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Sectoral Wage Rigidities and Labour and Product Market Institutions in the Euro Area*

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Abstract

We estimate wage Phillips curve relationships between sectoral wage growth, unemployment and productivity in a country-industry panel of euro area countries. We find that institutional rigidities – such as labour and product market institutions and regulations – limit the adjustment of euro area wages to unemployment, in both upturns and downturns, particularly in manufacturing and, to a lesser extent, in the construction and service sectors. In addition, there are also further limitations in the response of wages to changes in unemployment during economic downturns which suggests that euro area wages are also characterised by significant downward wage rigidities, especially in the manufacturing sector. These results are robust to specifications that account for factors that may affect structural unemployment (such as duration-dependent unemployment effects), as well as changes in the skill composition of employment that may affect the evolution of aggregate wages. The results also hold for panels including or excluding the public sector (where wages may be determined differently to the private sector also due to the effects of fiscal consolidation on public sector wages during the crisis). From a policy perspective, reforms in product and labour markets which reduce wage rigidities can facilitate employment growth and enhance the rebalancing process in the euro area.

JEL Classification: E24, E31, J31
Keywords: sector wages, wage rigidity, wage Phillips curve, labour market institutions, product market institutions

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1 Introduction

One important channel through which the economy adjusts to macroeconomic shocks is wages, in particular in a monetary union with a shared exchange rate and a common monetary policy. This paper investigates the responsiveness of real and nominal wages to unemployment across main economic sectors in euro area countries. In a country-industry panel we estimate a wage Phillips curve relationship between wage growth and the unemployment rate, augmented with productivity growth and inflation. Our objective is to learn about possible wage rigidities that may attenuate the response of wage growth to changes in unemployment and whether this response is exacerbated during economic downturns in the euro area.

A number of studies have estimated wage Phillips curve relationships using macroeconomic data, aggregated at the country level. In their seminal paper, Blanchard and Katz (1999) find evidence for a delayed response of wages to the unemployment rate. This is interpreted as rigidity. Arpaia and Pichelmann (2007) find significant heterogeneity in the response of wage growth to the unemployment rate both across euro area countries and across the business cycle. Babetskii (2007) also provides evidence for significant wage rigidities across euro area countries from a wage Phillips curve but does not find differences between early and late adopters of the common currency. On the other hand, Rusinova et al. (2015) conclude that Central and Eastern European countries have more flexible wages than countries of the euro area. Anderton and Bonthuis (2015) study the recent crisis in the euro area and find evidence for downward wage rigidity especially during economic downturns.[1] In a related study for the United States, Galí (2011) also concludes that wages are substantially downward rigid.

Our study builds on this evidence by taking a more disaggregated approach using a country-industry panel. Such a panel comes with a number of advantages. First, working with manufacturing, construction, services and the public sector as separate cross-sections allows us to account for sectoral differences in both wage growth and responses to unemployment during the crisis. Second, it helps us to address more directly the robustness of findings on wage rigidity to the changing skill composition of the labour force. Compared to micro-level research, where wages of individuals are observed, aggregate wages may appear rigid during downturns – especially during the crisis – from a macroeconomic perspective, if disproportionally more low-skilled/low-paid workers exit employment (Verdugo, 2015). Controlling for changes in sector-specific shares of temporary and young workers allows us to account for some of the possible spurious wage rigidity due to changing compositions of employment. Third, an additional bias in aggregate estimates of wage rigidity may arise from the presence of public sector wages. Public sector wages are determined differently than private sector wages. Sanz-de Galdeano and Turunen (2006) and Peng and Siebert (2007) find that they are more rigid and decoupled from the business cycle compared to wages in the private sector. However, in the crisis period public sector wages might appear

[1] Also see related work on the euro area in Anderton et al. (2015) and MPC Task Force [chairman Robert Anderton] (2012).

more pro-cyclical due to fiscal consolidation that has taken place in euro area countries. If wages in the public sector stagnate or decline as governments reduce their labour cost during the crisis period, then aggregate wages may appear spuriously flexible during downturns.

We find that on average across sectors, nominal and real wages are significantly rigid downwards. This result holds for sectoral wage growth and sector-specific downturns, if we control for employment composition effects and in panels including or excluding the public sector. Sector-specific results show that wage rigidities are most pronounced in manufacturing and, to a lesser extent, in services and construction. Regarding employment composition effects, we find that a decline in sector-specific temporary and youth employment increases wage growth in some sectors.

We also search for possible explanations of wage rigidity, in particular the role of labour and product market institutions. Rusinova et al. (2015) explain cross-country differences in wage rigidity with the general degree of regulation prevailing in the countries of their sample. Anderton and Bonthuis (2015) find that employment protection legislation and union density reduce the sensitivity of wages to unemployment as both institutional features increase the bargaining position of employed workers. The importance of labour market institutions in explaining wage rigidity is also supported by empirical work on wage curve relationships. The level of wages responds less to the business cycle if employment protection is high, union density or coverage is high, unemployment benefits are high, or collective bargaining is centralised.[2]

We also largely confirm, as well as extend, earlier findings by showing that employment protection legislation, product market legislation and union density can explain a smaller response of wage growth to unemployment (which applies symmetrically to both downturns and upturns). Labour and product market institutions and regulation, however, cannot fully explain downward wage rigidities, since those remain significant even after controlling for institutional effects.

We also assess the role of labour and product market institutions during the crisis in the euro area. The crisis is characterised by two distinct phases. During the Great Recession (2008Q2 to 2009Q2) all euro area economies experienced a similar economic contraction. By contrast, the second phase of the crisis (2011Q4 to 2013Q1), is characterised by concerns about sovereign debt and therefore more heterogeneous effects across euro area countries. We find that countries with initially more rigid labour markets saw a stronger downward response in wages during the second phase. This may be due to pent-up wage adjustment as well as an effect of labour market reforms.

This paper proceeds as follows. In the next section we introduce our empirical strategy and explain characteristics of our data. Section 3 presents baseline results on the existence of downward wage rigidity for a pool of country-industry cross-sections. Section 4 addresses the role of labour and product market institutions as well as differences across sectors, together with the distinction between the two phases of the crisis. In section 5 results from a

[2]Macroeconometric studies include Nunziata (2005), Clar et al. (2007), Camarero et al. (2014) and Knell (2013). Microeconomic analyses of wage curve relationships with a focus on institutional determinants include Nickell and Quintini (2003), Dickens et al. (2007), Agell and Bennmarker (2007), Holden and Wulfsberg (2008).

number of robustness checks are reported. Section 6 concludes.

2 Empirical strategy

2.1 Empirical model

We follow the literature in estimating a dynamic wage Phillips curve relationship where nominal wage growth is positively related to its own lags, negatively related to deviations of unemployment from its natural rate, and positively related to inflation:

$$\Delta w_{cit} = \sigma(L)\Delta w_{cit-1} - \beta(L)(UR_{ct} - UR_c^n) + \gamma(L)\Delta CPI_{ct} + \epsilon_{cit} \quad (1)$$

In our country-industry panel, we denote countries with the subscript c, economic sectors with subscript i, and t is time in quarterly periods. We consider four lags in the lag operator L and work with annual changes Δ in percent, i.e. for logged variables $\Delta x_{cit} = 100 * (\ln x_{cit} - \ln x_{cit-4})$. w_{cit} are sector-level wages in logs, i.e. nominal compensation per person and hour. ϵ_{cit} is the error term.

UR_{ct} is the unemployment rate in levels and UR_c^n its natural rate. We use aggregate unemployment assuming that labour is sufficiently mobile across economic sectors.[3] Estimates of the natural rate of unemployment, that are consistent across countries, are difficult to obtain.[4] We therefore work with overall unemployment rates and assume that the natural rate of unemployment, which results from the specific structure of the labour market, is relatively time-invariant. Using this assumption, we can subsume model parameters on the natural rate into country-industry fixed effects: $\alpha_{ci} = \beta UR_c^n + \pi_{ci}$, where π_{ci} may capture other, country-industry-specific structural factors that affect the level of wage growth, like institutional arrangements or geography.[5]

CPI_{ct} is the consumer price index in logs. Parameter γ measures the extent to which workers are able to include inflation in their nominal wage adjustments. We use consumer rather than producer price inflation as the former measure is more relevant to the bargaining process of workers. Using country-wide inflation in a regression with sector-specific nominal wage growth as dependent variable resolves partly the endogeneity problem that occurs, if aggregate wage growth is regressed on aggregate inflation. For workers, country-wide consumer prices are relevant for wage bargaining. In return, sector nominal wages only feed partially through to country-wide price inflation depending on the size of the sector.

We estimate our model both with nominal wages and real wages as dependent variable. Real wages are obtained by dividing nominal compensation by the country-wide consumer

[3] Estimates of sector-level unemployment are not available for our sample.

[4] Although some empirical estimates of structural unemployment are available from various institutions, they are not usually suitable for use in the current paper. For example, in many cases, structural unemployment is actually estimated by using wage Philips curve relationships. This would lead to endogeneity problems, if we used them in our wage equation.

[5] Since it can be argued that the natural rate of unemployment exhibits some degree of time variation, in particular during recessions, we estimate a specification in which we approximate it using a measure for long-term unemployment (>24 months unemployed) as robustness check (section 5.2).

price index. In that case, inflation does not enter as separate regressor, i.e. $\gamma = 1$ is imposed for CPI_{ct}, and $\gamma = 0$ for CPI_{ct-j} with $j \neq 0$.

