Does slack influence public and private labor market interactions?*

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Abstract

We analyze the impact of public employment and wages' policies on private labor market outcomes, in particular taking due account of the state of the economy. The literature has stressed, on the one hand, the "crowding-out" of private employment by public employment and, on the other, the signalling effect of public wages over private sector wages. These channels may operate differently in recessions than in expansions, and in high-unemployment instances than in normal times. We account for this possibility by means of, first, non-linear STVAR models and, second, local projection methods. We focus on Spanish and euro area aggregate data. Our results show that indeed allowing different reactions in different states of the economy is crucial for understanding the labor market impact of public employment and wages' policy actions. In particular, we find that the degree of unemployment slack is key to determine if public employment crowds-out or crowds-in private employment.

JEL Classification: E62; E65; H6; C3; C82.

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1 Introduction

This paper provides evidence on the impact of public employment and public wages policies on private labor market outcomes during the recession.

A fast expanding literature has begun to explore whether estimates of government spending multipliers vary depending on whether the economy is in recession or in expansion; It has provided abundant pieces of evidence showing that indeed this is the case. In contrast, there is little evidence on whether public and private labor markets interactions also vary depending on the state of the economy. This paper contributes to filling this gap.

The literature on state dependent government spending multipliers has developed in parallel to vivid policy debates around the effects of fiscal adjustments during the recession. Labor market channels however have not been sufficiently incorporated in these policy debates, in which, to our mind, budgetary considerations (i.e. the need to reduce sizeable public deficits and stabilize mounting levels of public debt) have been the main drivers of decisions leading to public employment and wages' restraint/cuts in a number of, particularly European Union (EU) countries.

The theoretical and empirical literature has traditionally looked at public-private labour interactions. It has stressed, on the one hand, the potential crowding-out of private employment by public employment and, on the other hand, the influence (signalling/causality effects) of public wages over private sector wages.

Regarding wages, while public sector wages' leadership may imply a decoupling of private sector wages from productivity with implications for competitiveness, private sector leadership may imply limited control of the government on the wages it pays, which are determined in the long-term by drivers originating in the private sector. Now, in a situation of economic recession (in bad times) the interplay between public and private wages might be different from that in normal times, also if wage setting practices in the government sector change.[1] For example, under conditions of economic distress public sector wage restraint could lead to overall economy wage moderation, and as a consequence result, in some instances, in a

[1]For example, Glassner (2010) shows that established collective bargaining procedures were not respected by many EU governments in the most recent crisis, and rather unilateral state decisions were the rule.

more employment-friendly labor market adjustment than otherwise. The operation of this channel depends crucially on labor market institutions and the relative rigidity/flexibility of wages in the economy (see e.g. Lamo, Pérez and Schuknecht, 2012; Lamo, Pérez and Sánchez-Fuentes, 2013).

With respect to employment, one could think that if the standard results in the literature on the crowding-out of public employment on private employment (see e.g. Algan et al., 2002) were symmetric, public employment cuts due to recent fiscal consolidation measures could have had medium-run positive effects on private employment. Such an outcome of crowing-in could be expected, given: (i) the exerted downward pressure on real wages, (ii) the margin to avoid increases in discretionary taxation; (iii) the margin for increased private activity in sectors in which government activity retracts. Nevertheless, also the interplay between public and private employment may be different depending on the degree of economic slack. For example, in a recent paper Michaillat (2014) develops a New-Keynesian model in which crowding-out appears basically in "good times". Indeed, in his model increasing public employment stimulates labor demand, which in turn increases tightness and therefore crowds-out private employment, while when labor demand is depressed and unemployment is high, the increase in tightness and resulting crowding-out are small.

In order to ascertain the quantitative relevance of the channels outlined above, we carry out an empirical investigation on the basis of quarterly data for Spain and the euro area aggregate.

Most of the empirical work on this issue estimates standard SVAR models in which public and private sector labor market variables are allowed to interact. (see e.g. Pappa, 2005; Linnemann 2009; Lamo, Pérez and Schuknecht, 2012; Ramey, 2012).

In this paper, to allow for non-trivial non-linearities, we estimate STVAR models, nowadays standard in the extant literature[2] With such an approach we aim at capturing the regime-specific labour market linkages among the public and the private sectors. STVAR are quite appropriate for the problem at hand, but are not free from critiques either, in

[2]In particular the influential application of the Smooth Transition Structural Vector Autoregression models (STVAR) of Auerbach and Gorodnichenko (2012a, 2012b). For the case of Spain see Hernández de Cos and Moral-Benito (2013).

particular when applied to small- to medium-size samples of data. Thus, we move a step forward from regime-switching models, and estimate also state-dependent models using Jordà's (2005) local projection method. This latter method offers a simple solution to some problems that arise in computing impulse responses in regime-switching models, as discussed for example by Ramey and Zubairy (2013).

Focusing on Spain and the euro area is possible due to the availability of quarterly fiscal and macro figures for the periods that start in 1986Q1 and 1980Q1, respectively. We take historical fiscal data from de Castro et al. (2014) in the case of Spain, and from Paredes et al. (2009; 2014) for the case of the euro area. Incorporating more EU countries would generally restrict the sample to the period starting in 1995 and we believe that the analysis of these two cases provide enough insights for the questions under study. On the one hand, the case of Spain is one of a high-unemployment country that has been subject over the past few years to a significant level of "fiscal stress". On the other hand, the euro area as a whole provides for a medium- to low-unemployment framework, and a moderate level of fiscal stress over the most recent economic crisis.

