EUROPEAN CENTRAL BANK
EUROSYSTEM

Working Paper Series

Maria Grazia Attinasi, Francesco Berardini, Alessandra Anna Palazzo

Do public wages in the euro area explain private wage developments? An empirical investigation

No 2231 / January 2019

Abstract

This paper investigates the relationship between public and private wages in the five largest euro area countries for the period 1997-2017. The analysis shows that there exists a positive and significant response of private wages to a public wage shock. This effect is found to be temporary and to differ across countries (positive and significant in France, Spain, Italy and non-significant in Germany and the Netherlands). Interestingly, the response of private wages is found to be asymmetric: a positive and statistically significant response is found in case of a positive shock to public wages, while no statistically significant effects are detected in case of a cut to public wages. As the public wage containment policies adopted during the sovereign debt crisis are expected to be gradually lifted in several euro area countries, the findings of this paper suggest that knock-on effects on private sector wages cannot be excluded in the years to come.

Keywords: government wages, private sector wages, asymmetries, spillovers

JEL Classification: E24; E62; J30; C33; C11

Non-technical summary

The question of how wages in the private sector respond to shocks to public sector wages, and viceversa, matters for the modelling and forecasting of wage dynamics in each of the two sectors. Understanding of such interactions is necessary as wage agreements or wage negotiation rounds in one of the two sectors may spillover to the other one, and therefore there may be a need to account for such links in the context of wage forecasts. Early studies on the interaction between public and private sector wages date back to the Scandinavian model of inflation of the 1970s, which predicted that wages in the tradeable sector (i.e. manufacturing sector) act as wage leader vis-à-vis the non-tradeable sector, including the public sector. Later on, the interaction between the two sectors' wages has been formalised in the context of searching and matching labour market models, augmented with the inclusion of a public sector. According to these models, an increase in public sector wages, by influencing the search direction of workers may also exert upward pressures on private sector wages. Ultimately, however, the issue of the interaction between the two sectors' wages remains an empirical one and, as shown by most of the literature on the topic, the direction and the sign of causality is country-specific and may also depend on a number of institutional factors. The aim of this paper is to empirically revisit the interaction between public and private sector wages for a sample of the euro area five largest countries (Germany, France, Italy, Spain and the Netherlands) over the period 1997-2017. This research question appears highly relevant in the current context of return to dynamic public wage growth. While in the recent past the contribution of public sector wages to total economy wages has been declining, wage containment policies adopted in most euro area countries are being gradually abandoned since 2016 and new negotiation rounds are likely to push-up public wages. In turn, it seems important to analyse the extent to which such new developments could impact on private wages.

The empirical analysis relies on three different approaches. First, in order to exploit the cross-country dimensionality of our sample, a panel BVAR framework is employed to estimate the average elasticity of private compensation to a shock in public compensation. The second empirical approach consists of a country specific BVAR analysis to test the presence of country heterogeneity. Finally we rely on a Local Projection Method approach with the aim to inspect possible asymmetries in the response to a positive or negative shock to public compensation, through the estimation of state-dependent coefficients. The empirical model features the key

determinants of private wages including labour productivity and inflation, as well as some additional control variables such as the size of the public sector and the unemployment gap.

Our analysis expands the existing empirical literature mainly in three aspects. First, the time span of our data set covers the period from 1997 to 2017, i.e. almost all sample contains years of wage dynamics within the euro area, thus it excludes potential issues related to different monetary policy or exchange rate regimes. Moreover, by distinguishing between periods of wage restraint and wage increase we are able to better link the propagation of public wage shocks to private wages along the business cycle. Finally, the use of an empirical approach based on a set of different models allows us to explore the linkages between private and public sector wages along several dimensions and increases the robustness of our results.

Overall, our estimates suggest that private wages react positively to a shock of public wages, yet results are heterogeneous across countries, with a positive and significant response in France, Spain, Italy and non-significant one in Germany and the Netherlands. Furthermore, our analysis points to some asymmetries in the response of private wages to a public wages shock: a positive shock to public wages triggers a a positive and statistically significant response, while public wages cuts are found to have no statistically significant impact.

These results are robust to empirical specifications based on an alternate measure of private and public sector wages and salaries.

1 Introduction

The growth rate of total economy compensation per employee[1] in the euro area peaked in 2008 before declining in the wake of the financial and economic crisis. It remained subdued during the 2014-17 recovery period, thus contributing also to weak inflation dynamics in the euro area as a whole. Although in principle insulated from cyclical developments, compensation of public sector employees started decelerating as well in several euro area countries as part of the broader consolidation efforts adopted since 2010 in response to the sovereign debt crisis. The wage containment policies adopted during the crisis consisted mainly of a reduction in the public employment turnover ratio and/or a freeze in public sector compensation. The effect of these measures was particularly visible in the countries most hardly hit by the crisis. In the coming years a gradual pick up in public compensation of employees is expected as the wage containment policies of the crisis years are gradually being abandoned.

Although public compensation accounts for a small share of total economy compensation, so that its direct contribution to aggregate developments is relatively small, it may influence total economy's compensation per employee indirectly, via its impact on private wages. The key transmission channel has been formalised in a theoretical labour market model with search and matching frictions (Pissarides, 1988). In this model, an increase (decrease) in public wages relative to private wages affects the search direction of workers thus reducing (increasing) labour supply to the private sector, and puts upward (downward) pressure on private wages. The relevance and strength of this transmission channel is an empirical question and the available empirical evidence is not fully conclusive regarding the direction of causation between public and private wages across countries.

Differently from most of the literature, which has focused on the casual link between private and public wages and assumes a leading role for private wages, the aim of this paper is to investigate whether shocks to public sector wages can help predicting private sector wage developments. Therefore, our work presents two distinctive features. First, we focus on public wages as variable of interest as opposed to private wages, given that wage containment policies are expected to be gradually abandoned. Moreover, we carry out an analysis of the predictive power of public wages as opposed to estimate their casual effect on private wage developments.

[1] Compensation of employees is the sum of wages and salaries (i.e. negotiated wages plus the wage drift) plus social security contributions paid by both employees and employers. When taken as a ratio to total employment, compensation per employee is obtained.Throughout the paper, for the sake of simplicity, we refer to public and private sector wages also when data are specified as compensation per employees.

The ability of public wages to predict private wage growth is particularly relevant from a policy prospective since macro-models usually do not account for the indirect contribution of public wages to total economy wages via their influence on private wages.

This paper contributes to the empirical literature by investigating the relationship between public and private wages in the five largest euro area countries (Germany, France, Italy, Spain and the Netherlands). The empirical strategy consists of three different approaches. First, the average response of private wages to a public wage shock for the countries and period under consideration is estimated using a Panel Bayesian VAR approach. Second, with a view to shed light on country heterogeneity in such response, a country-specific BVAR approach is used. Finally, and relevant from a policy perspective, possible asymmetries in the response of private wages to a public wage shock are analysed using a local projection method approach (LPM) for a panel of the five largest countries. The main findings of the paper are:

- On average, the Panel BVAR estimates suggest that in response to a 1% shock to public wages, private sector wages respond with with a lag, and the peak impact of 0.2% is reached after 5 years.

- The country-specific BVAR estimates show that the response of private wages to a public wage shock is positive and statistically significant for Italy, Spain and France, but not for Germany and the Netherlands.

- Finally, estimates based on the Local Projection Method, suggest that private wages respond asymmetrically to a public wages shock. In particular, we find that the response is positive and statistically significant in case of a positive shock to public wages, while it is statistically insignificant in case of public wage cuts[2]. This suggests that in periods of either public wage freezes or cuts, only the direct effect is likely to be at work, while in periods of positive public sector wage growth the impact on private sector wages is not negligible (around 0.8% after two years) and persistent.

The findings of this paper are robust to a number of robustness checks and suggest that strong and persistent public sector wage growth could pose some upside risks to private sector wages, in a context of dynamic public wage growth. The indirect contribution of public wages to total economy wages captured in this analysis, is generally not accounted for in macro-models where

[2]This result is also consistent with the literature on asymmetric wage adjustment as explained in Marotzke et al (2017)

private sector wages are modeled on the basis of a standard wage Philips curve. The absence of this channel may be not problematic in the short term, given the relatively low one-year ahead estimated elasticity. However, strong and persistent public sector wage growth might pose some upward risks to private sector wages over the medium to long term, as suggested by the Local Projection Method estimates in case of a positive shock to public wages.