As in Anderton and Bonthuis (2015), we augment the regression equation to also account explicitly for productivity growth as a determinant of changes in real wages. $Prod_{cit}$ is sector-level log hourly labour productivity:

$$\Delta w_{cit} = \sigma(L)\Delta w_{cit-1} - \beta(L)UR_{ct} + \rho(L)\Delta Prod_{cit} + \gamma(L)\Delta CPI_{ct} + \alpha_{ci} + \epsilon_{cit} \tag{2}$$

We define as wage rigidity the extent to which the response of wage growth to deviations of unemployment from the sample average – captured by parameter β in equation (2) – is impaired by labour market institutions. Galí (2011) provides a theoretical foundation for this by deriving parameter β from a New Keynesian model with staggered wage setting (Calvo, 1983). This results in a dynamic relation between wage growth and the difference between actual unemployment and its natural rate which is referred to as New Keynesian Wage Phillips Curve. β becomes a function of Calvo parameters which determine the frequency of wage changes in every period, i.e. can be interpreted as manifestation of labour market institutions that symmetrically affect wage growth. Adding an interaction between unemployment and a matrix that contains factors that approximate rigidities, X_{cit}, allows us to control for heterogeneity in the response of wage inflation to unemployment:

$$\begin{aligned}\Delta w_{cit} = \sigma(L)\Delta w_{cit-1} - \beta(L)UR_{ct} + (UR_{ct}{}'X_{cit})'b + \rho(L)\Delta Prod_{cit} + \gamma(L)\Delta CPI_{ct} \\ + X_{cit}{}'c + \alpha_{ci} + \epsilon_{cit}\end{aligned} \tag{3}$$

Similar to Anderton and Bonthuis (2015), we consider as a factor in X_{cit} a dummy variable that takes the value of one, if the change in the gross value added gap (relative to a long-term trend) for sector i is negative. An interaction between this dummy and unemployment allows us to introduce slope parameter heterogeneity into the wage Phillips curve relation and explicitly control for asymmetric, downwardly rigid responses of wage growth to unemployment during sector-specific recessions. Furthermore, we include a number of institutional factors in X_{cit} to test more specifically which types of rigidities or institutional features may affect the degree of downward rigidity of wages: changes in employment protection legislation, product market regulation and trade union density. Since we expect institutions to also affect the average level of wage inflation, we control for their intercept effect c independent of their slope effect b on the unemployment parameter. $X_{cit}{}'c$ and α_{ci} taken together can be interpreted as structural unemployment rate which is slowly moving if institutional reforms are adopted. Note that intercept effects differ from slope effects in the following sense: while slope effects directly measure the effect of institutions on the elasticity of wage growth to deviations of the unemployment rate from the sample average, intercept effects (or *level* effects) measure average effects on the level of wage growth. While more rigid institutions are expected to flatten out the negative response of wage growth to unemployment (posi-

tive slope effect), intercept effects can be ambiguous: rigid institutions may cause a steady positive wage growth independent of the business cycle (positive intercept effect on wage growth) or may be associated with low wage growth which will also be independent of the business cycle (negative intercept effect). In this paper we focus on slope effects.

We estimate equation (3) by dynamic fixed effects regression.[6] We deal with serial correlation by accounting for a rich dynamic structure with four lags and compute standard errors that are clustered at the country-industry level. Given that construction (7.7 percent share in overall employment on average across countries) and manufacturing (16.6 percent) would be over-represented relative to services (40.7 percent) in a pooled analysis, we report results from a weighted regression where regression weights are relative within-country industry employment shares averaged over time.

We report the sum of coefficients of all lags and conduct F-tests of joint significance for these terms. We also calculate long-run estimates for regressors by dividing the sum of coefficient estimates across lags by the sum of lags of coefficients on the lagged dependent variable.[7]

2.2 Data

Quarterly, sector-level data on our macroeconomic variables include wages, productivity and gross value added, combined with country-level unemployment rates and consumer price inflation. All variables of interest were obtained from Eurostat.[8]

Table 1: Euro area labour and product market institutions over time

	2000	**2007**	**2010**	**2013**
EPL	2.83	2.79	2.70	2.55
	(0.57)	(0.55)	(0.46)	(0.38)
ETCR	3.54	2.37	2.14	2.09
	(0.85)	(0.62)	(0.50)	(0.47)
Union density	30.5	25.3	24.6	24.2
	(16.8)	(15.9)	(15.7)	(16.5)

Note: Sourced from the OECD. Cross-country averages, standard deviation in brackets.

In order to approximate the institutional set-up we use indicators provided by the OECD on employment protection legislation (EPL), on regulation in energy, transport and communications as proxy for overall product market regulation (ETCR)[9], and on trade union density. Annual indicator values are interpolated. This yields an unbalanced multi-level panel which allows an analysis of 13 euro area countries[10] and the three private sectors manufac-

[6] To check the robustness of our baseline specification, we employ the Mean Group and Common Correlated Mean Group estimators as alternative. We have also experimented with (System) GMM estimation as alternative but found that our rich dynamic structure as well as our large time dimension pose a severe challenge to these estimators.

[7] For example $\overline{\beta} = \frac{\sum_{i=0}^{4} \beta_i}{1-\sum_{j=1}^{4} \sigma_j}$ yields the aggregate long-run unemployment coefficient.

[8] A list of data sources and details on the construction of variables can be found in Table A1 in the Appendix.

[9] We use ETCR as proxy for overall product market regulation as the PMR indicator is available from the OECD only at a 5-year frequency.

[10] We include Austria, Cyprus, Germany, Estonia, Spain, Finland, France, Ireland, Italy, Netherlands, Portugal, Slovenia, Slovakia given data availability.

turing, construction, market services, as well as the public sector, over the period 1992Q1 to 2014Q2.

Labour market reforms over the last decade have resulted in a significant relaxation of employment protection legislation (Table 1). The OECD indicator for EPL has slowly decreased from 2.83 in 2000 to 2.70 in 2010 but dropped significantly down to 2.55 between 2010 and 2013 as reforms were undertaken in euro area member states. Similarly, energy, transport and communication sectors saw a relatively higher degree of regulation in 2000 with significant heterogeneity across countries but were deregulated mostly between 2000 and 2007. Meanwhile, union density fell from 30.5 percent on average in 2000 to 24.2 percent in 2013.

3 Wage rigidity

We start by estimating our baseline wage Phillips curve specification (equation 2). Results from a weighted fixed effects OLS regression show that there is a clear, significantly negative relationship between wage growth and unemployment (Tables 2a and 2b, column 1). An increase in the unemployment rate of 10 percentage points on average is associated with a reduction of both nominal and real wage growth by around 3 percentage points in the long run. Wage growth is significantly linked to productivity growth although parameters are considerably smaller than unity.[11] As expected, inflation significantly determines nominal wage growth but its long-term weight lies as well below unity. In what follows, we continue to report all our results both for nominal and real wages.

Tables 2a and 2b show that if the public sector is included in the analysis (column 2), the long-run coefficient on unemployment increases in absolute terms relative to our baseline results which exclude the public sector (column 1). This indicates that pro-cyclical fiscal consolidation may make aggregate-economy wage developments look spuriously more flexible with respect to unemployment. Columns 3 to 5 confirm that our baseline results are robust to alternative estimation techniques that assign equal weight to every sector (unweighted regression), allow for heterogeneity in coefficients across sectors and countries (Mean Group estimation MG and Common Correlated Effects Mean Group estimation CCEMG), or for the presence of unobserved cross-sectional dependence (CCEMG) (Pesaran and Smith, 1995; Pesaran, 2006).

[11] Robustness checks in section 5.3 show that imposing unity on long-run productivity parameters does not qualitatively alter our results.

Table 2a: Baseline results: nominal wages

	1 baseline	2 incl. public sector	3 unweighted regression	4 MG	5 CCEMG
L.Wage	**0.452**	**0.455**	**0.382**	**0.258**	**-0.028**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.809)
Unemployment	**-0.165**	**-0.202**	**-0.198**	**-0.388**	**-0.373**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.015)
Productivity	**0.191**	**0.211**	**0.167**	**0.226**	**0.380**
	(0.000	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	**0.386**	**0.374**	**0.429**	**0.288**	**0.705**
	(0.000)	(0.000)	(0.000)	(0.004)	(0.009)
Constant	**2.095**	**2.466**	**2.694**	**5.413**	3.086
	(0.000)	(0.000)	(0.000)	(0.000)	(0.327)
Long-run parameters:					
Unemployment	**-0.300**	**-0.371**	**-0.320**	**-0.523**	**-0.363**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.013)
Productivity	**0.349**	**0.387**	**0.271**	**0.304**	**0.370**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	**0.704**	**0.687**	**0.693**	**0.388**	**0.686**
	(0.000)	(0.000)	(0.000)	(0.004)	(0.004)
Observations	2576	3,436	2,576	2,576	2,576
Country-industries	39	52	39	39	39
(Pseudo) R-squared	0.540	0.569	0.462	0.802	0.927

Table 2b: Baseline results: real wages

	1 baseline	2 incl. public sector	3 unweighted regression	4 MG	5 CCEMG
L.Wage	**0.417**	**0.425**	**0.369**	**0.311**	**0.203**
	(0.000	(0.000)	(0.000	(0.000)	(0.006)
Unemployment	**-0.145**	**-0.183**	**-0.168**	**-0.246**	**-0.348**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)
Productivity	**0.174**	**0.196**	**0.156**	**0.162**	**0.245**
	(0.000)	(0.000)	(0.000)	(0.000	(0.000)
Constant	**1.632**	**1.969**	**2.035**	**3.037**	0.252
	(0.000)	(0.000)	(0.000)	(0.000)	(0.858)
Long-run parameters:					
Unemployment	**-0.249**	**-0.319**	**-0.266**	**-0.358**	**-0.436**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)
Productivity	**0.299**	**0.342**	**0.248**	**0.236**	**0.307**
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	2,576	3,436	2,576	2,576	2,576
Country-industries	39	52	39	39	39
(Pseudo) R-squared	0.499	0.527	0.427	0.744	0.877

Note: p-values in parentheses computed using clustered standard errors, weighted regression (weight=sector employment share, averaged over time); private sector only apart from column 2; short-run parameters: sum over 4 lags reported, long-run parameters: sum over 4 lags divided by the sum over coefficients on the lagged dependent variable reported. MG = (unweighted) Mean Group estimator; CCEMG = (unweighted) Common Correlated Effects Mean Group estimator. These estimators allow for heterogeneity in parameter estimates across sections. Reported are cross-section averages of these estimates. In addition, CCEMG adds cross-section averages of all variables to the specification as a means to account for cross-sectional dependence. It is therefore difficult to interpret average estimates of the coefficient on the lagged dependent variable and of the constant term.