In sum, understanding labor market channels through which fiscal policy operates is of utmost importance to understand the most recent recession, in which some countries have registered unemployment records in parallel to unprecedented episodes of wage restraint and/or employment destruction in the public sector. This paper contributes to filling in a gap in the literature and provides relevant evidence in an attempt to contribute to the policy debate on the effects of restrictive public employment and wages' policies during recessions, but also on the effects of expansionary fiscal policies of that kind during economic expansions.

The rest of the paper is organized as follows. In Section 2 we provide some stylized facts to illustrate the main ideas of our paper, and in Section 3 the related literature. In Section 4 we explain the data used in the study. In Section 5 we present the empirical approaches adopted and the main results of the paper. Finally, we close the study with Section 6 in which we provide some conclusions.

2 Some stylized facts

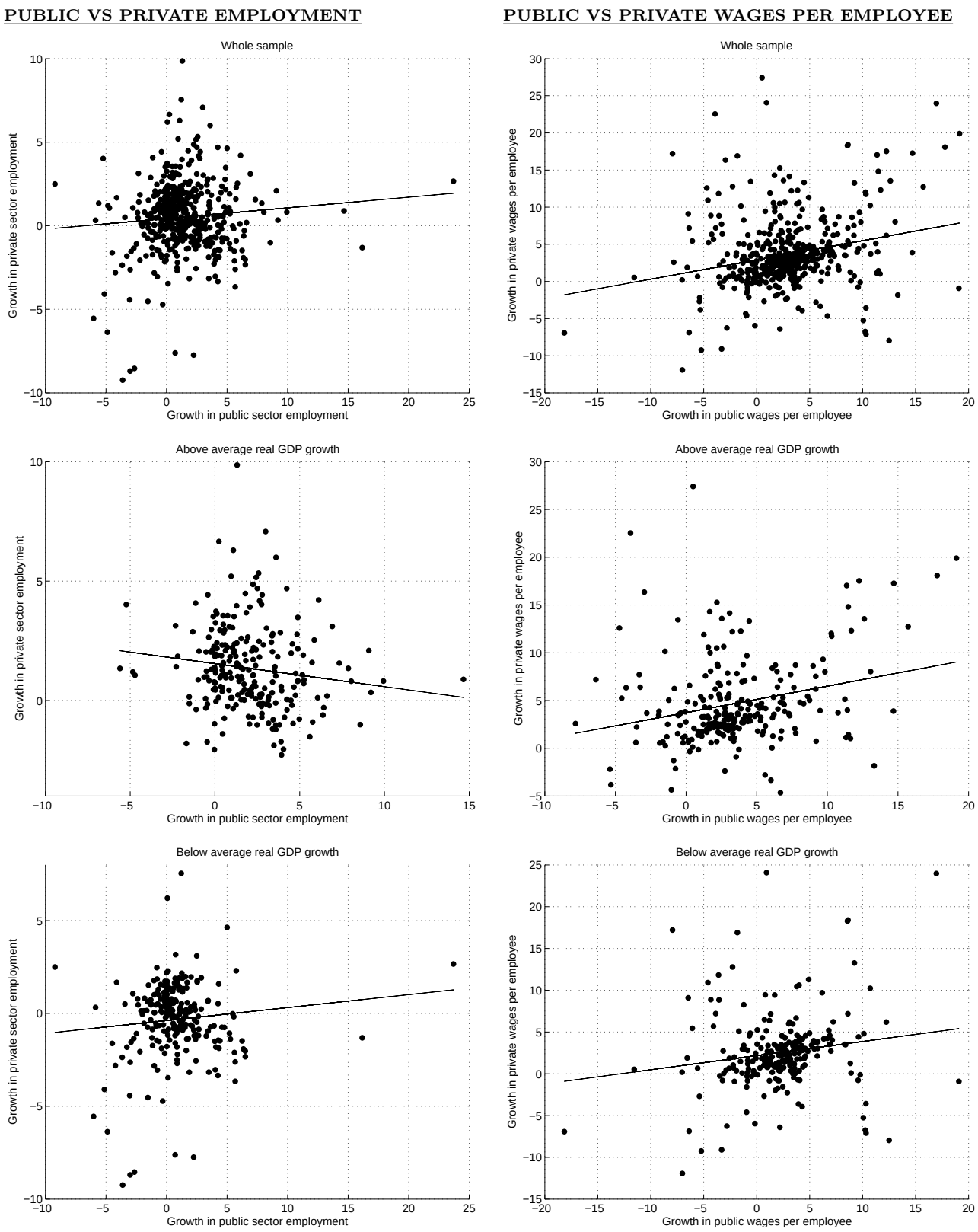
In Figure 1 we show the unconditional correlation line between public and private sector employment and wages for a number of European Union countries over the period 1970-2012.[3] The first row of the chart displays the scatter plots for the whole sample. As regards wages, this is just an illustration of the stylized fact that public and private sector wages in the euro area and for most of the euro area countries are positively and strongly correlated over the business cycle (see e.g. Lamo, Perez and Schucknecht, 2013a, 2013b; and the references quoted therein). This is a very robust result across countries, in spite of very different institutional settings and different inflation regimes witnessed over the decades covered by the chart. Wage leadership arguments can provide a rationalization for this evidence.