The paper is structured as follows. The second section reviews the existing literature on public-private wages interactions and the main transmission channels. The third section presents some stylized facts on recent development in public wages and their direct contribution to overall compensation per employee. The fourth section discusses the empirical strategy, describes the data and the results. The fifth section includes some robustness checks and the last section concludes.

2 Public and private wage interactions: transmission channels and empirical evidence from the literature

Early studies on public-private sector wage interactions date back to the Scandinavian model of inflation of the 1970s. This model predicts that changes in nominal wages in the tradeable sector act as wage leader (i.e. changes in the competitive sector are transmitted to the protected sector and non-vice-versa), implying that private wages (i.e. manufacturing sector) lead public sector wages. Lindquist and Vilhelmsson (2006) test these predictions for Sweden using a vector error correction model, and find supportive evidence that the central government does not act as wage leader.

The impact of shocks to public wages has been more formally analyzed in the context of a search and matching labour market model. Quadrini and Trigari (2007) add a public sector to the basic labour market model with search and matching frictions (Pissarides, 1988) in order to study the business cycle impact of public wages and employment for the U.S. In this set-up, the presence of a public sector increases the volatility of total employment by crowding out private employment. After a negative productivity shock, public sector jobs become more attractive, due to lower job creation in the private sector and a higher wage premium in the public sector. As more workers search for a job in the public sector, the probability of filling a vacancy in the private sector decreases, further decreasing the creation of new private sector jobs. These findings are explained by the low cyclicality of public wages and the presence of a wage premium. For the

period 1948-2003 available data show that both public employment and public wages in the U.S. were less procyclical than the private counterparts; the public sector wage premium was pro-cyclical and public and private sector wages tended to co-move over the cycle. Linnemann (2009) finds that the predictions of a standard RBC model (Finn, 1998) are not supported by the data. In a VAR analysis of quarterly post war U.S. data, he finds that a public employment shock induces a temporary positive response (rather than a negative one as predicted by theory) of private employment, output, private consumption and the real wage.

Since the onset of the crisis, a wealth of empirical studies focusing on the EU and OECD countries, have consistently found evidence of bi-directional causality, while evidence on the leadership role of public wages is rather mixed. Within a theoretical framework in line with Quadrini and Trigari (2007), Afonso and Gomes (2014) argue that a shock to public sector wages and employment can influence private sector wages via three channels. First, it affects the search direction of the unemployed people, thus putting pressure on private wage bargaining. Second, the relative scarcity of labour supply directed towards the private sector in a context of diminishing marginal productivity of labour, raises the average productivity and thus private sector wages. Third, since higher public wages have to be financed by higher taxes, this consideration might lead to higher wage pressures in the private sector. For the EU and OECD countries the authors find evidence of a contemporaneous bi-directional relationship between the wage dynamics in the two sectors, with private sector wages displaying a higher contemporaneous elasticity to public wages.

Lamo et al. (2008), find evidence of private sector nominal wage leadership over public wages over the business cycle, which seems to work mainly via the price level, and a few cases of bi-directional causality. For some countries (Ireland, France, Finland and Italy and, to a minor extent, Germany and Belgium), they uncover a leading role for public wages (also when controlling for prices) and show that strong bargaining coordination with government involvement in collective bargaining, strong product market regulations and high union density are conducive to public wage leadership. Likewise, for Germany, France, Italy and Spain Pérez and Sanchéz (2010) find direct intra-annual links between the two sectors' wages, though evidence is heterogeneous across countries and time, with the public sector wages leading mostly in the short term (within a year), otherwise the private sector tends to lead. For the Netherlands, Zeilestra and Elbourne (2014) do no find any evidence of public sector leadership; on the contrary private sector wages seem to lead public wages. The European Commission (2014) finds a large elasticity of private

wages to a government wage shock (elasticity of 1) in some countries (Italy, Portugal and Spain), while the average euro area response of government wages to a shock in private wages is much lower (about 0.45) and in most cases is not statistically significant. Interestingly, the degree of public wages leadership seems to decrease with the degree of trade openness. This corroborates the view that high exposure to trade reduces the scope for deviations of labour costs from those of foreign competitors, and raises the private sector resilience to public wages' shocks.

Peréz et al. (2016) assess the macroeconomic effects of the public wages moderation policies adopted during the sovereign debt crisis by means of macro econometric models. The authors argue that despite adverse short-term effects, public wages restraining policies generate positive medium-term effects via labour market dynamics, as public sector wages adjustments lead to competitiveness gains through the spillover effects on private wages. In addition, efficiency gains also materialise when public sector activity partially competes with the private sector (e.g. education and health). In this case a reduction in public sector employment directly spurs private employment. However, if public sector activity complements private sector productivity (e.g. provision of public goods) such efficiency gains materialise only if reforms lead to a more efficient provision of public goods.

Finally, Lamo et al. (2016) show that the state of the economy matters when analysing the impact of public employment and wages' shocks on private labour markets. Using the local projection method approach (Jordá, 2005) for the euro area and Spain, they find evidence that during economic expansions, public employment crowds out private employment, while during recessions, an unexpected increase in public employment leads to an increase in private employment, though short-lived. The authors find evidence that public wages may lead private wages in the euro area and interpret this finding as evidence that during recessions policies of public wage restraint set in motion a labour market adjustment, that otherwise would have taken longer to materialise.

3 Stylised facts and data description

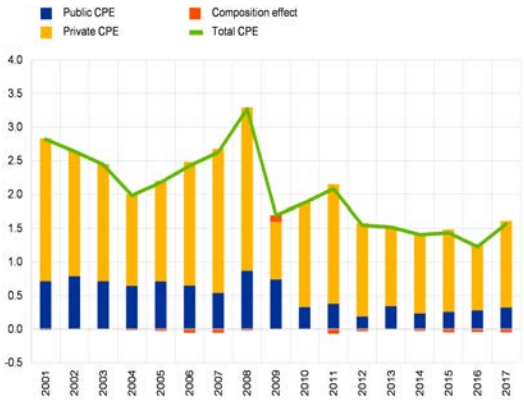
The paper focuses on the euro area five largest countries (Germany, Spain, France, Italy and Netherlands) given their relevance in shaping euro area aggregate developments. The empirical analysis covers the period 1997-2017.

Data on public sector compensation per employee, are originally at annual frequency and sourced

from the ESCB, while data on total economy aggregates are sourced from Annual and Quarterly National Accounts published by Eurostat. Data on private compensation per employees is obtained as the difference between compensation per employee in the total economy and the public sector equivalent. Additional control variables include other variables which normally feature in wage equations, i.e. labour productivity, HICP inflation,the unemployment gap, as well as the size of public employment relative to total employment (see Appendix for more details).

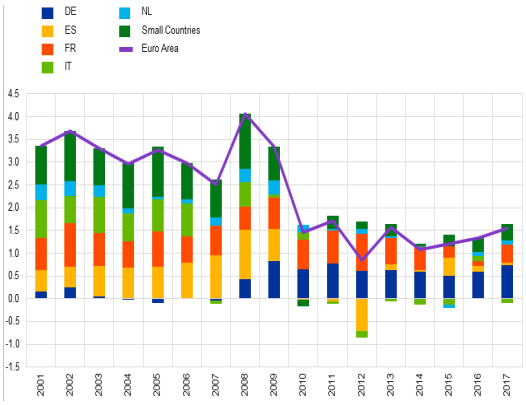
For the euro area as a whole, figure 1 decomposes the annual growth in total compensation per employees into the contribution from both the public and the private sector. The growth rate of total compensation per employees in the euro area peaked in 2008, at 3.3%, before declining in the wake of the financial and economic crisis. Albeit small, the contribution of public wages to total compensation growth has varied over the years. From an average of 0.7pp in the pre-crisis expansionary period (2001-2008), it more than halved during 2010-17 (0.3pp on average). This contribution will likely increase in the near term as the wage containment policies are being gradually abandoned and new negotiation rounds are projected to push-up public wages.