Table 3 introduces our measure of downward wage rigidity. We find that during sector-specific downturns, both nominal and real wages respond less to changes in unemployment than during normal times: coefficients on the interaction between unemployment and the downturn dummy are positively signed and statistically significant. Not accounting for downward rigidity leads to an underestimation of overall wage flexibility as the larger coefficients on unemployment (Table 3) relative to our baseline results (Tables 2a and 2b) show.

Table 3: Business cycle effects

	1 Nominal wages	2 Real wages
L.Wage	**0.447**	**0.413**
	(0.000)	(0.000)
Unemployment	**-0.200**	**-0.181**
	(0.000)	(0.000)
*downturn	**0.038**	**0.039**
	(0.014)	(0.008)
Productivity	**0.206**	**0.193**
	(0.000)	(0.000)
Inflation	**0.385**	
	(0.000)	
Constant	**2.217**	**1.733**
	(0.000)	(0.000)
Long-run parameters:		
Unemployment	**-0.361**	**-0.308**
	0.000	0.000
Productivity	**0.373**	**0.328**
	0.000	0.000
Inflation	**0.697**	
	0.000	
Observations	2,533	2,533
Country-industries	39	39
R-squared	0.542	0.502

Note: p-values in parentheses computed using clustered standard errors, weighted regression (weight=sector employment share, averaged over time); private sector only; short-run parameters: sum over 4 lags reported, long-run parameters: sum over 4 lags divided by the sum over coefficients on the lagged dependent variable reported; downturn dummy: takes the value of 1 if the sector GVA gap is negative.

4 Labour and product market institutions and differences across sectors

4.1 Institutional effects

We next look at the extent to which labour and product market institutions can explain wage rigidities. We focus on the effect of EPL, ETCR and union density on the unemployment elasticity of wages (Table 4). In order to avoid collinearity across slowly changing institutional indicators, we add them separately to our specifications.[12]

[12]Although the primary objective of this paper is to understand how structural rigidities interact with the unemployment term, Table A2 in the Appendix reports results from specifications that also add the institutional terms in levels. Overall, the results show that, depending on the specification, institutions have a statistically

Table 4: Institutional effects

	Nominal wages			Real wages		
	1	2	3	4	5	6
Institution:	EPL	ETCR	Union density	EPL	ETCR	Union density
L.Wage	**0.221**	**0.375**	**0.354**	**0.210**	**0.353**	**0.337**
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Unemployment	**-0.886**	**-0.311**	**-0.350**	**-0.484**	**-0.228**	**-0.267**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
*downturn	**0.049**	**0.048**	**0.057**	**0.047**	**0.044**	**0.051**
	(0.000)	(0.007)	(0.001)	(0.000)	(0.006)	(0.001)
*institution	**0.246**	**0.030**	**0.004**	**0.096**	0.011	**0.002**
	(0.000)	(0.037)	(0.034)	(0.074)	(0.186)	(0.066)
Productivity	**0.174**	**0.233**	**0.240**	**0.158**	**0.222**	**0.227**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	**0.420**	**0.349**	**0.370**			
	(0.000)	(0.000)	(0.000)			
Constant	**2.814**	**2.770**	**2.968**	**2.127**	**1.897**	**2.008**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Long-run parameters:						
Unemployment	**-1.138**	**-0.498**	**-0.541**	**-0.613**	**-0.352**	**-0.403**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Productivity	**0.224**	**0.372**	**0.371**	**0.200**	**0.343**	**0.343**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	**0.539**	**0.559**	**0.573**			
	(0.000)	(0.000)	(0.000)			
Observations	1,868	2,382	2,331	1,868	2,382	2,331
Country-industries	36	39	36	36	39	36
R-squared	0.491	0.525	0.516	0.438	0.483	0.480

Note: p-values in parentheses computed using clustered standard errors, weighted regression (weight=sector employment share, averaged over time); private sector only; short-run parameters: sum over 4 lags reported, long-run parameters: sum over 4 lags divided by the sum over coefficients on the lagged dependent variable reported; downturn dummy: takes the value of 1 if the sector GVA gap is negative.

Results in Table 4 show that a higher degree of employment protection legislation, product market regulation and union density significantly reduce the responsiveness of wage growth to the unemployment rate. In other words, interactions between institutional terms and the unemployment rate are statistically significant and positive: the response of wage growth to unemployment becomes less negative, i.e. smaller in absolute terms, if labour and product markets are more regulated. Another interesting aspect of Table 4 is that after allowing for the impacts of the above institutional indicators, the lagged dependent variable is smaller compared to Table 3 implying a much faster response of wages to shocks once rigidities are explicitly accounted for in the specification.

Interestingly, the coefficient on the interaction between unemployment and economic downturn remains statistically significant and even increases in size, implying that although labour market reforms in some euro area countries have made wages more flexible, workers

significant effect with roughly half of these results indicating that institutional terms in *levels* dominate, while the unemployment/institutional *interaction terms* dominate in the other half of the results. In the few remaining results, multicollinearity may explain why neither of these two institutional terms are statistically significant. Furthermore, multicollinearity may also occur between group-fixed effects and slowly changing institutional indicators which may bias results if institutional terms are included in levels.

remain protected from a somewhat larger response of wages to sector-specific downturns due to other rigidities.

4.2 Possible differential effects of institutions during the two phases of the crisis

In this section we investigate whether the effect of labour and product market institutions on the unemployment elasticity of wages has been asymmetric during the recent crisis. We therefore assess in more detail to what extent labour and product market institutions and reforms can explain downward wage rigidity during two phases of the crisis. To do so we employ two time dummy indicators. The first indicator C1 captures the Great Recession between 2008Q2 and 2009Q2. During this phase the global downturn affected euro area labour markets relatively symmetrically across countries. The second phase from 2011Q4 to 2013Q1 following concerns about sovereign debt, captured by indicator C2, had an asymmetric effect on labour markets. Unemployment surged in some countries while others remained relatively unaffected. The second phase also captures a period during which substantive labour market reforms were undertaken. We interact both dummy variables with the interaction between unemployment and the indicator for labour market institutions (Table 5).

These triple interactions can be interpreted as follows. Unemployment*institution is the average effect of a labour market institution on the unemployment elasticity of wages over the whole period. Unemployment*institution*C1 is the additional effect this labour market institution had on the responsiveness of wages during the first phase of the crisis. If, for example, it is found significantly positive we would conclude that more protected labour or product market regulation leads to a lower degree of wage responsiveness to unemployment in the first phase of the crisis compared, to what is estimated over the whole sample period. The same argument applies to unemployment*institution*C2.

We find that there is an additional positive effect during the first period of the crisis: countries that had relatively more protected labour and product markets during the Great Recession experienced a less pronounced reduction in wage growth. The coefficient on the interaction unemployment*institution*C2 on the other hand is negatively signed and statistically significant in the real wage equations. We conclude that countries with more rigid labour market institutions, that initially saw wages respond less to the global downturn, now experienced a relatively stronger adjustment compared to the unemployment*institution parameter estimated over the whole sample period. This may be due to pent-up wage adjustment. Or it may be an effect of reforms that are not quite captured by the OECD indicators (for example, some member countries would have undertaken reforms much wider than those captured by the indicators). Wage flexibility increased in countries with initially higher employment protection, less deregulated product markets or higher union density. Note however that coefficients on the interaction with C2 are more often smaller in absolute terms than on the interaction with C1. This suggests that initial rigidities have not been fully resolved during the second phase of the crisis over our sample period. Interestingly, although both results apply to nominal and real wages they are statistically more significant

Table 5: Asymmetries in institutional effects across the two phases of the crisis