In the case of public and private employment, an overall positive correlation is also observed. The literature would resort to political-economy related arguments to rationalize this correlation, namely that in upturns increased private sector activity (associated with increased private employment) would loosen the government budget constraint and as a consequence would allow the recruitment of additional staff (and the reverse in downturns).

In the second and third rows of Figure 1 we move one step forward, and show separately simple unconditional correlations for "good" and "bad" times, i.e. in above-the-average real GDP growth periods and below-the-average growth periods. Interestingly, while the results drawn from the whole sample scatter plot for the correlation between public and private wages are similar to those in the cases of high- and low-growth periods taken separately, this is not the case for public employment. Indeed, in bad times a positive correlation is observed, while in good times this correlation turns out to be negative. More specifically, in expansionary periods increases in public employment tend to be associated with reductions of private employment. This unconditional correlations in good times are in line with the standard crowding-out result found in many studies (see the next section for literature review). In contrast, in bad times public and private employment appear to move in the same direction.

[3]Countries included in the scatter plot are: Belgium, Germany, Ireland, Greece, Spain, France, Italy, the Netherlands, Austria, Portugal and Finland, i.e. the original (i.e. since 1999 or 2001) euro area countries with the exception of Luxembourg (not included due to data shortages).

Figure 1: Private versus public employment and wages in the euro area (1970-2012).



3 Review of the literature

In a neoclassical environment (Finn, 1996; Cavallo, 2005) an increase in government employment has a negative wealth effect on the consumer, but for plausible parameter values it also raises private wages and reduces private employment. The reason is that the higher labor supply caused by the negative wealth effect is lower than the increase in government employment, and hence private employment falls and private sector wages increase, what is consistent with crowding-out effects. Pappa (2009) finds similar crowding-out results in a neo-Keynesian model with price stickiness. Ardagna (2007), in a general equilibrium framework with labor unions, also predicts crowding-out, although through a different channel: an increase in public employment reduces the probability of being unemployed. If unemployment compensations are lower than the after-tax wage in the public sector, union members' reservation utility increases, leading to higher wages in the private sector.[4] [5] More recently, Michaillat (2014), exploits a different channel to find a crowing-out effect. He develops a New-Keynesian model in which increasing public employment stimulates labor demand, which in turn increases tightness and therefore crowds-out private employment. When labor demand is depressed and unemployment is high, the increase in tightness and resulting crowding-out are small.

On different grounds, Perotti (2007) finds evidence of public-sector employment crowding-in on private employment. He estimates a VAR with US data with real GDP, private consumption, hours worked and the real wage in the business sector and manufacturing, real government spending on goods and total government employment. Among other things

[4] Along the same lines are the partial equilibrium models of public/private employment determination of Algan, Cahuc and Zylberberg (2002) and Forni and Giordano (2003), and general equilibrium models like Fernández de Córdoba, Pérez, and Torres (2012). Also related model-based arguments can be found in Calmfors and Horn (1986).

[5] On related grounds, the empirical literature has provided support for the theoretical result of crowding-out of private employment by public employment (Malley and Moutos, 1996; 2001; Behar and Mok, 2013). Alesina et al. (2002) find a sizeable negative effect of public spending and in particular of its wage component (wage bill) on private-sector profits and on business investment. Lamo, Pérez and Sánchez-Fuentes (2013) find that the degree of crowding-out/-in depends on institutional factors (mainly from the labor and product markets).

he finds that, in response to a positive government employment shock, there is a highly persistent response of government employment itself, with a response of hours worked in the business and manufacturing sectors being positive. His overall finding is one of crowding-in, also found for the US by Linnemann (2009). However, Pappa (2009) shows that the evidence regarding the dynamics of total employment following a government employment shock is mixed. In aggregate data the predictions of the Real Business Cycle (RBC) model are supported (total employment increases after a positive shock), while in about half of the US states labor market responses present the wrong sign (total employment decreases).

Regarding public and private sector wages, a strand of recent literature has documented the existence of linkages from a macro and aggregate perspective. The main theoretical reference in this regard is the well-known Scandinavian model of inflation. With this, especially in the case of fixed exchange rates, there is an obvious case for the traded-goods sector being the wage leader (i.e., wage leadership is exerted by the sectors that are more open to competition; see, for example, Lindquist and Vilhelmsson, 2006). However, even though, theoretically and normatively, there is a strong case for private-sector wage leadership, there are important reasons why this might not always or not fully occur in practice, and why wage spillovers from the public sector might lead to wage costs growing faster than productivity in the private (including the tradable) sector. Nevertheless, this model is sometimes at odds with the empirical literature. Empirical results show dependence on the country analyzed and the specific sample, but also depending on the methodology adopted (see e.g. Friberg, 2007; Holmlund and Ohlsson, 1992; Tagtstrom, 2000; Lindquist and Vilhelmsson, 2006; Demekas and Kontolemis, 2000; Afonso and Gomes, 2014; Lamo, Pérez and Schuknecht, 2013, 2012; Pérez and Sanchez-Fuentes, 2011; Zeilstra and Elbourne, 2013). [6]

More recently, Bermperoglou et al. (2013) pose a sticky price DSGE model with matching frictions in the private and public sector, endogenous labor participation and heterogeneous unemployed jobseekers. According to their model, public wage cuts increase labor supply

[6]There is some literature supporting rent-seeking theories in the determination of public wages and the role of election cycles. For example, Borjas (1984) finds that pay hikes during the presidential election year are significantly greater than pay raises in other years, and Matschke (2003) shows empirical evidence of public employees' pressure in Germany ahead of political elections.

in the private sector and can undo the negative effects of the fiscal tightening, while public vacancy cuts reduce it and result in stronger contractions. A fall in public employment in their framework does not increase private employment since many long-term unemployed decide to exit labor force as they face a low probability of finding a job. Within the fiscal multipliers literature, Bermperoglou et al. (2013) find in a SVAR framework that cuts in the wage bill component identified as government vacancy cuts generate the largest output losses and achieve the smallest deficit reductions, regardless of the sample and the country (US, Canada, Japan, the UK), and significant unemployment losses in the US and the UK, while wage cuts have, if anything, insignificant expansionary effects to achieve the largest deficit reductions.