Figure 1: Euro area total economy compensation per employee: breakdown by sector



Compensation per employee (CPE) is the sum of wages (negotiated wages and wage drift) plus social security contributions as ratio over employees. Bars express the contribution of the public/private sector to compensation per employee growth in the overall economy

Figure 2: Euro area public sector compensation per employee – breakdown by country

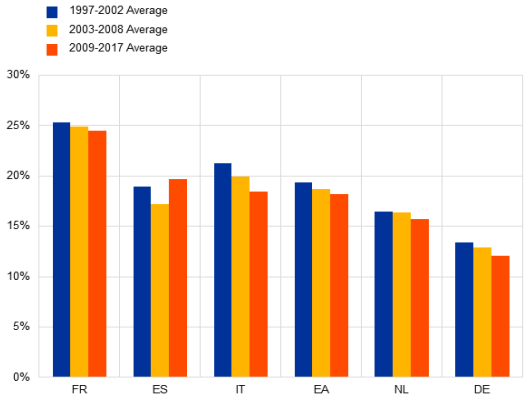


Compensation per employee is the sum of wages (negotiated wages and wage drift) plus social security contributions as ratio to employees in the public sector. Bars express the contribution of different countries to compensation per employee growth

The wage containment policies adopted during the crisis consisted mainly of a reduction in the public employment turnover ratio and/or a freeze in public sector compensation. Their

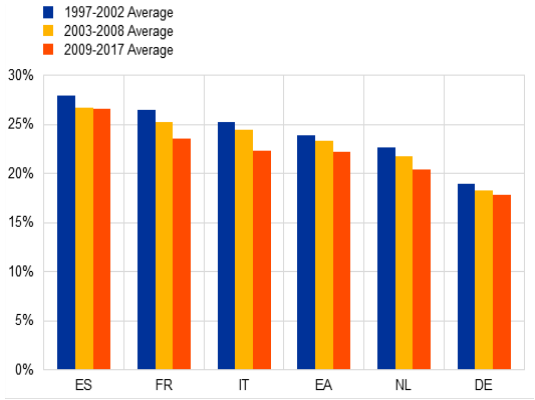
effect was particularly visible in the small countries but also in Spain and Italy (Figure 2), and based on available budgetary information their effect is expected to be reversed over the next two to three years. In Italy, after being frozen during 2010-15, wages are accelerating again in 2018, due to the application of the 2016-18 wage negotiation round. In Spain, an increase in wages is projected on the back of the wage increases legislated in the 2017 and 2018 budgets. In France, wages accelerated in 2017 reflecting the increase in the remuneration of teachers and the estimated impact of the reform of the public sector general salary grid for both 2017 and 2018. In Germany, public wages have started to grow at a robust rate due to labour supply bottlenecks and composition effects related to skill upgrade of the public sector workforce. Among the small countries, public wages have also accelerated significantly in Ireland in 2017, as a result of the new national pay agreement lasting until 2020 and aimed at unwinding the pay cuts enacted during the crisis. A gradual acceleration of public wages is ongoing also in Cyprus, where wages indexation to the cost of living allowance (COLA) has been re-introduced as of 2017 after a period of wage freeze.

Figure 3: Public employment in % total employment



Countries are sorted in decreasing order according to the ratio of public employment to total employment in 2017. Source: own elaboration based on ESCB data

Figure 4: Compensation of employees as % government primary spending



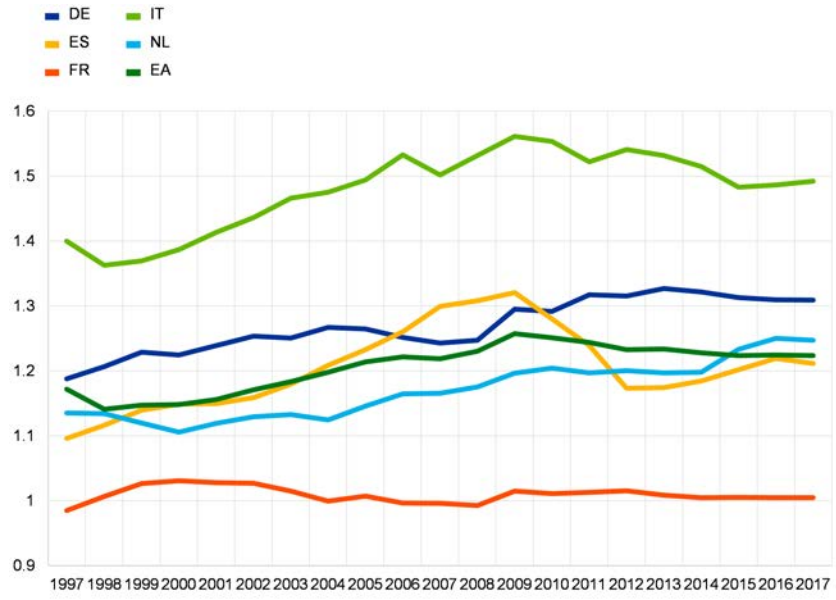
Countries are sorted in decreasing order according to the ratio of compensation of employees to government primary spending in 2017. Source: own elaboration based on ESCB data

The size of public employment may matter for the propagation of public wages shocks on private wages. For the period under consideration, data points to some heterogeneity in the size of public employment across countries. Figure 3 shows that France is the largest public employer, accounting for about 25% of total employment, followed by Italy and Spain, while

in Germany and the Netherlands, the public sector employs a significantly lower share of the total employment. Spending on compensation of employees also accounts for a sizeable share of total government spending across countries. Figure 4 shows that for the euro area as a whole it constitutes roughly 23% of total primary spending (or 10% of GDP), with France and Spain being above this level throughout the period of analysis.

Additionally, as argued by Quadrini and Trigari (2007), the existence of a gap between the public and private sector wages may act as a factor increasing the attractiveness of public sector jobs over the private ones. A simple way to gauge such premium is to look at the ratio of public and private wages (Figure 5). In all countries except France there seems to be a positive wage premium (i.e. ratio is above 1). This gap has been on average high and rising since 1997 mainly in Italy, Germany and Netherlands, while in Spain it decreased during the crisis, reflecting the wage containment measures adopted since, in France it remained broadly stable.

Figure 5: The public-private sector wage gap



The gap is reflected in the difference of the indicator value from one

Finally, the data point to a significant degree of correlation between public and private sector wages for the period of analysis and for various leads and lags (see Table 1). As the correlations appear to go both ways, they do not point to any conclusive evidence about which of the two sectors is dominant.

Therefore, in order to further investigate the predictive power of shocks to public sector wages

Table 1: Correlations between private and public sector compensation growth rates

	Public Leads Private					Private Leads Public			
	$\text{Corr}(Wpub_t, Wpr_{t+i})$					$\text{Corr}(Wpr_t, Wpub_{t+i})$			
i	4	3	2	1	T	1	2	3	4
DE	0.289**	0.239**	0.237**	0.232**	0.307***	0.421***	0.443***	0.484***	0.501***
ES	0.571***	0.544***	0.546***	0.538***	0.561***	0.602***	0.572***	0.501***	0.414***
FR	0.497***	0.439***	0.409***	0.339***	0.204*	0.291***	0.256**	0.253**	0.323***
IT	0.301***	0.176	0.204*	0.356***	0.234**	0.398***	0.408***	0.274**	0.319***
NL	0.321***	0.323***	0.400***	0.452***	0.545***	0.548***	0.528***	0.449***	0.434***

for private wages growth, we run Granger causality tests in a quarterly VAR framework with and without prices.[3] Following Toda and Yamamoto (1995) and Dolado and Lütkephol (1996), the two variables of interest are specified in log-levels at quarterly frequency for the period 1997-2017. We find evidence of bi-directional Granger causality for France and Italy, while for Germany private sector wages seem to Granger-cause public sector wages. In the case of Spain we found evidence of public sector leadership and no significant relationship in neither direction is found for the Netherlands. As the literature suggests, the interaction between private and public wages may occurs also via prices, therefore a Granger-causality test including the HICP index is also run. Results are consistent with the original specification with the exception of France where only evidence of public wage causality is robust to the inclusion of prices. [4]

Table 2: Granger Causality tests: VAR in log-levels

	Compensation per employee		Compensation per employee (model including hicp)	
	public → private	← private public	public → private	← private public
Germany	-	←	-	←
Spain	→	-	→	-
France	→	←	→	-
Italy	→	←	→	←
Netherlands	-	-	-	-

[3] These tests have a clear interpretation as Granger-causality captures the predictive ability of past values of a given variable when forecasting another variable.