	Nominal wages			Real wages		
	1	2	3	4	5	6
Institution:	EPL	ETCR	Union density	EPL	ETCR	Union density
L.Wage	**0.206**	**0.363**	**0.342**	**0.187**	**0.336**	**0.323**
	(0.003)	(0.000)	(0.000)	(0.004)	(0.000)	(0.000)
Unemployment	**-0.827**	**-0.283**	**-0.340**	**-0.442**	**-0.189**	**-0.250**
	(0.000)	(0.000)	(0.001)	(0.001)	(0.002)	(0.002)
*downturn	**0.046**	**0.047**	**0.055**	**0.040**	**0.042**	**0.049**
	(0.000)	(0.008)	(0.001)	(0.004)	(0.007)	(0.001)
*institution	**0.233**	**0.026**	**0.004**	**0.097**	0.009	**0.002**
	(0.000)	(0.055)	(0.048)	(0.053)	(0.295)	(0.092)
*institution*C1	**0.021**	0.021	**0.003**	**0.047**	**0.052**	**0.005**
	(0.098)	(0.258)	(0.027)	(0.001)	(0.001)	(0.000)
*institution*C2	-0.011	-0.016	-0.001	**-0.017**	**-0.026**	**-0.001**
	(0.159)	(0.142)	(0.520)	(0.032)	(0.006)	(0.076)
Productivity	**0.178**	**0.237**	**0.245**	**0.167**	**0.232**	**0.236**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	**0.458**	**0.379**	**0.395**			
	(0.000)	(0.000)	(0.000)			
Constant	**2.577**	**2.574**	**2.795**	**1.746**	**1.603**	**1.784**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Long-run parameters:						
Unemployment	**-1.042**	**-0.445**	**-0.516**	**-0.544**	**-0.285**	**-0.369**
	(0.000)	(0.000)	(0.002)	(0.000)	(0.004)	(0.004)
Productivity	**0.224**	**0.372**	**0.373**	**0.206**	**0.349**	**0.349**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	**0.577**	**0.596**	**0.599**			
	(0.000)	(0.000)	(0.000)			
Observations	1,868	2,382	2,331	1,868	2,382	2,331
Country-industries	36	39	36	36	39	36
R-squared	0.493	0.527	0.519	0.450	0.490	0.487

Note: p-values in parentheses computed using clustered standard errors, weighted regression (weight=sector employment share, averaged over time); private sector only; short-run parameters: sum over 4 lags reported, long-run parameters: sum over 4 lags divided by the sum over coefficients on the lagged dependent variable reported; downturn dummy: takes the value of 1 if the sector GVA gap is negative; C1: 1 if 2008Q2-2009Q2; C2: 2011Q4-2013Q1.

for the latter.[13][14]

[13]This could be a sign that inflation adds an additional dimension to the relationship between labour market reforms and the response of wages to unemployment: as workers care about real wages rather than nominal wages, labour market institutions are designed to protect them predominantly from a reduction in real wages. For a discussion on inflation and real wage rigidity see Babetskii (2007) and Rusinova et al. (2015).

[14]We also experimented with a triple interaction between unemployment, institutional terms and our downturn dummy to test whether institutions can explain downward rigidity more generally. If institutions would be responsible for downward wage rigidities then one would expect the coefficient on this triple interaction to be significantly positively signed while both the interaction between unemployment and the downturn dummy and the interaction between unemployment and institutional terms would remain significantly positive. However, what we find is a significantly negative coefficient estimate (Table A3 in the Appendix). This could either suggest that institutions, rather than preventing wages to fall during recessions, delay the wage response to a decline in unemployment as the economy recovers. In the light of our results on differential effects during the recent crisis it seems more likely that the negative coefficient estimated stems from the fact that countries with more regulated labour and product markets experienced a deeper recession which ultimately led to a stronger wage adjustment compared to countries with less regulation.

4.3 Differences across sectors

In a last step we aim to exploit fully the country-industry dimension of our panel to learn about differences in the wage Phillips curve relationship across economic sectors. We therefore estimate our model separately for construction, manufacturing, services and the public sector (Table 6). We find that the construction sector shows the highest degree of flexibility. Inertia in wage growth is only half as strong compared to the other sectors.[15] The unemployment elasticity of wages is also larger relative to other sectors, apart from the public sector, while the coefficient for downward wage rigidity is statistically insignificant. Columns 1 and 5 of Table 6 also show that our previous results on downward rigidity apply mostly to manufacturing where the wage response to unemployment is of intermediate magnitude and wages are significantly downward rigid. As expected, public sector wages appear relatively more flexible with respect to unemployment which is likely a result of pro-cyclical fiscal consolidation efforts, particularly during the crisis.

Table 6: Sectoral differences

	Nominal wages				**Real wages**			
	1	2	3	4	5	6	7	8
	Manu-facturing	Cons-truction	Services	Public sector	Manu-facturing	Cons-truction	Services	Public sector
L.Wage	**0.431**	**0.255**	**0.539**	**0.411**	**0.417**	**0.267**	**0.476**	**0.396**
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Unemployment	**-0.199**	**-0.327**	**-0.163**	**-0.315**	**-0.164**	**-0.264**	**-0.168**	**-0.270**
	(0.000)	(0.001)	(0.002)	(0.000)	(0.000)	(0.002)	(0.005)	(0.000)
*downturn	**0.048**	0.052	0.035	-0.035	**0.051**	0.030	**0.039**	-0.050
	(0.004)	(0.111)	(0.145)	(0.302)	(0.008)	(0.293)	(0.075)	(0.127)
Productivity	**0.147**	**0.179**	**0.367**	**0.436**	**0.107**	**0.183**	**0.359**	**0.410**
	(0.005)	(0.004)	(0.003)	(0.000)	(0.023)	(0.006)	(0.004)	(0.000)
Inflation	**0.413**	**0.495**	**0.380**	**0.326**				
	0.000	0.035	0.007	0.000				
Constant	**2.294**	**4.189**	**1.334**	**3.939**	**1.814**	**3.140**	**1.254**	**3.022**
	(0.000)	(0.005)	(0.001)	(0.001)	(0.003)	(0.001)	(0.005)	(0.000)
Long-run parameters:								
Unemployment	**-0.350**	**-0.439**	**-0.352**	**-0.534**	**-0.282**	**-0.361**	**-0.320**	**-0.448**
	(0.000)	(0.001)	(0.002)	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)
Productivity	**0.259**	**0.240**	**0.795**	**0.740**	**0.183**	**0.249**	**0.686**	**0.679**
	(0.008)	(0.003)	(0.001)	(0.000)	(0.027)	(0.004)	(0.003)	(0.000)
Inflation	**0.727**	**0.664**	**0.824**	**0.553**				
	(0.000)	(0.026)	(0.000)	(0.000)				
Observations	843	845	845	847	843	845	845	847
Country-industries	13	13	13	13	13	13	13	13
R-squared	0.572	0.370	0.681	0.670	0.525	0.345	0.633	0.631

Note: p-values in parentheses computed using clustered standard errors, weighted regression (weight=sector employment share, averaged over time); short-run parameters: sum over 4 lags reported, long-run parameters: sum over 4 lags divided by the sum over coefficients on the lagged dependent variable reported; downturn dummy: takes the value of 1 if the sector GVA gap is negative.

Furthermore, wages respond less to productivity growth in manufacturing and construction in comparison to services and the public sector. We would expect that in relatively more deregulated sectors, the wage response to productivity is stronger than in more regulated

[15] As indicated by the relatively lower parameters for the lagged dependent variable for the construction sector.

sectors.[16] This can be explained with competition that aligns wages with productivity while lower levels of competition and higher bargaining power lead to a deviation of wage dynamics from productivity growth. We would therefore expect that more deregulated sectors show a higher responsiveness of wages to productivity growth.

On the other hand, the openness of economic sectors to increasing competition and globalisation also determines the responsiveness of wages to productivity. International trade in manufacturing, as well as outsourcing to low-cost countries, including the use of foreign labour in construction, may explain the lower pass-through of productivity to wages in these two sectors compared to services and the public sector. This seems to be consistent with the well documented pronounced fall in the euro area wage share of income over the last decades, which may be partly due to globalisation.[17][18]

Table 7: Sectoral differences in institutional effects

Institution:	**EPL**		**ETCR**		**Union density**	
	Nominal wages	Real wages	Nominal wages	Real wages	Nominal wages	Real wages
Manufacturing	**0.238**	**0.086**	**0.039**	0.020	**0.005**	**0.004**
	(0.006)	(0.003)	(0.049)	(0.147)	(0.002)	(0.001)
Construction	**0.310**	0.122	0.034	0.009	0.003	0.001
	(0.026)	(0.164)	(0.200)	(0.624)	(0.360)	(0.585)
Services	**0.265**	0.133	0.011	0.005	0.002	0.001
	(0.066)	(0.198)	(0.608)	(0.742)	(0.459)	(0.570)
Public sector	0.044	-0.109	**0.041**	0.013	0.003	0.001
	(0.723)	(0.263)	(0.042)	(0.482)	(0.150)	(0.427)

Note: coefficient estimates for the interaction unemployment*institution from separate regressions, p-values computed using clustered standard errors, weighted regression (weight=sector employment share, averaged over time), full results in Tables A4 and A5 in the Appendix.

In order to shed more light on the channels through which labour and product market institutions affect the responsiveness of wages to unemployment, we also conduct sector-specific regressions for our specification with unemployment*institution interactions (summarised in Table 7, full results can be found in Tables A4 and A5 in the Appendix). We find that labour and product market regulation has the largest impact on wages in manufacturing. In particular interactions between the unemployment rate and EPL as well as union density are found statistically significant for manufacturing nominal and real wage growth, while ETCR affects manufacturing nominal wages. In construction and in services significant effects are also found for EPL. The heterogeneity in these estimated effects confirms the advantages of our general approach of investigating wage rigidities at the sector

[16] For a cross-country analysis on this topic see Rusinova et al. (2015).

[17] See Anderton and Hiebert (2009) for further details.