4 The data

We take the euro area aggregate figures for the period 1980Q1-2012Q4 from ECB's Area Wide Model Database (see Fagan, Henry and Mestre, 2005; Gumiel, 2012). This database is disseminated regularly through the official AWM site with the Euro Area Business Cycle Network (www.eabcn.org\data\awm\index.htm). The fiscal block of the latter database is described in Paredes et al. (2009; 2014). The potential for policy applications of the Paredes et al. (2009; 2014) database has been tested in a number of recent papers that have used it (see e.g. Burriel et al., 2010; Batini, 2011; Coenen et al., 2012, 2013; Cimadomo et al., 2012; de Castro and Garrote, 2011; Brand, 2012; Kollmann et al., 2012).[7] In the case of Spain, we use the macro data from Bank of Spain's MTBE database, and fiscal data from de Castro et al. (2014). The latter dataset uses the same methodological approach as in Paredes et al. (2009; 2014) to assemble a consistent and comprehensive set of fiscal time series for the period 1986Q1 to 2012Q4.

We compute compensation per employee using employee compensation and employment data. Compensation of private sector employees is defined as total economy employee compensation minus the compensation of government employees. Compensation per private em-

[7]In addition, since the September 2010 edition of the euro area AWM database (see Fagan et al., 2001, 2005), the Paredes et al. (2009; 2014) database has been adopted as the fiscal block of the AWM database.

ployee is defined as private employee compensation divided by the number of private sector employees (i.e. total employment minus government employment minus self-employment). Compensation per employee, deflated by the private consumption deflator, will be our concept of "wage per employee". This is the standard approach of the literature analyzing aggregate public and private wages, given data shortages and limitations.

5 Empirical approaches and results

In this section, we present empirical evidence on the reaction of private employment (and wages) to shocks on public employment (and wages) using non-linear frameworks that allow for heterogeneous responses across states of the economy. The literature however has traditionally considered linear VARs that do not account for that heterogeneity; we will adopt the standard identification strategy of these linear VARs for our non-linear frameworks, in order to facilitate comparability with previous literature.

5.1 A first glimpse at non-linearities: STVAR approach

5.1.1 Methodology

Our first step to look into non-linear effects on private employment (and wages) of public employment (and wage) policies is considering a smooth transition vector autoregression model (STVAR). The STVAR approach allows us to estimate heterogeneous IRFs depending on the state of the economy, e.g., expansion versus recession.[8] The key intuition of the STVAR methodology is to define a set of probabilities for each state of the economy (e.g.

[8] Auerbach and Gorodnichenko (2012a, 2012b) estimated STVAR models for the analysis of state-dependent multipliers of public spending. Along these lines, some authors have employed threshold VAR (TVAR)approaches aiming to estimate state-specific multipliers over the business cycle (see e.g. Baum and Koester, 2011, for Germany). While the TVAR discretely switches from one to another regime, STVARs allow the regimes to change smoothly from one regime to another. From a practical point of view, within the STVAR approach all observations in the sample can be used for estimation of the parameters in both regimes. We opt for the STVAR framework because we think it is very unlikely that the economy jumps between the regimes in a discrete fashion as imposed by the TVAR approach.

expansion versus recession) and then estimate state-specific VAR coefficients and variance-covariance matrices; thus, one can estimate IRFs and multipliers that depend on the state of the economy.

Formally, the STVAR model is:

$$\begin{aligned} X_t^\dagger &= C + (1 - F(z_{t-1}))\Phi_{S_1} X_{t-1}^\dagger + F(z_{t-1})\Phi_{S_2} X_{t-1}^\dagger + e_t \\ e_t &\sim iid(0, \Omega_t) \\ \Omega_t &= \Omega_{S_1}(1 - F(z_{t-1})) + \Omega_{S_2} F(z_{t-1}) \\ F(z_t) &= \frac{exp(-\gamma z_t)}{(1 + exp(-\gamma z_t))}, \ \gamma > 0 \end{aligned} \tag{1}$$

where the sub-indices S_1 and S_2 refer to the states of the economy (e.g. expansion versus recession, and high versus low unemployment). The vector $X_t^\dagger$ contains the variables included in the STVAR, which is only a subset of those traditionally used in linear models. We must restrict the number of variables to be included in $X_t^\dagger$ because the sample size available for estimation does not yield enough degrees of freedom to robustly estimate the high number of coefficients of the model (this is a crucial concern of the STVAR approach, not only restricted to our particular empirical application, see section 5.1.3 below for more details). In particular, STVAR exercises are based on either $X_t^\dagger = (N_t^g, N_t^{pr}, GDP_t)'$ for the employment STVAR, and $X_t^\dagger = (W_t^g, W_t^{pr}, PROD_t)'$ for the wages STVAR.