[4] These findings are consistent with the existing literature - see Lamo,Perez and Schuknecht (2008, 2021)

4 Empirical methodology

This paper analyses the impact of a shock to public wages on private sector wages. Given the empirical nature of our research question, the analysis is articulated along three different approaches. First, a panel BVAR technique is used to gauge the equilibrium relationship between the two sectors' wages. Data are in annual terms, the use of a panel specification allows exploiting the cross-country dimension of the data as well as investigating the average response (elasticity) of private wages to a public wages shock. Second, a country-specific BVAR analysis is conducted with a view to assess possible country-heterogeneity in such response as suggested by some empirical literature. Given the relatively short sample, the analysis is conducted at quarterly frequencies over the same period. Finally, and differently from most existing empirical studies, the analysis addresses possible asymmetries in the response of private wages to public wages shocks (i.e. different responses to public wages cuts or increases). To this purpose a Local Projection Method (Jordà, 2005) with annual data expressed in terms of growth rates, is used. In addition to public and private sector compensation of employees, the model specification includes the key variables that affect wage determination namely labour productivity, HICP inflation and the size of public employment relative to total employment. For the LPM specification we also include the unemployment gap as the specification in growth rates allows to gauge the effect of cyclical factors. Additional robustness checks using wages and salaries instead of compensation of employees as the dependent variable confirm the findings of the main analysis.

4.1 The average response of private wages to a public wages shock: a Panel BVAR analysis

The first approach used to investigate the dynamic interaction between private and public wages is a Panel BVAR framework for the five largest euro area countries over 1997-2017. This method allows us to estimate the average response of private wages to a public wages shock and to compute the corresponding Impulse Response Functions (IRFs). The model consists of 5 variables: public and private nominal compensation per employee, size of public sector, HICP and labour productivity. Following Ciccarelli and Canova (2013), the VAR in reduced form is the following:

$$Y_{i,t} = A_{0,i}(t) + A(l)Y_{t-1} + u_{i,t} \quad (1)$$

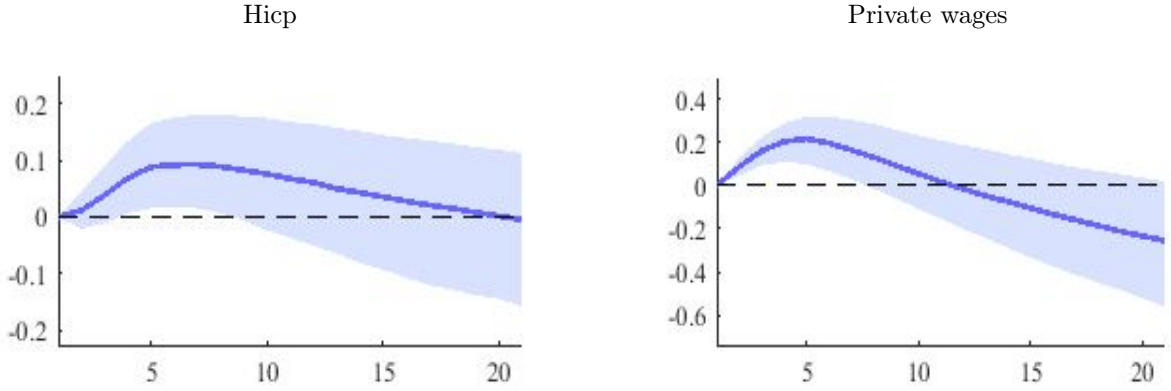
Where $Y_{i,t}$ is the vector of our variables and the baseline ordering of variables is $Y_{i,t}$ = (productivity, private wages, HICP, public wages, public sector size), $u_{i,t}$ are identically and independently distributed errors $u_(i,t) \sim iid(0, \Sigma_u)$. Public and private wages are expressed in nominal terms, labour productivity is defined as real GDP divided by total economy employment, the size of public sector is expressed as public employment in % of total employment. Following Toda and Yamamoto (1995), we run the model in log levels of the variables. In equation (1), 5 years lags of each endogenous variable have been included. The model is estimated by Bayesian pooled estimator, using a traditional Normal-Wishart prior[5].

In line with existing empirical studies such as Linnemann (2009) and European Commission (2014), the identification of structural public wage shocks is achieved via a standard Cholesky decomposition which imposes restrictions on the timing of the response of the different variables to a public wage shock. In the Cholesky decomposition the order of the variables included in the VAR might matter for computing the size of the elasticities. In most of the previous literature, the subject of the interaction between public and private sector wages has been addressed with the aim of capturing the effects of a private wage shock on public wages. Therefore, it has generally been assumed that public wages are unaffected – within the same quarter – by shocks to other variables and thus ordered first. However, the data description presented in section 3, points to some bidirectional effect. Indeed, the Granger-causality tests suggest that an influence of private sector wages over the public ones cannot be ruled out a priori, and moreover the correlations hint to some lagged responses of private wages to public wages. Given that our aim is to uncover a predictive role of public wages, we focused on the response of private wages to a public wage shock. In this context, ordering public wage first may not be fully plausible as it amouts to assuming that private wages react on impact to a public wage shock. Therefore, in our preferred baseline ordering of variables, ordering public wages after private wages could help us in capturing their predictive power for private wage developments. It should be noted, however, that the results are qualitatively robust to a specification where the ordering of the variables is changed and in particular government wages are ordered first in the Choleski factorization (see Section 5). Figure 6 reports the impulse response functions of the model variables to a public wages'shock in our baseline ordering of variables. These IRFs should be interpreted as the average response across a panel composed by the 5 largest euro area countries. In response to a 1% shock to public wages, private sector wages are found to increase by around 0.1% after

[5]The Panel BVAR is estimates using the BEAR tool v. 3.0 as documented in Dieppe et al. (2016)

one year, the peak effect of around 0.2% is reached after 5 years. This effect slowly decays afterwards. Consistent with the literature, the effect of a shock to public wages on private wages is long-lasting but temporary. Effects on HICP are significant but very small, i.e. the peak effect of 0.1% is reached after 5 years.

Figure 6: Deviation from baseline level in response to 1% shock to public wages (%, annual)



The figure reports the median and the 16th and 84th percentiles of the distribution of the impulse response functions

4.2 Country-specific response to a public wage shock: the country BVAR analysis

The analysis now turns to investigating country-specific responses of private wages to public wages shocks with the aim of uncovering heterogeneity in such responses. Conceptually, the motivation for this exercise goes back to the findings of some literature (e.g. Lamo et al. 2008, Afonso and Gomes 2014), according to which the institutional framework underlying the public sector wage setting mechanism varies across countries and may help explaining why in some countries public wages lead private wages. While the role of institutional factors is beyond the scope of this paper, this section looks at the individual responses of private wages to a public wage shock by estimating for each of the five largest euro area countries the VAR model presented in section 4.1, using quarterly data over 1997Q1-2017Q4:

$$Y_t = C + B_1 y_{t-1} + ... + B_p y_{t-p} + \epsilon_t \quad (2)$$

$$\epsilon_t \sim N(0, \Sigma) \tag{3}$$

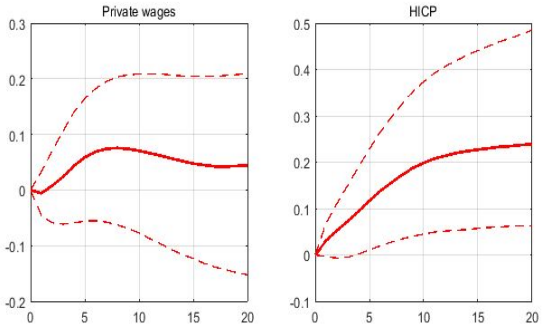
Where y_t is an $n \times 1$ vector of endogenous variables (productivity, private wages, HICP, public wages, public sector size) and ϵ_t is an $n \times 1$ vector of exogenous shocks. The model is estimated by means of Bayesian techniques following the approach described in Giannone et al. (2015) with all variables expressed in log levels.[6]. Consistently with the panel BVAR analysis above the structural identification of the shocks is obtained by means of a Choleski factorization with public wages ordered after private wages. The shock is standardized to a 1% increase in public wages. Figure 7 displays the IRFs of the estimated BVAR for each country and points indeed to some cross-country heterogeneity in the response of private sector wages. In particular, the response of private wages to a public wage shock is positive and statistically significant for Italy, Spain and France, but not for Germany and the Netherlands. For Italy a 1% public wage shock is estimated to impact private wages by around 0.14% in the first year, and remains broadly at that level thereafter. In Spain, the effect picks up gradually reaching 0.1% after 2 years. For France, the estimated response of private wages to a public wage shock is somewhat higher, at 0.45% in the first year, which cumulates to 0.49% after 2 years. This result can be explained partly in light of the larger size of public sector employment in France, and partly by the fact that per capita compensation in the public and private sectors are very close. Therefore, and in line with the literature, it seems plausible to assume that an increase in public sector compensation, by opening up a gap vis-á-vis the private sector, puts upward pressure on private wages as this would influence the search direction of workers[7].