[18] Differences in productivity measurement across sectors may also explain why wage growth seems to respond less to productivity growth in manufacturing and construction compared to services and the public sector. Compared to manufacturing and construction, productivity is harder to measure for the services sector. For example, in the services sectors it is less clear what constitutes output and when it is produced since the output is not stockable. This applies even more so to public services, making the statistical measurement of productivity in market and public services more difficult or at least inherently different (Djellal and Gallouj, 2009). In this sense, our results would then suggest that wages are more responsive to the measure of productivity in services and the public sector which may not be fully comparable to lower coefficients on the measure of productivity for manufacturing and construction. This may also partly explain why aggregate analyses find wage growth to respond more strongly to productivity growth compared to our more disaggregate analysis.

level rather than country level. Our results on the role of labour and product market institutions in explaining wage rigidity seem to apply mostly to manufacturing, and to a lesser extent to construction and services. We also conclude that public sector wages are driven by separate dynamics, such as fiscal consolidation efforts, which may bias the overall results if conducted at the country-level rather than sectoral-level. In addition, interactions between unemployment and our economic downturn dummy remain significant if we control for institutional factors in manufacturing and services (Tables A4 and A5 in the Appendix). As before for our pooled results, we conclude that other types of wage rigidities not captured by the institutional indicators EPL, ETCR and union density play a significant role in these sectors.

Overall, the sectoral results have implications for the rebalancing process in the euro area: first, downward wage rigidities in the manufacturing sector can hamper the rebalancing mechanisms of competitiveness and trade for trade-deficit countries in the euro area; second, institutional rigidities also limit the adjustment of euro area wages to unemployment in both upturns and downturns which has broader implications for the rebalancing process in the euro area.

5 Robustness checks

5.1 Employment composition

A general concern in empirical work on wage rigidities when using aggregate datasets relates to changes in the composition of the employed labour force. During recessions - and particularly during the crisis - young, unskilled and temporary workers tend to suffer from a disproportionately high share of lay-offs. This leads, all else equal, to an increase in average wages. Hence aggregate downward wage rigidity may be over-estimated if composition effects are not taken into account (Verdugo, 2015). While in micro analyses this issue can be dealt with by focusing on those employees that stay in employment, macro approaches may spuriously interpret compositional effects as wage rigidity. Our country-industry perspective provides us with the opportunity to control for compositional effects more directly and to thereby identify the underlying rigidity more clearly.

To check the robustness of our results to employment composition effects we include as additional control variables: (i) the quarterly change in sectoral temporary employment relative to total sectoral employment; as well as (ii) the quarterly change in the share of young employees (15-24 years) in a sector relative to total employment in this sector. A decline in these shares during recessions is expected to be associated with an increase in experienced, skilled, and permanent employment and hence upward pressure on the evolution of aggregate or sectoral wage inflation.[19] A priori one would expect a negative parameter for these compositional-share variables.

[19] An increase in the share of unskilled employment on the other hand may be associated either with stronger wage dynamics or with stagnation in aggregate wages as low-paid workers enter employment. Hence effects on wage growth may be ambiguous. We therefore set our control variables for compositional effects to zero if annual changes in temporary or youth employment are positive.

Table 8: Robustness check: controlling for employment composition

	Nominal wages				Real wages			
	1	2	3	4	5	6	7	8
Institution:		EPL	ETCR	Union dens.		EPL	ETCR	Union dens.
L.Wage	**0.451**	**0.224**	**0.379**	**0.358**	**0.417**	**0.214**	**0.358**	**0.342**
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Unemployment	**-0.194**	**-0.872**	**-0.312**	**-0.350**	**-0.174**	**-0.474**	**-0.231**	**-0.271**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
*downturn	**0.036**	**0.048**	**0.046**	**0.056**	**0.036**	**0.044**	**0.042**	**0.049**
	(0.017)	(0.000)	(0.009)	(0.001)	(0.013)	(0.001)	(0.008)	(0.002)
*institution		**0.242**	**0.032**	**0.004**		**0.095**	**0.015**	**0.002**
		(0.000)	(0.025)	(0.031)		(0.070)	(0.087)	(0.054)
Temporary work	-0.016	-0.029	-0.012	0.003	-0.071	-0.111	-0.041	-0.035
	(0.867)	(0.772)	(0.911)	(0.981)	(0.491)	(0.342)	(0.712)	(0.753)
Youth employment	-0.170	-0.111	**-0.225**	**-0.231**	-0.223	**-0.222**	**-0.287**	**-0.308**
	(0.189)	(0.226)	(0.076)	(0.085)	(0.191)	(0.084)	(0.080)	(0.065)
Productivity	**0.209**	**0.175**	**0.235**	**0.243**	**0.198**	**0.161**	**0.226**	**0.232**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	**0.391**	**0.425**	**0.350**	**0.375**				
	(0.000)	(0.000)	(0.000)	(0.000)				
Constant	**2.060**	**2.705**	**2.593**	**2.789**	**1.538**	**1.916**	**1.678**	**1.796**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Long-run parameters:								
Unemployment	**-0.354**	**-1.124**	**-0.503**	**-0.546**	**-0.298**	**-0.603**	**-0.360**	**-0.412**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Productivity	**0.380**	**0.226**	**0.378**	**0.378**	**0.339**	**0.204**	**0.352**	**0.353**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)
Inflation	**0.712**	**0.548**	**0.564**	**0.585**				
	(0.000)	(0.000)	(0.000)	(0.000)				
Observations	2,533	1,868	2,382	2,331	2,533	1,868	2,382	2,331
Country-industries	39	36	39	36	39	36	39	36
R-squared	0.544	0.491	0.527	0.518	0.504	0.442	0.487	0.485

Note: p-values in parentheses computed using clustered standard errors, weighted regression (weight=sector employment share, averaged over time); private sector only; short-run parameters: sum over 4 lags reported, long-run parameters: sum over 4 lags divided by the sum over coefficients on the lagged dependent variable reported; downturn dummy: takes the value of 1 if the sector GVA gap is negative.

We obtain negative estimates for coefficients on both the change in temporary and youth employment: all else equal, if disproportionally more workers leave sectoral employment that are temporarily employed or young, this has a positive impact on wage growth in the short run as the shares of higher-skill/higher-paid workers in employment increase (Table 8). As noted, during downturns this may spuriously be interpreted as wage rigidity. Nevertheless, Table 8 suggests that the overall result of downward wage rigidity still holds: the coefficient on the interaction between unemployment and economic downturn remains significant and positively signed when we account for employment composition effects. At the same time, effects of institutional terms remain significant (columns 2 to 4 and 6 to 8).[20] We conclude that our findings on downward rigidity and the role of labour and product market institutions are robust, if we also allow for changes in the skills composition of employment.

[20]Coefficient estimates for changes in temporary and youth employment are found insignificant if institutional terms are excluded. The coefficient on youth employment however turns statistically significant once cross-country differences in labour and product market institutions are accounted for.

Results also suggest that, on aggregate, a delay in the response of wages during economic downturns can result from an interaction of three, not necessarily mutually exclusive effects: a high degree of labour and product market regulation; changes in the skills composition of the employed labour force; and other rigidities not captured by institutional terms and employment composition. Table A6 in the Appendix shows that sector-specific results are also robust to changes in the employment composition.

5.2 Accounting for structural unemployment proxied by long-term unemployment

If the rate of structural unemployment exhibits some degree of time variation, as may be the case during severe recessions, our assumption of time invariance is no longer valid. Country-industry fixed effects will not be sufficient to capture heterogeneity in structural unemployment. While slowly changing institutional terms capture some of the time variation in structural unemployment as institutions determine the structure of the labour market (level effects, see Table A2 in the Appendix), we employ a more direct approach by approximating structural unemployment with long-term unemployment. We use the share of those unemployed for longer than 24 months relative to the labour force and subtract this measure from total unemployment. In other words, we use short-term unemployment as a proxy for the deviation of unemployment from structural unemployment (Table 9).

Comparing results in Table 9 to Tables 2a, 2b and 3, we find that wage growth responds more strongly to short-term unemployment than to overall employment.[21] It follows from our results that those unemployed for a relatively short time period are more effective in competing for jobs than the long-term unemployed. However, our finding on downward wage rigidity holds independently of whether the model specification accounts for time variation in the structural rate of unemployment: the interaction term between unemployment and our downturn dummy remains positive and significant (Table 9, columns 2 and 4). We also conclude that our result on downward wage rigidity seems to be robust to increases in structural unemployment. Tables A7 and A8 in the Appendix show that our results on institutional effects and sectoral differences remain robust, independent of the chosen measure of unemployment.

5.3 Productivity growth

Our disaggregate analysis suggests a smaller link between productivity growth and wage growth than usually suggested by aggregate country-level analyses.[22] This may be a result of sectoral differences in the link between productivity and wages as explained in section

[21] Compare short- and long-run coefficient estimates for unemployment in Table 9 of around -0.3 and -0.5 respectively to estimates of around -0.2 and -0.3 in Tables 2a, 2b and 3.

[22] While our baseline specification for real wages yields short-run coefficients on productivity of between 0.156 and 0.245 (Table 2b), Rusinova et al. (2015) obtain results from a comparable specification of 0.44 to 0.48 which depend on the business cycle, country group and level of inflation. Anderton and Bonthuis (2015) estimate comparable short-run estimates of 0.287 to 0.326. Their long-run estimates of 0.597 to 0.788 are larger than our estimates which lie in the range of 0.236 and 0.342.