Matrices Φ_{S_1}, Φ_{S_2}, Ω_{S_1}, and Ω_{S_2} contain the coefficients of the lag polynomials and the variance-covariance matrices of the shocks in the different regimes.[9] Finally, z_t is an indicator of the state of the economy in quarter t, normalized to have zero mean and unit variance. The weights assigned to each regime vary between 0 and 1 according to the weighting function $F(\cdot)$. Note also that the index z is dated at $t-1$ to avoid contemporaneous feedbacks from policy actions to the state of the economy.

Turning to the choice of z_t, we consider both GDP growth and the unemployment rate as indicators, and consider the 7-quarter moving average in both cases. Intuitively, $F(z_t)$ can be interpreted as the probability of being in recession when z_t is GDP growth. Figure 2 shows the estimated weights (probabilities) for the recession and high-unemployment regimes, for

[9]Note that equation (1) contains one single lag to avoid notational clutter; however, we estimate the model considering a maximum of three lags

Table 1: *STVAR: Response of private sector employment to a public employment shock.*

EURO AREA							
	A.1. $z_t \equiv$Real GDP				A.2. $z_t \equiv$Unemp. rate		
Regime	Impact	4q	8q	Regime	Impact	4q	8q
Recession	0.43	0.04	0.06	High U	0.48	0.45	0.41
	(1.99)	(1.26)	(1.01)		(1.34)	(0.65)	(0.44)
Expansion	-0.16	-0.57	-0.59	Low U	0.08	-0.50	-0.42
	(1.36)	(0.75)	(0.56)		(2.14)	(1.38)	(1.11)
SPAIN							
	A.3. $z_t \equiv$Real GDP				A.4. $z_t \equiv$Unemp. rate		
Regime	Impact	4q	8q	Regime	Impact	4q	8q
Recession	-0.50	2.45***	3.15***	High U	2.27***	2.63***	2.62***
	(0.77)	(0.92)	(0.88)		(0.63)	(0.83)	(0.78)
Expansion	-0.62	-0.36	0.03	Low U	-1.78***	-1.18	-0.61
	(0.63)	(0.79)	(0.80)		(0.68)	(0.98)	(1.28)

[a] Standard errors in parentheses. Statistical significance: ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

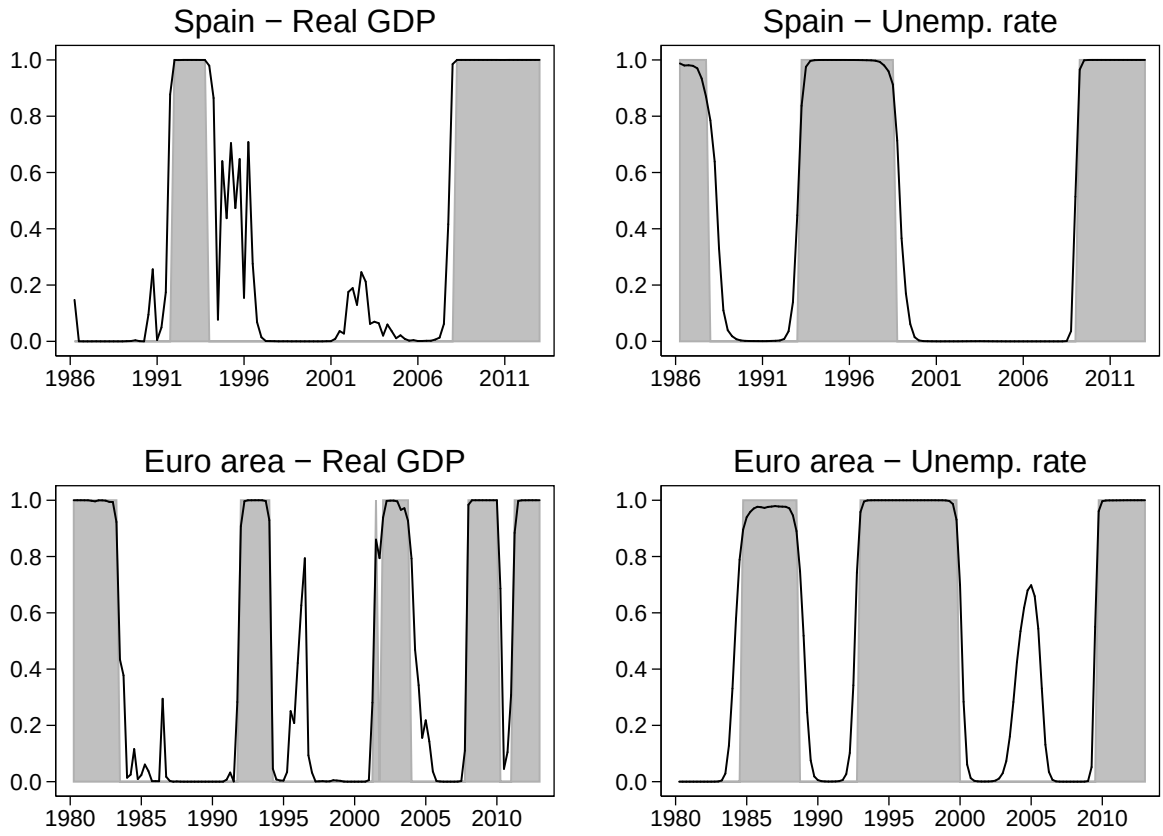
the cases Spain and the Euro area aggregate, respectively. In the case of real GDP, in both cases the indicators seem to capture appropriately the recessions typically characterized by the extant literature.