[6] This approach exploits the hierarchical approach to select the prior tightness.

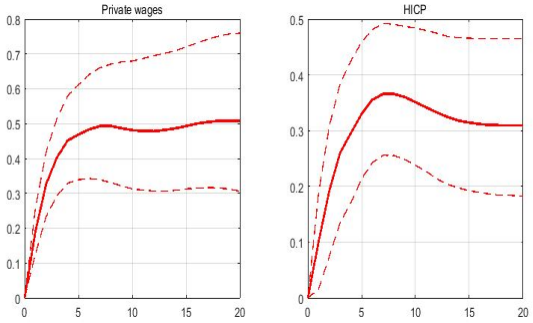
[7] This result is robust to a number of alternative specifications which control for the impact of the minimum wage, and the role of cyclical factors (e.g. unemployment gap). Results are available from the authors upon request.

Figure 7: Deviation from baseline level in response to 1% shock to public wages (%, quarterly)

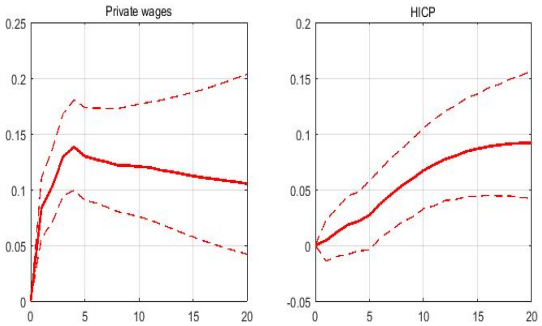
Germany



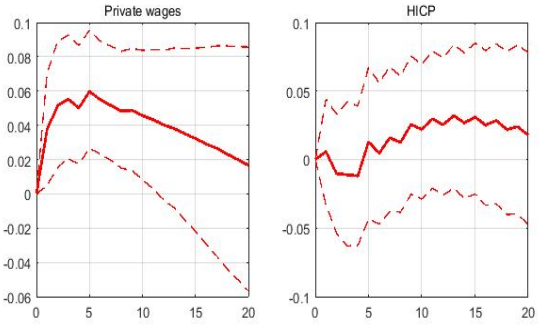
France



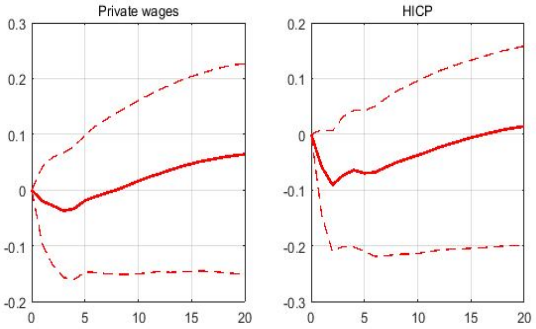
Italy



Spain



Netherlands



The figure reports the median and the 16th and 84th percentiles of the distribution of the impulse response functions

4.3 Is the response of private wages to a public wage shock symmetric? The Local Projection Method approach

Finally the paper looks at whether the response of private wages to public wages shocks is symmetric, or rather it differs depending on the sign of the shock. To answer this question we use a local projection method (LPM) á la Jordá (2005). As discussed in Lamo et al. (2016), one of the appealing features of the LPM, among others, is that this framework can be easily adapted to non-linear specifications. This approach derives the IRFs at horizon k by directly regressing the change in private wages in the period ranging from t to t+k over a measure of the shock in public wages at time t. In so doing, state-dependent IRFs can be evaluated because, for example, the regression can allow for possibly different coefficients according to the sign of the shock to public wages. Following Jordá (2005), our empirical approach consists in estimating the following dynamic equation at each time horizon k (k=0...5):

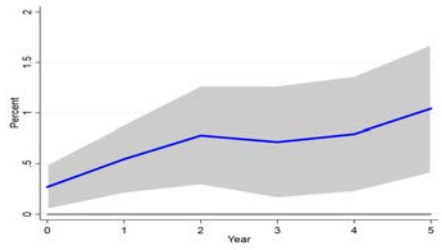
$$Wpr_{i,t+k} - Wpr_{i,t-1} = \alpha_k + \sum_{j=1}^{j=2} \beta_{k,j} * \Delta(Wpr_{i,t-j}) + \sum_{j=0}^{j=2} \theta_{k,j} * Shock(Wpu)_{i,t-j} + \sum_{j=0}^{j=2} \delta_{k,j} * X_{i,t-j} + \gamma_{i,k} + \gamma_{t,k} + \epsilon_{i,t,k} \quad (4)$$

where $Wpr_(i, t+k) - Wpr_(i, t-1)$ is the change in private wages, $\theta_{k,t}$ represents the response to a shock to public wages ($ShockWpu_{i,t}$), $X_{i,t}$ is a vector of control variables which, in addition to labour productivity and HICP, includes some additional control variables such as the unemployment gap, as an indicator of the cyclical position of the economy, and a measure of public sector size (the ratio of public employment to total employment). We estimate four different models according to different shock definitions. In model 1, the variable $ShockWpu_{i,t}$ corresponds to a 1% change in public wages. In model 2 $ShockWpu_{i,t}$ corresponds to a change in public wages by more than one standard deviation. In this case, the variable $ShockWpu_{i,t}$ is equal to the actual change in the variable if this is greater than than one panel standard deviation in absolute value in the same year, it takes value 0 if the change is below one standard deviation and therefore no shock is identified. Models 3 and 4 consider one-sided shocks, that is only a positive shock and a negative shock, respectively, which are defined according to one standard deviation threshold rule of model 2. The model is estimated dynamically including up to two lags of all variables. Public and private wages are in nominal terms, labor productivity is defined as real GDP divided by total economy employment. Country and time fixed effects are included to account for unobservable country-level and time fixed effects. The results of the

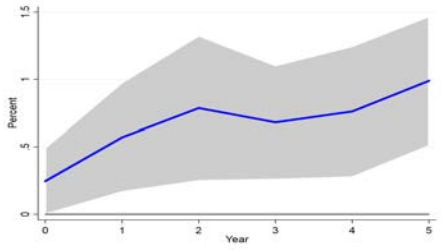
analysis are reported in figure 8, while table A3-A6 reports the detailed estimates for the other explanatory variables. As in the case of the Panel BVAR, these results are to be interpreted as the average effects of the panel composed by the five largest euro area countries.

Figure 8: Percent deviation of private wages from the baseline growth in response to a shock to public wages specified as:

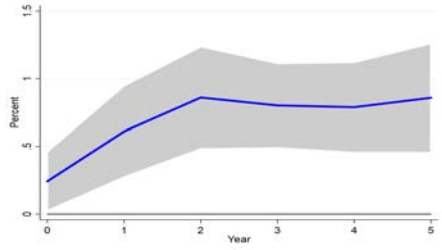
1% shock to public wages.



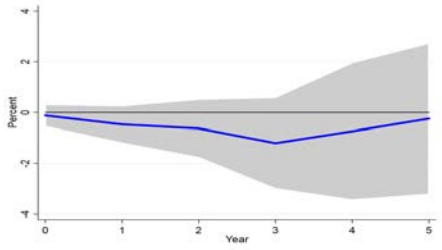
1 std. to public wages.



+1% shock to public wages.



-1 std. to public wages.



The figure reports the 95% confidence interval of the coefficients of the impulse response functions

The first panel in figure 8 illustrates the response of private wages to a 1% shock to public wages. Results are qualitatively in line with the Panel BVAR analysis: a shock to public wages growth triggers a statistically significant and positive response in private wages of around 0.2p.p in the first year. The peak effect is reached after two years, when the cumulative response is a change in private wages of around 0.78p.p.. This finding is qualitatively unchanged when specifying the public wage shock in terms of its standard deviation (i.e. $ShockWpu_{it} \geq 1$ standard deviation in absolute value) (second panel). Finally, the third and fourth panel illustrate the IRFs for a positive public wages shock (i.e. $ShockWpu_{it} > +1$ standard deviation) and a negative one (i.e. $ShockWpu_{it} < -1$ standard deviation) respectively. The results point to different responses of private wages, depending on the sign of the shock. A positive and statistically significant response is found in case of a positive shock to public wages (i.e. a public wage increase), while no

statistically significant response is detected in case of a negative shock (i.e. a public wage cut). The results are robust also when extending the panel to the other euro area countries (see Section 5) which allows increasing the number of episodes of actual wage cuts. These findings are in line with empirical studies on asymmetries in the dynamics of wage adjustments, which predict that upward adjustments are relatively faster that downward ones. In particular, in a paying efficiency wages scenario, companies will be incentivazed to react more promptly to a positive change in competitors wages than to negative ones (Rõõm and Dabušinskas, 2011). Further, asymmetric responses can be rationalized also in an insider-outsider framework. Lindbeck et al. (1989) argue that, since firing decisions follow a seniority system and insiders can control labor turnover costs, they can prevent a decrease in their wages in response to a labor demand shock, and raise them significantly once the shock has been absorbed.