Table 9: Robustness check: short-term unemployment

	Nominal wages		Real wages	
	1	2	3	4
L.Wage	**0.450**	**0.447**	**0.406**	**0.403**
	(0.000)	(0.000)	(0.000)	(0.000)
Unemployment	**-0.281**	**-0.330**	**-0.267**	**-0.322**
	(0.000)	(0.000)	(0.000)	(0.000)
*downturn		**0.046**		**0.053**
		(0.023)		(0.010)
Productivity	**0.197**	**0.211**	**0.188**	**0.207**
	(0.000)	(0.000)	(0.001)	(0.000)
Inflation	**0.408**	**0.411**		
	(0.000)	(0.000)		
Constant	**2.379**	**2.515**	**2.032**	**2.176**
	(0.000)	(0.000)	(0.000)	(0.000)
Long-run parameters:				
Unemployment	**-0.511**	**-0.597**	**-0.449**	**-0.540**
	(0.000)	(0.000)	(0.000)	(0.000)
Productivity	**0.359**	**0.381**	**0.317**	**0.346**
	(0.000)	(0.000)	(0.001)	(0.000)
Inflation	**0.741**	**0.742**		
	(0.000)	(0.000)		
Observations	2,507	2,464	2,507	2,464
Country-industries	39	39	39	39
R-squared	0.547	0.549	0.504	0.507

Note: p-values in parentheses computed using clustered standard errors, weighted regression (weight=sector employment share, averaged over time); private sector only; short-run parameters: sum over 4 lags reported, long-run parameters: sum over 4 lags divided by the sum over coefficients on the lagged dependent variable reported; downturn dummy: takes the value of 1 if the sector GVA gap is negative. Short-term unemployment: overall unemployment less long-term unemployment, where long-term unemployment is unemployment for more than 24 months.

4.3. However, we double-check the overall robustness of our analysis by imposing a unity parameter for the productivity term. We find that key results, most notably the sign and significance of the downturn interaction term, remain qualitatively the same (Table A9 in the Appendix).

6 Conclusion

We estimate wage Phillips curve relationships across individual sectors of euro area economies. In our country-industry panel, we find evidence for significant downward wage rigidity which confirms findings from aggregate data analyses. This result holds if we control for the skill composition of the employed labour force, which can affect the evolution of aggregate wages. It also holds if we limit the focus of our analysis to private sector industries, i.e. excluding public sector wages which are influenced by fiscal consolidation during the crisis. We show that labour market reforms, which relax employment protection, deregulate product markets, or limit the power of unions, tend to increase the responsiveness of wage growth to unemployment. This applies in particular to manufacturing and, to a lesser extent, to the construction and service sectors. We also analyse the role of labour and product market institutions during the recent crisis. We find that countries with initially more protected

labour markets experienced a less pronounced downward adjustment of wages at the onset of the crisis but, as unemployment rose during later phases of the crisis, the adjustment of wages in these countries increased. Overall, reforms in labour and product markets which reduce wage rigidities will facilitate employment growth as well as enhancing the rebalancing process in the euro area. In order to shed more light on how labour and product market institutions and regulations affect adjustments along the employment margin relative to the wage margin, the analysis should be extended to labour demand relationships.

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Table A1: Variable definition and data sources

Nominal wages	Hourly compensation per employee, current prices, seasonally adjusted, not working day adjusted, Eurostat (ESA 1995); for real wages consumer price inflation (ECB Statistical Data Warehouse) is used
Productivity	Hourly labour productivity, chain linked volumes, national currency, seasonally adjusted, not working day adjusted, Eurostat (ESA 1995)
Employment	Total hours worked, Eurostat (ESA 2010)
Gross value added	At basic prices, national currency, current prices, raw data, not seasonally adjusted, HP-filtered, not working day adjusted, Eurostat (ESA 1995)
Employment protection legislation	Version 2 of OECD indicator that measures the strictness of regulation of individual and collective dismissals of employees on regular/ indefinite contracts, cubic spline interpolation applied to convert annual to quarterly data
Product market regulation	OECD indicator of regulation in energy, transport and communications (ETCR), cubic spline interpolation applied to convert annual to quarterly data
Temporary employment	Sector temporary employment, 15 to 64 years, Labour Force Survey via Eurostat
Youth employment	Sector employment of 15 to 24 year-olds, Labour Force Survey via Eurostat
Union density	OECD Labour Force Statistics, trade union density (ratio of wage and salary earners that are trade union members divided by the total number of wage and salary earners), cubic spline interpolation applied to convert annual to quarterly data

Table A2: Institutional effects (slope and level effects)

	Nominal wages						Real wages					
	1	2	3	4	5	6	7	8	9	10	11	12
Institution:	EPL	EPL	ETCR	ETCR	Union density	Union density	EPL	EPL	ETCR	ETCR	Union density	Union density
L.Wage	**0.242**	**0.219**	**0.370**	**0.370**	**0.343**	**0.340**	**0.212**	**0.209**	**0.348**	**0.343**	**0.336**	**0.335**
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Unemployment	**-0.225**	**-0.823**	**-0.236**	**-0.255**	**-0.280**	**-0.323**	**-0.230**	**-0.452**	**-0.202**	**-0.127**	**-0.215**	**-0.247**
	(0.000)	(0.000)	(0.000)	(0.011)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.080)	(0.000)	(0.001)
*downturn	**0.038**	**0.048**	**0.049**	**0.049**	**0.062**	**0.063**	**0.044**	**0.046**	**0.045**	**0.046**	**0.051**	**0.052**
	(0.004)	(0.000)	(0.007)	(0.007)	(0.001)	(0.001)	(0.002)	(0.001)	(0.005)	(0.007)	(0.001)	(0.001)
*institution		**0.225**		0.007		0.001		**0.085**		-0.030		0.001
		(0.000)		(0.811)		(0.426)		(0.056)		(0.125)		(0.425)
Institution	1.438	0.620	**0.326**	0.263	**0.108**	**0.089**	0.706	0.293	**0.198**	**0.495**	**0.050**	0.035
	(0.102)	(0.268)	(0.011)	(0.296)	(0.002)	(0.038)	(0.317)	(0.562)	(0.025)	(0.013)	(0.024)	(0.222)
Productivity	**0.171**	**0.174**	**0.231**	**0.231**	**0.234**	**0.235**	**0.156**	**0.157**	**0.220**	**0.219**	**0.225**	**0.225**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	**0.521**	**0.418**	**0.371**	**0.364**	**0.308**	**0.307**						
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)						
Constant	-1.284	1.077	**1.904**	**2.086**	0.397	0.963	0.267	1.303	**1.409**	0.672	0.671	1.107
	(0.636)	(0.539)	(0.000)	(0.015)	(0.624)	(0.409)	(0.895)	(0.379)	(0.000)	(0.249)	(0.227)	(0.209)
Long-run parameters:												
Unemployment	**-0.297**	**-1.054**	**-0.375**	**-0.404**	**-0.427**	**-0.490**	**-0.292**	**-0.572**	**-0.310**	**-0.193**	**-0.324**	**-0.371**
	(0.000)	(0.000)	(0.000)	(0.012)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.086)	(0.000)	(0.003)
Productivity	**0.225**	**0.223**	**0.366**	**0.367**	**0.357**	**0.356**	**0.198**	**0.199**	**0.337**	**0.334**	**0.339**	**0.339**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Inflation	**0.688**	**0.535**	**0.589**	**0.577**	**0.469**	**0.465**						
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)						
Observations	1,868	1,868	2,382	2,382	2,331	2,331	1,868	1,868	2,382	2,382	2,331	2,331
Country-industries	36	36	39	39	36	36	36	36	39	39	36	36
R-squared	0.483	0.491	0.526	0.526	0.519	0.520	0.437	0.438	0.484	0.485	0.481	0.481

Note: p-values in parentheses computed using clustered standard errors, weighted regression (weight=sector employment share, averaged over time); private sector only; short-run parameters: sum over 4 lags reported, long-run parameters: sum over 4 lags divided by the sum over coefficients on the lagged dependent variable reported; downturn dummy: takes the value of 1 if the sector GVA gap is negative.

Table A3: Asymmetries in institutional effects across the business cycle

	Nominal wages			**Real wages**		
Institution:	EPL	ETCR	Union density	EPL	ETCR	Union density
L.Wage	**0.219**	**0.361**	**0.351**	**0.208**	**0.331**	**0.333**
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Unemployment	**-0.967**	**-0.400**	**-0.370**	**-0.553**	**-0.366**	**-0.296**
	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)
*downturn	0.138	**0.163**	**0.086**	0.124	**0.213**	**0.089**
	(0.241)	(0.000)	(0.003)	(0.296)	(0.000)	(0.002)
*institution	**0.275**	**0.057**	**0.004**	**0.120**	**0.052**	**0.003**
	(0.000)	(0.000)	(0.010)	(0.066)	(0.000)	(0.009)
*institution*downturn	-0.032	**-0.041**	-0.001	-0.028	**-0.059**	**-0.001**
	(0.428)	(0.003)	(0.122)	(0.490)	(0.000)	(0.038)
Productivity	**0.177**	**0.238**	**0.241**	**0.160**	**0.231**	**0.229**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	**0.420**	**0.381**	**0.377**			
	(0.000)	(0.000)	(0.000)			
Constant	**2.837**	**2.835**	**3.006**	**2.142**	**2.082**	**2.082**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Long-run parameters:						
Unemployment	**-1.238**	**-0.626**	**-0.570**	**-0.698**	**-0.547**	**-0.443**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Productivity	**0.226**	**0.372**	**0.371**	**0.202**	**0.345**	**0.343**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	**0.538**	**0.596**	**0.582**			
	(0.000)	(0.000)	(0.000)			
Observations	1,868	2,382	2,331	1,868	2,382	2,331
Country-industries	36	39	36	36	39	36
R-squared	0.491	0.528	0.517	0.439	0.488	0.482

Note: p-values in parentheses computed using clustered standard errors, weighted regression (weight=sector employment share, averaged over time); private sector only; short-run parameters: sum over 4 lags reported, long-run parameters: sum over 4 lags divided by the sum over coefficients on the lagged dependent variable reported; downturn dummy: takes the value of 1 if the sector GVA gap is negative.