5.1.2 Results

The main results of our empirical exercise are presented in Tables 1 and 2. In all the empirical material we only show responses up to eight quarters to account for the fact that a change in regime may occur while in the simulation horizon and, as a consequence, as discussed in Ramey (2013), it is important to focus on relatively short-term responses.

Table 1 displays the multipliers that correspond to the effect of a 1 percent shock to public employment on private sector employment. We report the impact multiplier and the cumulative multiplier at two longer horizons: four quarters and eight quarters. As a reaction to a public employment positive shock (increase) we find that in expansions (using either real GDP or unemployment as the variable defining the state, z_t) the effect on private employment is negative for the two analyzed economies (euro area and Spain).

Figure 2: Regime indicators (STVAR): weights on the recession and high unemployment regime.



The solid lines refer to the weights on the recession and high unemployment regimes used in the STVAR estimation. The shaded regions show recessions and high unemployment quarters as used in the local projections estimation; for Spain we use the crises identified by ECRI (http://www.ecri.org) while for the Euro area we label as crisis periods those with estimated weights above 0.8.

This is in line with existing results in the empirical and theoretical literature, and can be interpreted as evidence of "crowding-out". Nevertheless, results are estimated with low precision, and are hardly significant from a statistical point of view, with the exception of the low-unemployment case for Spain. In recessions, however, the correlation is positive: a shock to public employment generates a positive response in private sector employment. This result is statistically significant for the case of Spain, under the two measures of z_t. When looking at quantitative estimates, the multipliers in Table 1 show that indeed the cumulative effect after four and eight quarters in Spain is positive, significant and relatively high (2.45 and 3.15, respectively, when z_t is defined by real GDP). It is worth noticing that public employment shocks are very persistent in the considered cases. This might be a reflection of the fact that public employment restraint policies tend to last several quarters in fiscal consolidation periods, while in fiscally loose periods the opposite may happen.

To deepen the intuition on the possible channels through which public employment shocks may affect private employment, we also run a modified model in which we include now public employment and private employment, as in the previous case, but instead of real GDP we add private sector wages. The results (not shown for the sake of brevity) show that the effects of public employment shocks on private employment are the same as those just described. The impact on private sector wages, however, is quite interesting. Indeed, in recessionary periods the positive effect on private employment comes hand-in-hand with a reduction in private sector wages, while in the "expansion" regime the crowding-out on private employment is accompanied by an increase in private wages. The private sector wages' channel has been underlined, in fact, by the related literature, as one of the main channels to rationalize crowding-out effects.

In Table 2, in turn, we display the multipliers that correspond to the effect of a shock to public wages on private sector wages. In the case of Spain regime-dependent responses, even if positive, show very different dynamics in expansion than in recession. In good times or expansion a positive shock to public wages is indeed associated with a positive response of private sector wages, but the response quickly fades away, with an impact multiplier of 0.55, while the cumulative multiplier at four quarters is already close to zero, and so is the one at the eight quarters horizon. In contrast, in the bad-times state the effect is

Table 2: *STVAR: Response of private sector wages to a public wage shock*

EURO AREA							
	A.1. $z_t \equiv$Real GDP				A.2. $z_t \equiv$Unemp. rate		
Regime	Impact	4q	8q	Regime	Impact	4q	8q
Recession	0.38***	0.78***	0.47***	High U	0.41***	0.35***	0.45***
	(0.06)	(0.05)	(0.06)		(0.10)	(0.08)	(0.08)
Expansion	-0.27***	-0.29***	-0.43***	Low U	-0.22***	-0.23***	-0.25***
	(0.05)	(0.04)	(0.07)		(0.05)	(0.04)	(0.03)
SPAIN							
	A.3. $z_t \equiv$Real GDP				A.4. $z_t \equiv$Unemp. rate		
Regime	Impact	4q	8q	Regime	Impact	4q	8q
Recession	0.37***	0.39***	0.52***	High U	0.72***	0.47***	0.46***
	(0.10)	(0.03)	(0.06)		(0.09)	(0.05)	(0.05)
Expansion	0.55***	0.03	0.03	Low U	0.60***	0.26***	0.37***
	(0.06)	(0.04)	(0.05)		(0.10)	(0.08)	(0.09)

[a] Standard errors in parentheses. Statistical significance: ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

much more persistent, despite the similar persistence of the shock. In this latter case the impact multiplier estimate is 0.37, and the four and eight quarter cumulative multiplier are 0.39 and 0.52, respectively. The same result also holds for the euro area aggregate in the recession/high unemployment states. The observed reaction, similarly to the one in the case of Spain, displays strong persistence. When real GDP is the variable defining the state, the impact multiplier is estimated to be 0.38 and the four and eight quarter cumulative multiplier estimates are 0.78 and 0.47, respectively (see table). In the "high unemployment" state results are of a similar order of magnitude. On the contrary, in "good times", a positive shock to public wages in the euro area case is associated, though, with a fall in private sector wages. The sign of the response had to be certainly determined by the degree of complementarity and/or sustitutability of public and private activities, but clearly this finding is puzzling.

