECHP	ECHP/ LG-SILC	ECHP/ LG-SILC	ECHP	ECHP	ECHP	ECHP
Time period	1994-2001	1994-2001 // 2003-2008		1994-2001			
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE (First Step)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	63	109	109	63	63	63	63

Robust SE.

Table 3: Wage Elasticity across the distribution of wages

	(1)	(2)	(3)	(4)	(5)	(6)
	P10	Q1	Q2	Q3	Q4	P90
$\Delta Unemp_{kt}$	-2.349**	-1.960***	-0.869**	-1.226***	-0.827*	-0.821
	(0.856)	(0.543)	(0.329)	(0.367)	(0.383)	(0.489)
Sample	ECHP	ECHP	ECHP	ECHP	ECHP	ECHP
Time period	1994-2001					
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE (First Step)	Yes	Yes	Yes	Yes	Yes	Yes
N	63	63	63	63	63	63

Robust SE.

Table 4: Wage Elasticity and Inflation rate

	(1)	(2)
$\Delta Unemp_{kt}$	-0.941	0.229
x Inflation < 1 %	(1.833)	(1.886)
$\Delta Unemp_{kt}$	-1.122*	-0.821
x Inflation $\in [1,2]$	(0.469)	(0.471)
$\Delta Unemp_{kt}$	-1.122**	-0.906*
x Inflation $\in [2,3]$	(0.418)	(0.423)
$\Delta Unemp_{kt}$	-1.362*	-1.472*
x Inflation > 3%	(0.658)	(0.643)
Sample	ECHP+SILC	
Time period	1994-2001 // 2003-2008	
Time FE	No	Yes

Table 5: Real Wage Decompositions in 2008-2009 and 2009-2010

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Country	Δ Unempl.	Δ HICP	Change Real Labour Compensation	***CS-SILC data: annual wage of full-time full-year workers***			*Predicted Price Effect*
				Observed change	Composition Effect	Price Effect	
	A. Period 2008-2009						
AT	1.0	0.37	4.14	5.53	-0.13	5.67	0.23
BE	0.9	0.00	1.16	3.45	0.83	2.61	0.21
DE	0.3	0.19	3.33	-0.84	-0.17	-0.68	0.07
ES	6.7	-0.27	4.03	1.30	1.29	0.01	1.53
FI	1.8	1.68	0.61				
FR	1.7	0.09	3.02	1.56	0.88	0.68	0.39
IE	5.6	-1.65	2.21	8.30	4.35	3.95	1.28
IT	1.1	0.74	1.23	2.16	1.10	1.06	0.25
NL	0.6	1.04	1.75	2.75	1.19	1.57	-0.49
PT	1.9	-0.83	3.59	7.19	0.42	6.78	0.44
	B. Period 2009-2010						
AT	-0.4	1.67	-0.01	-0.41	-0.49	0.08	0.33
BE	0.4	2.30	-0.91	0.49	1.43	-0.93	-0.36
DE	-0.7	1.21	-0.92	1.14	0.82	0.31	0.57
ES	2.1	2.08	-1.89	-2.41	0.68	-3.08	-1.90
IT	0.6	1.65	0.66	2.22	1.99	0.23	-0.49
NL	0.8	0.94	0.59	2.63	1.39	1.24	0.18
PT	1.4	1.40	0.63	-0.95	2.34	-3.29	-1.15

Note: For each country and period, Column 1 reports the change in the unemployment rate, column 2 the change in HICP, column 3 reports the change in real labour compensation. In columns 4, we report changes in real average wage for full time full years workers obtained from CS-SILC that we decompose between composition effects in column 5 and price effects in column 6. In column 7, we report the predicted change in wage net of composition effects using the elasticities reported in Figure 2.