Table A4: Sectoral differences in institutional effects: nominal wages

Institution:	EPL				ETCR				Union density			
	1	2	3	4	5	6	7	8	9	10	11	12
	Manu-facturing	Cons-truction	Services	Public sector	Manu-facturing	Cons-truction	Services	Public sector	Manu-facturing	Cons-truction	Services	Public sector
L.Wage	**0.220**	0.013	**0.286**	**0.362**	**0.302**	**0.230**	**0.460**	**0.396**	**0.281**	**0.217**	**0.433**	**0.388**
	(0.084)	(0.905)	(0.006)	(0.000)	(0.005)	(0.003)	(0.000)	(0.000)	(0.011)	(0.003)	(0.000)	(0.000)
Unemployment	**-0.885**	**-1.173**	**-0.879**	**-0.440**	**-0.339**	**-0.420**	**-0.232**	**-0.447**	**-0.406**	**-0.407**	**-0.260**	**-0.404**
	(0.000)	(0.000)	(0.005)	(0.095)	(0.000)	(0.016)	(0.004)	(0.001)	(0.000)	(0.049)	(0.013)	(0.002)
*downturn	**0.072**	0.055	**0.030**	0.001	**0.059**	**0.050**	0.043	0.001	**0.061**	0.047	**0.053**	-0.010
	(0.001)	(0.280)	(0.044)	(0.982)	(0.001)	(0.075)	(0.120)	(0.980)	(0.003)	(0.109)	(0.075)	(0.730)
*institution	**0.238**	**0.310**	**0.265**	0.044	**0.039**	0.034	0.011	**0.041**	**0.005**	0.003	0.002	0.003
	(0.006)	(0.026)	(0.066)	(0.723)	(0.049)	(0.200)	(0.608)	(0.042)	(0.002)	(0.360)	(0.459)	(0.150)
Productivity	**0.111**	**0.193**	**0.378**	**0.501**	**0.159**	**0.192**	**0.446**	**0.488**	**0.154**	**0.202**	**0.461**	**0.457**
	(0.014)	(0.005)	(0.000)	(0.007)	(0.003)	(0.007)	(0.000)	(0.001)	(0.005)	(0.010)	(0.000)	(0.000)
Inflation	**0.389**	**0.533**	**0.410**	**0.269**	**0.357**	**0.423**	**0.425**	**0.232**	**0.382**	**0.454**	**0.432**	**0.289**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.060)	(0.000)	(0.012)	(0.000)	(0.076)	(0.000)	(0.000)
Constant	**3.284**	**4.645**	**1.873**	**3.996**	**3.125**	**4.568**	**1.709**	**4.238**	**3.402**	**4.639**	**1.904**	**4.187**
	(0.000)	(0.002)	(0.005)	(0.004)	(0.000)	(0.008)	(0.001)	(0.001)	(0.000)	(0.016)	(0.001)	(0.001)
Long-run parameters:												
Unemployment	**-1.134**	**-1.188**	**-1.231**	**-0.690**	**-0.486**	**-0.546**	**-0.429**	**-0.740**	**-0.565**	**-0.520**	**-0.459**	**-0.660**
	(0.000)	(0.000)	(0.000)	(0.144)	(0.000)	(0.012)	(0.001)	(0.000)	(0.000)	(0.046)	(0.020)	(0.001)
Productivity	**0.142**	**0.195**	**0.530**	**0.786**	**0.228**	**0.249**	**0.826**	**0.807**	**0.214**	**0.258**	**0.812**	**0.746**
	(0.031)	(0.000)	(0.000)	(0.000)	(0.025)	(0.006)	(0.001)	(0.000)	(0.027)	(0.008)	(0.000)	(0.000)
Inflation	**0.498**	**0.540**	**0.575**	**0.421**	**0.511**	**0.550**	**0.788**	**0.383**	**0.531**	**0.580**	**0.761**	**0.472**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.053)	(0.000)	(0.030)	(0.000)	(0.063)	(0.000)	(0.000)
Observations	622	623	623	623	793	795	794	796	776	778	777	779
Country-industries	12	12	12	12	13	13	13	13	12	12	12	12
R-squared	0.569	0.420	0.564	0.632	0.550	0.361	0.669	0.678	0.548	0.356	0.661	0.668

Note: p-values in parentheses computed using clustered standard errors, weighted regression (weight=sector employment share, averaged over time); short-run parameters: sum over 4 lags reported, long-run parameters: sum over 4 lags divided by the sum over coefficients on the lagged dependent variable reported; downturn dummy: takes the value of 1 if the sector GVA gap is negative.

Table A5: Sectoral differences in institutional effects: real wages

Institution:	EPL				ETCR				Union density			
	1	2	3	4	5	6	7	8	9	10	11	12
	Manu-facturing	Cons-truction	Services	Public sector	Manu-facturing	Cons-truction	Services	Public sector	Manu-facturing	Cons-truction	Services	Public sector
L.Wage	**0.230**	0.048	**0.229**	**0.378**	**0.293**	**0.255**	**0.393**	**0.401**	**0.275**	**0.243**	**0.367**	**0.391**
	(0.029)	(0.676)	(0.061)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.004)	(0.001)	(0.000)	(0.000)
Unemployment	**-0.464**	**-0.636**	**-0.539**	0.012	**-0.233**	**-0.276**	**-0.216**	**-0.289**	**-0.305**	**-0.282**	**-0.244**	**-0.281**
	(0.000)	(0.001)	(0.035)	(0.957)	(0.000)	(0.045)	(0.016)	(0.005)	(0.000)	(0.059)	(0.040)	(0.004)
*downturn	**0.062**	0.023	**0.031**	-0.028	**0.054**	0.020	**0.046**	-0.031	**0.054**	0.023	**0.056**	-0.033
	(0.001)	(0.549)	(0.063)	(0.334)	(0.001)	(0.299)	(0.079)	(0.272)	(0.005)	(0.313)	(0.060)	(0.250)
*institution	**0.086**	0.122	0.133	-0.109	0.020	0.009	0.005	0.013	**0.004**	0.001	0.001	0.001
	(0.003)	(0.164)	(0.198)	(0.263)	(0.147)	(0.624)	(0.742)	(0.482)	(0.001)	(0.585)	(0.570)	(0.427)
Productivity	**0.082**	**0.195**	**0.321**	**0.455**	**0.116**	**0.198**	**0.447**	**0.422**	**0.109**	**0.206**	**0.464**	**0.410**
	(0.084)	(0.003)	(0.000)	(0.004)	(0.013)	(0.006)	(0.000)	(0.001)	(0.022)	(0.007)	(0.000)	(0.000)
Constant	**2.457**	**3.492**	**1.455**	**2.990**	**2.056**	**3.181**	**1.517**	**2.809**	**2.261**	**3.249**	**1.608**	**2.880**
	(0.000)	(0.001)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.001)	(0.001)	(0.005)	(0.005)	(0.001)
Long-run parameters:												
Unemployment	**-0.602**	**-0.669**	**-0.699**	0.020	**-0.329**	**-0.371**	**-0.356**	**-0.483**	**-0.420**	**-0.372**	**-0.385**	**-0.461**
	(0.000)	(0.010)	(0.003)	(0.956)	(0.000)	(0.037)	(0.009)	(0.001)	(0.000)	(0.052)	(0.042)	(0.003)
Productivity	**0.107**	**0.205**	**0.417**	**0.731**	**0.165**	**0.266**	**0.737**	**0.704**	**0.151**	**0.272**	**0.734**	**0.673**
	(0.098)	(0.000)	(0.001)	(0.000)	(0.037)	(0.004)	(0.001)	(0.000)	(0.052)	(0.005)	(0.001)	(0.000)
Observations	622	623	623	623	793	795	794	796	776	778	777	779
Country-industries	12	12	12	12	13	13	13	13	12	12	12	12
R-squared	0.540	0.391	0.471	0.619	0.504	0.341	0.618	0.640	0.509	0.340	0.615	0.636

Note: p-values in parentheses computed using clustered standard errors, weighted regression (weight=sector employment share, averaged over time); private sector only; short-run parameters: sum over 4 lags reported, long-run parameters: sum over 4 lags divided by the sum over coefficients on the lagged dependent variable reported; downturn dummy: takes the value of 1 if the sector GVA gap is negative.