5 Robustness checks

In this section we present a number of robustness checks. Our robustness check can be grouped along three main directions: ordering of the variables in the BVAR, inclusion of different information set in our baseline model and expansion of the analysis to a larger panel of countries. First, we check the robustness of the VAR based estimates to our preferred ordering of variables, by ordering public sector wages first (Table 2 and 3). This amounts to assuming that public sector wages are fully exogenous (i.e. are not simultaneously affected by shocks to other variables), something which, in our view, does not seem to necessarily hold given previous findings from the literature. Overall, the results are qualitatively unchanged, though in the Panel VAR the first year impact is now significantly larger than in the baseline specification.

As far as it regards the second set of robustness checks, we start by checking the robustness of our results to the inclusion of additional control variables which may potentially impact the linkage between public and private wages. Some of the literature has pointed to the importance of trade openness in influencing the relationship between public and private sector compensation (e.g. European Commission, 2014). However, when including trade openness (measured as the ratio between the sum of imports and exports to real GDP) in the wage determination equation, results are qualitatively unchanged, and do not alter significantly the public-private wage relationship (Table 2, 3 and 4). Moreover, as suggested by some literature (Lamo, 2014) we test for

the relevance of institutional factors, by adding to the Panel BVAR and the LPM also a measure of union density. The latter captures the percentage of workers who are union members. For the panel BVAR the results are qualitatively unchanged though the size of the effect is slightly larger (Table 2). Similarly the evolution of union density in the model in growth rates seems not to meaningfully affect the relationship between private and public wages; indeed for the Local Projection Method (Table 5) we find that the degree of union density has no statistically significant effect on the growth of private sector wages. Finally, we look at the estimates when specifying the baseline model in terms of public and private wages and salaries (i.e. the sum of negotiated wages and the wage drift) rather than compensation of employees. The results are robust across all three methodologies. In particular, the Panel BVAR estimates show that a 1% shock to public wages has a positive and significant impact on private sector wages, though the peak effect is reached already after two years and remains below 0.2% (table 2). Results are qualitatively similar also for the other two model specifications (table 3 and 4).

To conclude, we further check for the Panel BVAR and LPM the robustness of our results to a larger panel of countries, beyond the five largest countries. Due to lack of data availability for some countries, the country sample is extended to all euro area countries except Latvia, Lithuania, Malta and Greece. Overall the baseline results hold (Table 2 and 4). For the LPM, despite the magnitude of the coefficients being significantly smaller, we found the same asymmetric response to a shock to public wages.

Table 3: Robustness checks for the Panel BVAR (impact of a 1% shock in public wages)

years	Baseline	Different Ordering	Wages ex.SSC	Trade openness	Larger countries sample	Union Density
1	**0.08**	**0.33**	**0.06**	**0.08**	**0.07**	**0.11**
2	**0.13**	**0.14**	**0.14**	**0.14**	**0.10**	**0.20**
5	**0.17**	**0.17**	**0.13**	**0.17**	**0.12**	**0.28**

Table 4: Robustness checks for the country-specific BVAR (impacto of 1% schock to public wages)

	Baseline			Different Ordering			Wages ex.SSC			Trade openness		
Country	Year 1	Year 2	Year 5	Year 1	Year 2	Year 5	Year 1	Year 2	Year 5	Year 1	Year 2	Year 5
DE	0.04	0.08	0.04	0.07	0.11	0.09	0.03	0.04	0.02	0.04	0.08	0.11
FR	**0.45**	**0.49**	**0.51**	**0.40**	**0.44**	**0.49**	**0.36**	**0.40**	**0.42**	**0.36**	**0.35**	**0.36**
IT	**0.14**	**0.12**	**0.11**	**0.13**	**0.12**	**0.10**	**0.11**	**0.14**	**0.12**	**0.10**	**0.08**	**0.06**
ES	**0.05**	**0.05**	**0.02**	**0.04**	**0.03**	**0.00**	**0.06**	**0.06**	**0.02**	**0.05**	**0.05**	**0.00**
NL	-0.03	0.00	0.06	0.06	0.06	0.06	0.04	0.01	0.16	-0.03	0.02	0.12

Table 5: Robustness checks for the Local Projection Method

	Baseline			Wages ex.SSC			Trade openness			Larger countries sample		
Type of shock	Year 1	Year 2	Year 5	Year 1	Year 2	Year 5	Year 1	Year 2	Year 5	Year 1	Year 2	Year 5
Linear	**0.55**	**0.78**	**1.04**	**0.46**	**0.76**	**0.88**	**0.50**	**0.81**	**1.02**	**0.23**	**0.28**	0.12
SD	**0.57**	**0.79**	**0.99**	**0.40**	**0.61**	**0.73**	**0.52**	**0.75**	**0.90**	**0.20**	**0.27**	**0.22**
SD Positive	**0.61**	**0.86**	**0.86**	**0.39**	**0.63**	**0.66**	**0.54**	**0.78**	**0.84**	**0.22**	**0.30**	**0.38**
SD Negative	-0.47	-0.63	-0.24	-0.15	-0.38	1.7	-0.35	-0.43	-0.51	0.05	0.05	0.02

Ordering : public wages ordered first in the VAR
Wages: specification with public wages and salaries instead of compensation of employees
Trade openness: adding a control for trade openness to the baseline specification
Countries sample: Euro Area excluding Greece, Latvia, Lithuania, Malta due to data availability
Union density: adding a control for union density to the baseline specification
Significant results are reported in bold

Table 6: Local Projection Method: controlling for Union Density

	(1) ΔY_t	(2) ΔY_{t+1}	(3) ΔY_{t+2}	(4) ΔY_{t+3}	(5) ΔY_{t+4}	(6) ΔY_{t+5}
Change	0.233*	0.548**	0.769**	0.693*	0.681	0.978**
	[0.0902]	[0.190]	[0.242]	[0.297]	[0.384]	[0.261]
Union density	-0.243	0.495	0.955	0.339	-0.344	-0.169
	[0.391]	[0.560]	[1.028]	[1.483]	[1.947]	[2.507]
Symmetric shock	0.217	0.547*	0.747**	0.625**	0.687*	0.981**
	[0.121]	[0.199]	[0.265]	[0.211]	[0.292]	[0.258]
Union density	-0.461	0.0947	0.590	-0.0360	-0.678	-0.698
	[0.388]	[0.545]	[0.963]	[1.085]	[1.460]	[1.899]
Positive shock	0.220*	0.616**	0.880**	0.777**	0.771**	0.868**
	[0.0942]	[0.173]	[0.254]	[0.207]	[0.200]	[0.212]
Union density	-0.677	-0.155	0.0412	-0.530	-0.833	-0.838
	[0.348]	[0.516]	[0.838]	[1.045]	[1.450]	[1.783]
Negative shock	-0.242	-0.513	-0.679	-1.272	-0.521	-0.135
	[0.226]	[0.361]	[0.925]	[1.131]	[1.343]	[1.536]
Union density	-0.500	0.0720	0.158	-0.326	-0.0117	-0.0971
	[0.470]	[0.774]	[1.528]	[1.321]	[1.630]	[2.180]
N	90	85	80	75	70	65

Standard errors in brackets
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

6 Conclusions

This paper revisits the relationship between public and private sector compensation of employees focusing on the five largest euro area countries over the period 1997-2017. Although public sector compensation is a small share of total economy compensation, the literature points to some indirect influence on private sector compensation, via spillover and signalling effects.

Given the empirical nature of the research question, this paper relies on three different estimation methods: first, a panel BVAR technique is used which allows estimating the equilibrium relationship between the two sectors' wages and the average response of private wages to a public wages shock. Second, a country-specific BVAR analysis is conducted to assess country-heterogeneity in such response as suggested by some empirical literature. Third, the analysis addresses possible asymmetries in the response of private wages to public wages shocks (i.e. different responses to public wages cuts or increases) using the Local Projection Method (Jordà, 2005).