5.1.3 Drawbacks of STVARs

As discussed above, the STVAR results are suggestive of the existence of heterogeneous responses of private employment (wages) to public employment (wages) shocks depending on the degree of slack in the economy. However, we acknowledge that these STVAR estimates should be interpreted with caution because they may suffer from lack of robustness as well as non-negligible biases. On the one hand, the STVAR approach involves highly nonlinear estimation of a large number of parameters, which is very challenging in terms of numerical computation and thus very demanding in terms of data. Indeed, as acknowledged by Auerbach and Gorodnichenko (2012b), lack of data represents a concern in terms of the convergence properties of the numerical methods employed for the likelihood maximization required by the STVAR approach. While Auerbach and Gorodnichenko (2012a) overcome the challenge using quarterly US data over the postwar period 1947-2008, i.e., 248 observations, we only have 108 and 132 observations for our samples of Spanish and European data respectively. On the other hand, constructing impulse responses in nonlinear models is far from being straightforward (see Koop et al., 1996). Within the non-linear STVAR approach, we compute the impulse response functions under the assumption that the shocks cannot modify the state of the economy. Indeed, we are implicitly assuming that the economy remains in the same regime, either expansion or recession, over the entire horizon for which IRFs are computed. These assumptions might lead to biases in the estimated IRFs as highlighted by e.g. Ramey and Zubairy (2013).

Given these concerns when using the STVAR approach, we turn now to the local projections method developed in Jordá (2005) adapted to the non-linear setting considered here.

5.2 Local projections

The main motivation of the Local projections (LPs) approach (Jordá 2005) was to develop a method to reduce the dependence of the IRF estimates on the specification of the data generating process, that is, LPs are more robust to model misspecification. Moreover, LPs are easy to implement, and they can be easily adapted to non-linear specifications. In fact, LPs are becoming very popular in the literature for these reasons. For instance, Ramey and

Zubairy (2013) consider this approach to estimate state-dependent multipliers of government spending. The LPs method is not without drawbacks, however. It might present higher variances (efficiency losses) if the data generating process is well approximated by a VAR.

5.2.1 Methodology

Intuitively, LPs are based on a sequence of linear projections of the variable of interest on the current information set. The slope parameters of such projections combined with any estimate of the structural impact multiplier matrix (e.g. the Cholesky decomposition) directly produce the IRFs of interest. Provided the data generating process is stationary and linear, IRFs based on LPs are asymptotically equivalent to those based on the standard VAR alternative. However, in contrast to standard VARs, LPs do not require any non-linear transformation of the slope parameters and their estimation involves much less parameters, which prove specially useful in non-linear settings.

To begin with, we introduce LPs in a linear specification for the sake of simplicity, then we extend the LPs method to a nonlinear framework. Our baseline linear VAR specifications is similar to the ones traditionally used in the literature on this topic. Regarding employment, this baseline VAR contains five variables, namely, public employment (N^g), private employment (N^{pr}), real GDP (GDP), the real interest rate (R), and real total government revenues (T). Macroeconomic fluctuations are accounted for by the inclusion of output and real interest rate; for instance, aggregate shocks other than fiscal shocks might simultaneously affect private and public employment so these two variables aim to control for this potential source of endogeneity. In addition, the variable on government revenues is included to account for the indirect effect that private activity (e.g. employment) might have on public employment through increases in the amount of funds available to the government. Formally, the reduced-form VAR is:

$$X_t = B_1 X_{t-1} + ... + B_p X_{t-p} + \epsilon_t \tag{2}$$

where $X_t = (N_t^g, N_t^{pr}, GDP_t, R_t, T_t)'$, $B_1, ..., B_p$ are coefficient matrices and ϵ_t is a $5-$dimensional i.i.d. white noise; $E(\epsilon_t) = 0$, $E(\epsilon_t \epsilon_t') = \Sigma_\epsilon$ with Σ_ϵ being a non-singular and positive definite

matrix.[10] In the case of wages, the vector X_t includes public wages (W^g), private wages (W^{pr}), productivity ($PROD$), the real interest rate (R), and real total government revenues (T). The rationale for this specification is essentially the same as that of the employment VAR. Moreover, one can write in structural form the reduced-form VAR in equation (2)as:

$$A_0 X_t = A_1 X_t + ... + A_p X_{t-p} + \eta_t \tag{3}$$

where η_t are the structural shocks and $E(\eta_t \eta_t') = \Sigma_\eta = I_5$ without loss of generality. Following Linnemann (2009), we include all variables in logarithms of their levels, except the real interest rate, which is entered as the logarithm of one plus the real rate.

Then, we formally consider a sequence of H forward projections for $h = 1, ..., H$ as follows:

$$N^{Pr}_{t+h} = \alpha^h + \beta^h_1 X_t + ... + \beta^h_p X_{t-p+1} + u_{t+h} \tag{4}$$

where the 5×1 vector X_t is defined above.[11] By construction, β^h_1 can be interpreted as the response of N^{Pr}_{t+h} to a reduced-form disturbance in t:

$$\beta^h_1 = E(N^{Pr}_{t+h} | \epsilon_t = 1; X_t, ..., X_{t-p}) - E(N^{Pr}_{t+h} | \epsilon_t = 0; X_t, ..., X_{t-p}) \tag{5}$$

where ϵ_t is the reduced form shock in (2). Therefore, we can easily estimate the structural response at horizon h of private employment to a public employment shock as follows:

$$\Theta_h = \beta^h_1 d_{N^g} \tag{6}$$

where d_{N^g} is the first column of the impact matrix A_0^{-1} defined in (3). Analogously, we could construct IRFs based on local projections (i.e. LPIRFs) for shocks in other variables by simply considering alternative columns of the impact matrix. In the case of public wages shock, we consider the first column but for the alternative VAR in which the X_t vector features public wages, private wages, productivity, interest rates and tax revenues.