Table A6: Robustness check: controlling for employment composition (sectoral differences)

	Nominal wages				Real wages			
	1	2	3	4	5	6	7	8
	Manu-facturing	Cons-truction	Services	Public sector	Manu-facturing	Cons-truction	Services	Public sector
L.Wage	**0.430**	**0.244**	**0.541**	**0.408**	**0.414**	**0.259**	**0.480**	**0.394**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Unemployment	**-0.206**	**-0.310**	**-0.159**	**-0.304**	**-0.167**	**-0.246**	**-0.162**	**-0.260**
	(0.000)	(0.001)	(0.002)	(0.000)	(0.000)	(0.003)	(0.007)	(0.000)
*downturn	**0.053**	0.044	0.033	-0.031	**0.055**	0.022	0.037	-0.045
	(0.002)	(0.137)	(0.170)	(0.354)	(0.003)	(0.425)	(0.103)	(0.180)
Temporary work	0.266	**-0.209**	0.057	0.227	0.207	**-0.222**	-0.034	0.271
	(0.300)	(0.026)	(0.651)	(0.383)	(0.525)	(0.011)	(0.805)	(0.325)
Youth employment	-0.228	0.067	**-0.242**	0.398	-0.250	0.019	**-0.314**	0.441
	(0.445)	(0.703)	(0.042)	(0.163)	(0.493)	(0.919)	(0.066)	(0.227)
Productivity	**0.144**	**0.180**	**0.380**	**0.425**	**0.106**	**0.184**	**0.374**	**0.398**
	(0.006)	(0.007)	(0.003)	(0.000)	(0.027)	(0.010)	(0.005)	(0.001)
Inflation	**0.408**	**0.488**	**0.394**	**0.329**				
	(0.000)	(0.044)	(0.006)	(0.000)				
Constant	**2.328**	**4.037**	**1.170**	**4.023**	**1.765**	**2.890**	**1.051**	**3.123**
	(0.000)	(0.007)	(0.002)	(0.001)	(0.004)	(0.002)	(0.008)	(0.001)
Long-run parameters:								
Unemployment	**-0.360**	**-0.410**	**-0.347**	**-0.515**	**-0.285**	**-0.332**	**-0.311**	**-0.429**
	(0.000)	(0.001)	(0.002)	(0.000)	(0.001)	(0.001)	(0.004)	(0.000)
Productivity	**0.252**	**0.237**	**0.826**	**0.719**	**0.181**	**0.248**	**0.718**	**0.656**
	(0.010)	(0.004)	(0.001)	(0.000)	(0.031)	(0.006)	(0.003)	(0.000)
Inflation	**0.716**	**0.645**	**0.857**	**0.556**				
	(0.000)	(0.000)	(0.000)	(0.000)				
Observations	843	845	845	847	843	845	845	847
Country-industries	13	13	13	13	13	13	13	13
R-squared	0.574	0.373	0.683	0.673	0.528	0.348	0.637	0.635

Note: p-values in parentheses computed using clustered standard errors, weighted regression (weight=sector employment share, averaged over time); short-run parameters: sum over 4 lags reported, long-run parameters: sum over 4 lags divided by the sum over coefficients on the lagged dependent variable reported; downturn dummy: takes the value of 1 if the sector GVA gap is negative.

Table A7: Robustness check: short-term unemployment (institutional effects)

	Nominal wages			**Real wages**		
	1	2	3	4	5	6
Institution:	EPL	ETCR	Union density	EPL	ETCR	Union density
L.Wage	**0.242**	**0.367**	**0.328**	**0.216**	**0.336**	**0.307**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Unemployment	**-1.175**	**-0.500**	**-0.636**	**-0.623**	**-0.409**	**-0.530**
	(0.000)	(0.000)	(0.000)	(0.010)	(0.000)	(0.001)
*downturn	**0.051**	**0.062**	**0.078**	**0.055**	**0.060**	**0.073**
	(0.016)	(0.023)	(0.004)	(0.026)	(0.012)	(0.003)
*institution	**0.330**	**0.050**	**0.009**	0.116	0.025	**0.006**
	(0.003)	(0.050)	(0.020)	(0.190)	(0.122)	(0.024)
Productivity	**0.174**	**0.246**	**0.260**	**0.165**	**0.243**	**0.256**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	**0.438**	**0.384**	**0.406**			
	(0.000)	(0.000)	(0.000)			
Constant	**2.651**	**3.000**	**3.227**	**2.143**	**2.311**	**2.416**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Long-run parameters:						
Unemployment	**-1.551**	**-0.789**	**-0.947**	**-0.794**	**-0.616**	**-0.765**
	(0.000)	(0.000)	(0.000)	(0.006)	(0.000)	(0.000)
Productivity	**0.230**	**0.388**	**0.387**	**0.211**	**0.367**	**0.369**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	**0.579**	**0.606**	**0.605**			
	(0.000)	(0.000)	(0.000)			
Observations	1,868	2,316	2,265	1,868	2,316	2,265
Country-industries	36	39	36	36	39	36
R-squared	0.486	0.534	0.527	0.441	0.491	0.490

Note: p-values in parentheses computed using clustered standard errors, weighted regression (weight=sector employment share, averaged over time); private sector only; short-run parameters: sum over 4 lags reported, long-run parameters: sum over 4 lags divided by the sum over coefficients on the lagged dependent variable reported; downturn dummy: takes the value of 1 if the sector GVA gap is negative. Short-term unemployment: overall unemployment less long-term unemployment, where long-term unemployment is unemployment for more than 24 months.

Table A8: Robustness check: short-term unemployment (sectoral differences)

	Nominal wages				**Real wages**			
	1	2	3	4	5	6	7	8
	Manu-facturing	Cons-truction	Services	Public sector	Manu-facturing	Cons-truction	Services	Public sector
L.Wage	**0.438**	**0.252**	**0.534**	**0.387**	**0.414**	**0.250**	**0.463**	**0.368**
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Unemployment	**-0.360**	**-0.411**	**-0.260**	**-0.531**	**-0.327**	**-0.364**	**-0.281**	**-0.485**
	(0.000)	(0.008)	(0.002)	(0.000)	(0.000)	(0.002)	(0.002)	(0.000)
*downturn	**0.057**	0.033	0.045	-0.037	**0.062**	0.018	0.054	-0.053
	(0.016)	(0.497)	(0.147)	(0.287)	(0.039)	(0.701)	(0.058)	(0.129)
Productivity	**0.142**	**0.206**	**0.377**	**0.480**	**0.112**	**0.212**	**0.374**	**0.459**
	(0.011)	(0.000)	(0.007)	(0.000)	(0.036)	(0.001)	(0.009)	(0.000)
Inflation	**0.396**	**0.586**	**0.427**	**0.353**				
	(0.000)	(0.002)	(0.007)	(0.000)				
Constant	**2.879**	**3.896**	**1.469**	**4.566**	**2.429**	**3.267**	**1.574**	**3.730**
	(0.001)	(0.015)	(0.001)	(0.001)	(0.000)	(0.001)	(0.002)	(0.000)
Long-run parameters:								
Unemployment	**-0.640**	**-0.550**	**-0.558**	**-0.867**	**-0.559**	**-0.486**	**-0.524**	**-0.768**
	(0.000)	(0.011)	(0.004)	(0.000)	(0.000)	(0.002)	(0.003)	(0.000)
Productivity	**0.253**	**0.275**	**0.809**	**0.782**	**0.191**	**0.282**	**0.696**	**0.726**
	(0.014)	(0.000)	(0.001)	(0.000)	(0.035)	(0.001)	(0.004)	(0.000)
Inflation	**0.704**	**0.783**	**0.917**	**0.576**				
	(0.000)	(0.001)	(0.000)	(0.001)				
Observations	820	822	822	824	820	822	822	824
Country-industries	13	13	13	13	13	13	13	13
R-squared	0.575	0.387	0.685	0.675	0.531	0.361	0.634	0.636

Note: p-values in parentheses computed using clustered standard errors, weighted regression (weight=sector employment share, averaged over time); private sector only; short-run parameters: sum over 4 lags reported, long-run parameters: sum over 4 lags divided by the sum over coefficients on the lagged dependent variable reported; downturn dummy: takes the value of 1 if the sector GVA gap is negative. Short-term unemployment: overall unemployment less long-term unemployment, where long-term unemployment is unemployment for more than 24 months.

Table A9: Robustness check: productivity growth

	Nominal wages					Real wages				
	1	2	3	4	5	6	7	8	9	10
Institution:			EPL	ETCR	Union density			EPL	ETCR	Union density
L.Wage	**0.452**	**0.385**	**0.264**	**0.349**	**0.340**	**0.417**	**0.376**	**0.263**	**0.343**	**0.336**
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Unemployment	**-0.165**	**-0.327**	**-0.944**	**-0.397**	**-0.452**	**-0.145**	**-0.311**	**-0.642**	**-0.339**	**-0.388**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)
*downturn		**0.127**	**0.170**	**0.133**	**0.142**		**0.133**	**0.174**	**0.134**	**0.140**
		(0.000)	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)
*institution			**0.199**	0.014	**0.003**			0.085	0.002	0.002
			(0.016)	(0.344)	(0.080)			(0.333)	(0.885)	(0.102)
Productivity	1	1	1	1	1	1	1	1	1	1
Inflation	**0.386**	**0.492**	**0.490**	**0.481**	**0.467**					
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
Constant	**2.095**	**2.137**	**2.643**	**2.501**	**2.703**	**1.632**	**1.684**	**2.155**	**1.894**	**1.956**
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Long-run parameters:										
Unemployment	**-0.300**	**-0.532**	**-1.283**	**-0.610**	**-0.685**	**-0.249**	**-0.498**	**-0.872**	**-0.515**	**-0.584**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Productivity	1	1	1	1	1	1	1	1	1	1
Inflation	**0.704**	**0.800**	**0.666**	**0.740**	**0.707**					
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
Observations	2,576	2,533	1,868	2,382	2,331	2,576	2,533	1,868	2,382	2,331
Country-industries	39	39	36	39	36	39	39	36	39	36
R-squared	0.741	0.545	0.550	0.551	0.552	0.708	0.497	0.499	0.500	0.502

Note: constraint: sum over coefficients on all lags of productivity = 0.8; p-values in parentheses computed using clustered standard errors, weighted regression (weight=sector employment share, averaged over time); private sector only; short-run parameters: sum over 4 lags reported, long-run parameters: sum over 4 lags divided by the sum over coefficients on the lagged dependent variable reported; downturn dummy: takes the value of 1 if the sector GVA gap is negative.