Figure 1: Yulized Residuals from Regression Col 6

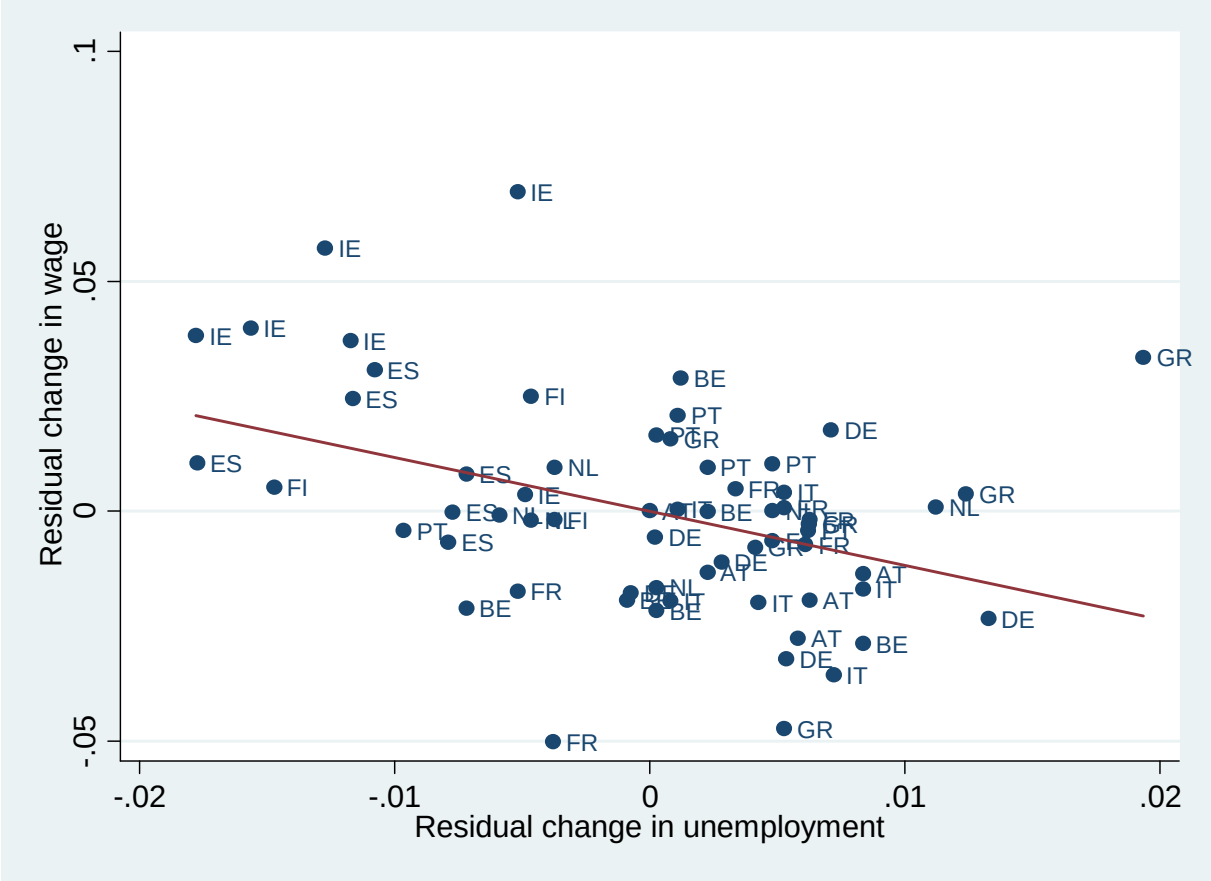
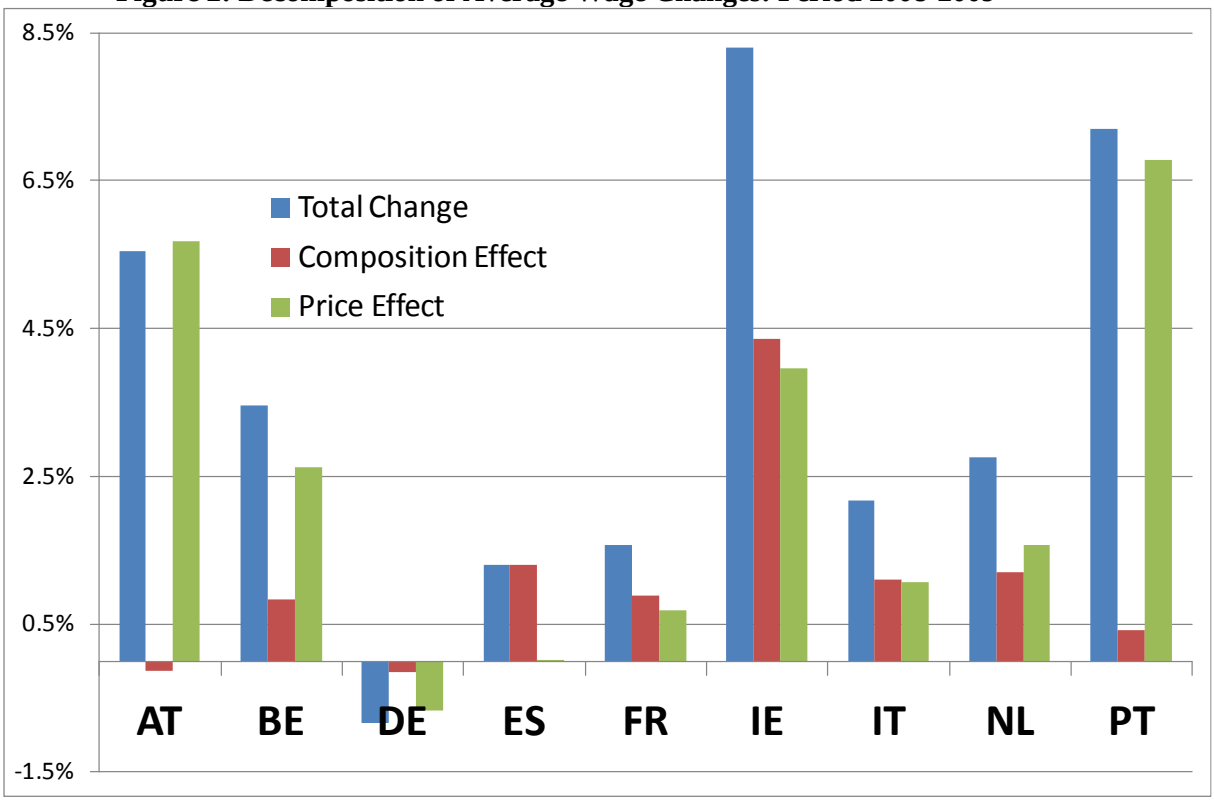
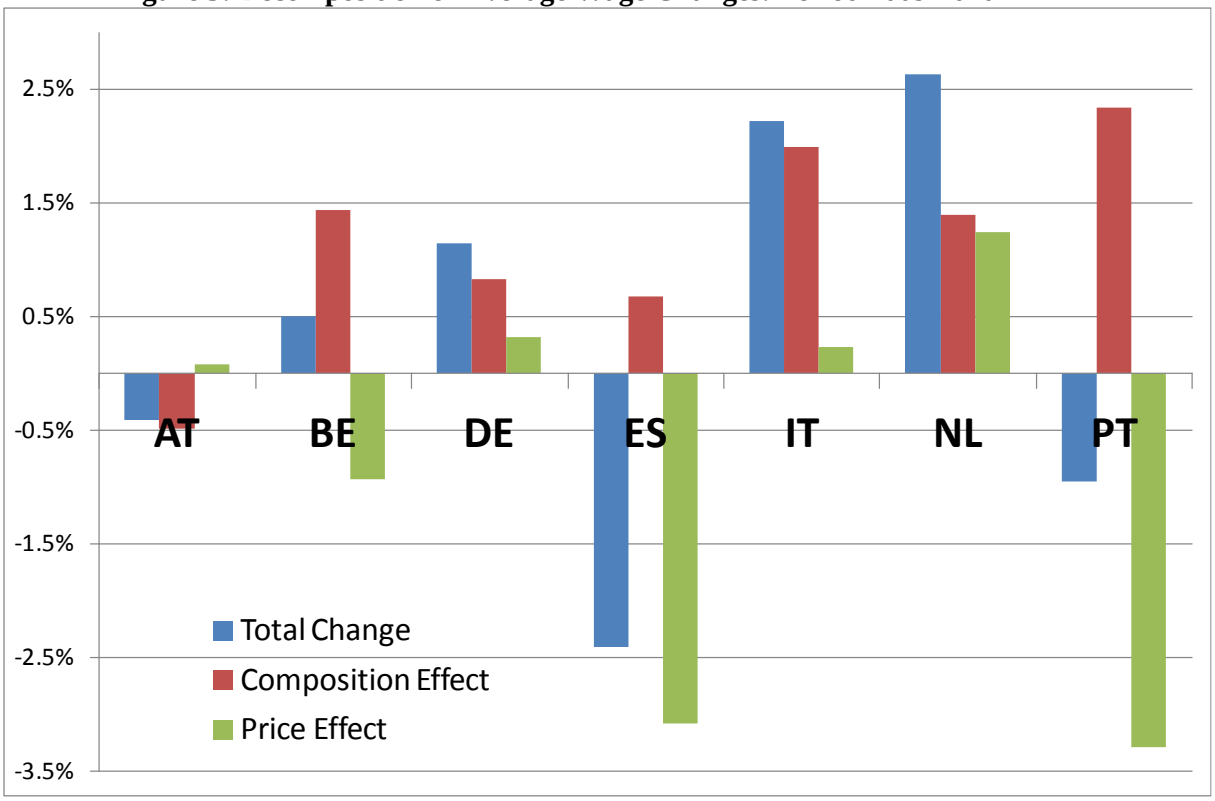


Figure 2: Decomposition of Average Wage Changes: Period 2008-2009



Note: For each country, the bar represents a decomposition of the evolution of real average wages for full-time full year workers between a composition and a price effect. See text for details.

Figure 3: Decomposition of Average Wage Changes: Period 2009-2010



Note: For each country, the bar represents a decomposition of the evolution of real average wages for full-time full year workers between a composition and a price effect. See text for details.