Based on the Panel BVAR estimates, our results suggest that on average, in response to a 1% shock to public wages, private sector wages respond with with a lag, and the peak impact of 0.2% is reached after 5 years. This response, however, appears to be country-specific, in that the country BVAR estimates show that the response of private wages to a public wage shock is positive and statistically significant for Italy, Spain and France, but not for Germany and the Netherlands. These results are in line with previous studies (e.g. Lamo et al., 2008 and Perez and Sanchez, 2010) which find a statistically significant response of private wages to public wages shocks, although evidence is heterogeneous across countries and time. For some countries (namely Italy, France and Spain), these studies uncover a leading role of public wages and show that, when the government sector is larger public wages are more likely to Granger-cause private wages. Finally, our estimates based on the Local Projection Method, suggest that private wages respond asymmetrically to a public wages shock. In particular, the response is positive and statistically significant in case of a positive shock to public wages, while it is statistically insignificant in case of public wage cuts. This suggests that in periods of either public wage freezes or cuts, only the direct effect is likely to be at work, while in periods of positive public sector wage growth the impact on private sector wages is not negligible (around 0.8% after two years) and persistent.

The findings of this paper are robust to a number of robustness checks and suggest that strong and persistent public sector wage growth could pose some upside risks to private sector wages, es-

pecially in the medium to long term. The indirect contribution of public wages to total economy wages captured in this analysis, is generally not accounted for in macro-models where private sector wages are modelled on the basis of a standard wage Phillips curve. The absence of this channel may be not problematic in the short term, given the relatively low one-year ahead estimated elasticity. However, strong and persistent public sector wage growth might pose some upward risks to private sector wages over the medium to long term and, as suggested by the Local Projection Method estimates, the risks are more pronounced in case of a positive shock to public wages.

References

Afonso A. and Gomes P. (2014). Interactions between private and public sector wages. *Journal of Macroeconomics*, 39 Part A:97–112, a.

Agell J. and Lommerud K. (1992). Union egalitarianism as income insurance. *Economica*, 59,(235):295–310.

Bouis R. et al (2012). The short-term effects of structural reforms: an empirical analysis. OECD Economics Department Working Papers, No. 949, OECD Publishing.

Canova F. and Ciccarelli M. (2013). Panel vector autoregressive models: a survey. CEPR Discussion Paper No. DP9380.

Dickens William T. (2006). How wages change: micro evidence from the international wage flexibility project. *Journal of Economic Perspectives*, 21 (2):195–214.

European Commission (2014). Government wages and labour market outcomes. Occasional Paper n.190.

Finn M.G. (1998). Cyclical effects of government's employment and goods purchases. *International Economic Review*, 39 (3):635–657.

Kohn K. Fitzenberger B. and C. Lembcke A. (2007). Union density, collective bargaining, and individual coverage: The anatomy of union wage effects. Unpublished manuscript, Goethe University Frankfurt.

Giannone D. Lenza M. Primiceri G.E. (2015). Prior selection for vector autoregressions. *The Review of Economics and Statistics*, MIT Press, Vol. 97 (2):436–451.

Holden S. and Wulfsberg F. (2007). Downward nominal wage rigidity in the oecd. Working Paper Series 777, European Central Bank.

Jacquinot P. Lozej M. and Pisani M. (2018). Labour tax reforms, cross-country coordination and monetary policy stance in the euro area: a structural model-based approach. Forthcoming in the International Journal of Central Banking.

Jordá O. (2005). Estimation and inference of impulse responses by local projections. *American Economic Review*, 95 (1):161–182.

Lamo A. Schuknecht L. and Pérez J.J. (2008). Public and private sector wages: co-movement and causality. Working Paper Series 963, European Central Bank.

Lamo A. Pérez J.J. and Moral-Benito E. (2016). Does slack influence public and private labor market interactions? Working Paper Series 1890, European Central Bank.

Linnemann L. (2009). Macroeconomic effects of shocks to public employment. *Journal of Macroeconomics*, 31:252–267.

Lindquist J. and Vilhelmsson R. (2006). Is the swedish central government a wage leader? *Applied Economics*, 38:1617–1625.

Mortensen D. and (1999) Pissarides C. New developments in models of search in the labor market. *Handbook of Labor Economics*, 3:Part B.

Pérez J.J. and Sánchez J. (2010). Is there a signalling role for public wages? evidence for the euro area based on macro data. Working Paper Series 1148, European Central Bank.

Pérez J.J. Rodríguez-Vives M. Depalo D. Paparetrou E. Aouriri M. Campos M.M. Celvov D. Pesliakate J. and Ramos R. (2016). The fiscal and macroeconomic effects of government wages and employment reform. Occasional Paper Series 176, European Central Bank.

Pissarides C. (1988). The search and equilibrium approach to fluctuations in employment. *American Review Papers and Proceedings*, 78:363–638.

Quadrini V. and Trigari A. (2007). Public employment and business cycle. *Scandinavian Journal of Economics*, 109:723–742.

Zelistra A. and Elbourne A. (2014). Follow the leader? public and private wages in the netherlands. CPB Discussion Paper N.274, b.

Toda H.Y. and Yamamoto T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics*, 66:225–250.

7 Appendix

Table A.1: Descriptive Statistics (1997-2017)

		Germany				Italy			
	N	mean	se	max	min	mean	se	max	min
Compensation per employee public	21	42593	5405	52689	34902	43540	6009	49351	33222
Compensation per employee private	21	33452	3264	40244	29373	29336	3061	33065	24372
Wages public	21	31653	3994	39361	25945	30579	4263	34662	23047
Wages private	21	28780	3050	34919	24869	23357	2551	26605	18651
Labour productivity	21	62260	2493	65901	58044	65277	1508	67570	63291
Growth rate compensation per employee public	20	2.06	1.11	4.68	0.0649	1.82	2.17	4.53	-3.1
Growth rate compensation per employee private	20	1.57	0.972	2.82	-0.418	1.51	1.2	3.06	-1.29
Growth rate wages public	20	2.08	1.21	4.86	-0.0936	1.99	2.07	5.04	-0.841
Growth rate wages private	20	1.7	0.897	2.9	-0.17	1.78	1.25	3.18	-1.13
Growth rate labour productivity	20	0.636	1.85	3.56	-5.81	-0.171	1.42	2.28	-3.99
Unemployment gap	21	-0.548	1.19	1.1	-3	-0.0883	1.58	2.68	-2.7
Inflation rate	21	1.41	0.743	2.76	0.134	1.88	0.999	3.49	-0.05
Trade openess	21	72.3	12.6	86.6	49.4	51.6	4.72	59.5	44.6
Union density	20	21	3.14	27	17	34.6	1.22	36.8	33.1
Wage gap	21	1.27	0.41	1.33	1.19	1.48	0.06	1.56	1.36
Public sector size	21	0.17	0.01	0.14	0.12	0.20	0.01	0.22	0.17

		Spain				France			
	N	mean	se	max	min	mean	se	max	min
Compensation per employee public	21	34863	6719	42463	23697	39546	5786	47853	30001
Compensation per employee private	21	28797	4707	34187	21618	39194	5836	47627	30454
Wages public	21	27060	5327	33250	18329	26940	3391	31833	21045
Wages private	21	23605	3942	28209	17783	30291	4560	36844	23207
Labour productivity	21	54100	2548	58500	51829	72761	3336	77441	66277
Growth rate compensation per employee public	20	2.78	3.14	7.1	-4.93	2.33	0.823	3.57	0.926
Growth rate compensation per employee private	20	2.28	1.67	6.37	-0.569	2.24	0.918	3.78	0.871
Growth rate wages public	20	2.84	3.39	7.71	-5.7	2.07	0.837	3.55	0.446
Growth rate wages private	20	2.25	1.94	7.41	-0.809	2.31	0.958	4.04	0.957
Growth rate labour productivity	20	0.597	0.824	2.84	-0.578	0.822	0.886	2.45	-1.69
Unemployment gap	21	-0.565	5.19	6.58	-9.99	0.14	0.685	1.5	-0.768
Inflation rate	21	2.17	1.42	4.13	-0.629	1.46	0.833	3.16	0.0867
Trade openess	21	56.9	4.74	65.5	46.5	55.5	4.55	62.9	47.8
Union density	19	16.2	1.18	18.6	13.9	8.03	0.143	8.36	7.79
Wage gap	21	1.21	0.63	1.32	1.1	1.01	0.01	1.03	0.99
Public sector size	21	0.19	0.01	0.21	0.17	0.25	0.01	0.26	0.24

		Netherlands			
	N	mean	se	max	min
Compensation per employee public	21	44454	7692	55876	31782
Compensation per employee private	21	37809	5266	44787	27994
Wages public	21	33500	5330	41614	25302
Wages private	21	35112	4594	40950	26857
Labour productivity	21	70579	3532	76200	63303
Growth rate compensation per employee public	20	2.82	1.12	4.75	0.859
Growth rate compensation per employee private	20	2.35	1.47	5.57	-0.712
Growth rate wages public	20	2.47	1.61	4.91	-0.308
Growth rate wages private	20	2	1.93	5.6	-2.16
Growth rate labour productivity	20	0.924	1.32	2.93	-2.99
Unemployment gap	21	0.128	1.14	2.3	-1.75
Inflation rate	21	1.87	1.17	5.12	0.104
Trade openess	21	132	15.8	159	11
Union density	20	20.4	2.1	24.4	17.3
Wage gap	21	1.17	0.04	1.25	1.11
Public sector size	21	0.16	0.01	0.17	0.15

Table A.2: Data sources

Variable	Source
Compensation of employees public	Eurostat/ESCB
Compensation of employees private	Eurostat/ESCB
Wages and salaries	Eurostat/ESCB
HICP	Eurostat
Productivity	Eurostat
Employment	Eurostat
Unemployment gap	ESCB
Trade openness	Eurostat
Union density	OECD

Table A.3: Estimated coefficients of the response of private wages to a 1% shock to public wages

	(1) ΔY_t	(2) ΔY_{t+1}	(3) ΔY_{t+2}	(4) ΔY_{t+3}	(5) ΔY_{t+4}	(6) ΔY_{t+5}
Change	0.270*	0.546**	0.780**	0.715*	0.793*	1.043**
	[0.113]	[0.173]	[0.250]	[0.283]	[0.292]	[0.324]
L.Change	0.0738	0.293*	0.122	0.192	0.549	0.479
	[0.0656]	[0.122]	[0.278]	[0.359]	[0.396]	[0.412]
Productivity	0.486**	0.432	0.399*	0.556***	0.859**	0.938*
	[0.137]	[0.217]	[0.157]	[0.0779]	[0.257]	[0.380]
Unemployment gap	-0.226	-0.308	-0.844	-1.049***	-1.973***	-2.395**
	[0.337]	[0.487]	[0.578]	[0.158]	[0.389]	[0.520]
L.Public sector size	0.770	2.356	3.318**	2.901	3.444	1.664
	[0.774]	[1.120]	[1.122]	[1.612]	[1.719]	[3.493]
L2.Public sector size	-1.052	-3.047*	-4.187**	-3.931	-4.989*	-2.603
	[0.912]	[1.313]	[1.328]	[1.874]	[1.855]	[4.033]
Constant	5.748	15.41	20.93	24.39	34.52	21.84
	[4.464]	[8.064]	[14.70]	[17.29]	[19.09]	[32.73]
N	90	85	80	75	70	65

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A.4: Estimated coefficients of the response of private wages to a 1 standard deviation shock to public wages

	(1) ΔY_t	(2) ΔY_{t+1}	(3) ΔY_{t+2}	(4) ΔY_{t+3}	(5) ΔY_{t+4}	(6) ΔY_{t+5}
Symmetric shock	0.246	0.570*	0.786**	0.680**	0.761**	0.988**
	[0.126]	[0.206]	[0.274]	[0.215]	[0.247]	[0.244]
L.Symmetric shock	0.127	0.346***	0.291	0.473	0.666	0.582
	[0.0628]	[0.0539]	[0.245]	[0.375]	[0.453]	[0.453]
Productivity	0.449**	0.339	0.303	0.454**	0.767**	0.830*
	[0.162]	[0.284]	[0.235]	[0.158]	[0.172]	[0.307]
Unemployment gap	-0.243	-0.369	-0.955	-1.121**	-2.087***	-2.523***
	[0.327]	[0.526]	[0.644]	[0.274]	[0.146]	[0.378]
L.Public sector size	0.773	2.582*	3.960**	3.876**	4.373*	2.588
	[0.658]	[1.082]	[1.070]	[1.286]	[1.861]	[4.047]
L2.Public sector size	-1.045	-3.197**	-4.539**	-4.420**	-5.082*	-2.468
	[0.717]	[1.076]	[1.069]	[1.559]	[2.274]	[4.735]
Constant	5.885	14.59*	15.84	15.20	18.58	1.887
	[3.189]	[6.384]	[12.35]	[17.86]	[20.62]	[39.24]
N	90	85	80	75	70	65

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A.5: Estimated coefficients of the response of private wages to +1 standard deviation shock to public wages

	(1) ΔY_t	(2) ΔY_{t+1}	(3) ΔY_{t+2}	(4) ΔY_{t+3}	(5) ΔY_{t+4}	(6) ΔY_{t+5}
Positive shock	0.243*	0.610**	0.860**	0.801***	0.788***	0.857**
	[0.111]	[0.171]	[0.192]	[0.159]	[0.169]	[0.205]
L.Positive shock	0.175	0.364*	0.376	0.525	0.533	0.484
	[0.112]	[0.132]	[0.262]	[0.339]	[0.420]	[0.445]
Productivity	0.459**	0.359	0.330	0.460**	0.814**	0.934*
	[0.120]	[0.226]	[0.157]	[0.132]	[0.181]	[0.338]
Unemployment gap	-0.276	-0.503	-1.078*	-1.306***	-2.277***	-2.765***
	[0.250]	[0.395]	[0.487]	[0.231]	[0.214]	[0.422]
L.Public sector size	0.472	2.059	3.063*	3.519**	3.432	1.683
	[0.613]	[1.094]	[1.400]	[1.193]	[2.051]	[4.263]
L2.Public sector size	-0.726	-2.564*	-3.563*	-4.097**	-3.999	-1.223
	[0.697]	[1.090]	[1.401]	[1.410]	[2.378]	[4.967]
Constant	5.277	12.04	13.38	15.22	14.97	-6.189
	[3.479]	[7.739]	[12.29]	[15.36]	[21.36]	[40.09]
N	90	85	80	75	70	65

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A.6: Estimated coefficients of the response of private wages to −1 standard deviation shock to public wages

	(1) ΔY_t	(2) ΔY_{t+1}	(3) ΔY_{t+2}	(4) ΔY_{t+3}	(5) ΔY_{t+4}	(6) ΔY_{t+5}
Negative shock	-0.119	-0.468	-0.626	-1.203	-0.737	-0.243
	[0.222]	[0.374]	[0.585]	[0.917]	[1.380]	[1.518]
Productivity	0.541**	0.537*	0.585*	0.729**	1.026**	1.114**
	[0.154]	[0.244]	[0.227]	[0.173]	[0.319]	[0.387]
Unemployment gap	-0.373	-0.642	-1.345	-1.794***	-2.532***	-2.835**
	[0.358]	[0.649]	[0.728]	[0.344]	[0.528]	[0.760]
L.Public sector size	-0.202	-0.118	0.680	1.099	0.279	-1.418
	[0.985]	[1.774]	[2.555]	[3.047]	[2.907]	[4.003]
L2.Public sector size	0.135	-0.0922	-0.807	-1.355	-0.333	2.270
	[0.987]	[1.644]	[2.206]	[2.783]	[3.115]	[3.868]
Constant	1.798	5.958	6.282	9.563	5.489	-13.20
	[2.619]	[4.640]	[12.31]	[24.24]	[29.59]	[48.38]
N	90	85	80	75	70	65

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Acknowledgements

The authors gratefully acknowledge useful comments and suggestions from Beatrice Pierluigi, Michele Lenza and Niccoló Battistini.

Maria Grazia Attinasi
European Central Bank, Frankfurt am Main, Germany; email: maria_grazia.attinasi@ecb.europa.eu

Francesco Berardini
European Central Bank, Frankfurt am Main, Germany; email: francesco.berardini@ecb.europa.eu

Alessandra Anna Palazzo
European Central Bank, Frankfurt am Main, Germany; email: alessandra_anna.palazzo@ecb.europa.eu

Postal address 60640 Frankfurt am Main, Germany
Telephone +49 69 1344 0
Website www.ecb.europa.eu

PDF ISBN 978-92-899-3493-0 ISSN 1725-2806 doi:10.2866/052205 QB-AR-19-012-EN-N