In practice, we simply need to obtain the $\hat{A}_0^{-1}$ matrix by using standard VAR methods. We rely on a Cholesky identification strategy with the public employment/wage variable

[10] For expository purposes, we abstract from deterministic regressors, although we allow for lags of each endogenous variable, a time trend, and a constant throughout the paper.

[11] Moreover, p is the lag length of each projection. In practical terms, note that one cannot forecast further than the sample size available for estimation, which is reduced as p and H increase.

ordered first, which is standard in the linear literature.[12] The remaining variables enter in the same order as they are listed in the vector X_t above. In practice, this identification strategy implies that A_0^{-1} is a lower triangular matrix satisfying $A_0^{-1}(A_0^{-1})' = \Sigma_\epsilon$.[13] It is based on the assumption that fiscal policy actions are independent of economic activity (e.g. private employment/wages, output) within the current quarter. As long as fiscal authorities require some planning and preparations to conduct policy, it seems reasonable to assume that public employment/wages do not react to either private employment/wages or GDP within the current quarter.

We estimate a sequence of least-squares regressions in (4) for each horizon h.[14] Turning to inference, we use the Newey-West correction for our standard errors to account for the serial correlation in the error terms induced by the successive leading of the dependent variable; Jordá (2009) and Kilian and Kim (2009) provide an in-depth analysis of confidence intervals in the LPs framework.

It is straightforward to extend the LPs method to a nonlinear framework. Let us define a dummy variable I_t that indicates the state of the economy at period t taking the value 1 if it is recession/high unemployment and 0 for expansion/low unemployment. In particular, for the case of Spain we borrow the recession periods identified by ECRI (http://www.ecri.org), while for the Euro Area we follow Auerbach and Gorodnichenko (2012a) and define a recession quarter if the probability of being in recession is above 0.8, i.e., $F(z_t) > 0.8$. Shaded regions in Figure 2 correspond to the periods of slack (i.e., $I_t = 1$) identified for Spain and the Euro area according to the two indicators, GDP growth and unemployment.

Armed with the I_t indicator of the state of the economy, we can simply estimate a set of

[12]This identification strategy is also standard in the multipliers literature (see e.g. Blanchard and Perotti, 2002; Gali et al., 2007) and in the public employment literature. Malley and Moutos (1996) assume that public employment is weakly exogenous in a VEC-ECM model including public employment, private employment and the stock of capital. Algan et al. (2002) consider a panel approach and instrument public employment with its own lags assuming lack of contemporaneous correlation between public employment and shocks to private employment. Finally, Linnemann (2009) considers a linear VAR model adopting the same ordering as the one we adopt here.

[13]Note that $\epsilon_t = A_0^{-1}\eta_t$ so that $E(\epsilon_t\epsilon_t') = \Sigma_\epsilon = A_0^{-1}\Sigma_\eta(A_0^{-1})'$.

[14]See Ronayne (2011) for a detailed discussion of LPIRFs in comparison with traditional VAR-based IRFs.

regressions for each horizon h:

$$\begin{aligned} N_{t+h}^{Pr} &= I_t \left\{ \alpha^{h,REC} + \beta_1^{h,REC} X_t + ... + \beta_p^{h,REC} X_{t-p+1} \right\} \\ &+ (1 - I_t) \left\{ \alpha^{h,EXP} + \beta_1^{h,EXP} X_t + ... + \beta_p^{h,EXP} X_{t-p+1} \right\} + u_{t+h} \end{aligned} \tag{7}$$

Importantly, we allow the slope coefficients to vary according to whether the economy is in recession (REC) or expansion (EXP) as defined by the I_t indicator (for the ease of exposition, we refer here to periods of slack, namely, low GDP growth or high unemployment, as recessions). Thus, we are able to construct a LPIRF for recessions as a sequence of $\Theta_h^{REC} = \beta_1^{h,REC} d_{N^g}$, and a different LPIRF for expansions by computing Θ_h^{EXP}. Analogously, we can also estimate LPs and the corresponding LPIRFs to a public employment (or wages) shock for any variable of interest by simply substituting the dependent variable in equation (7). In addition to private employment (N_{t+h}^{Pr}), we also explore the responses of public employment and wages, private wages, GDP, productivity, interest rates, and tax revenues.

Crucially, note that we estimate our LPIRFs by means of single OLS regressions, thus, the number of parameters to be estimated to obtain each LPIRF is drastically reduced. This is in sharp contrast with the STVAR above, where one needs to estimate the full set of parameters in the highly parametrized nonlinear VAR. Moreover, as pointed out by Koop et al. (1996), estimation of IRFs in nonlinear models poses a challenge. In contrast to linear models, the response may depend on the magnitude of the shock as we as on the history of previous shocks. By means of the LP method, we estimate separate regressions for each horizon h; thus, the estimated parameters ($\beta_1^{h,REC}$, $\beta_1^{h,EXP}$) and the resulting LPIRFs depend on the average behavior of the economy in the historical sample between t and $t+h$. Intuitively, the parameter estimates on the right-hand-side variables in (7) take into account the average tendency of the economy to evolve between states (e.g. expansion vs. recession).

5.2.2 Results

The results obtained with LP the method reinforce the main messages already hinted at in the STVAR case. Multipliers are shown in the case of public employment shocks in Table 3 and Figure 3.

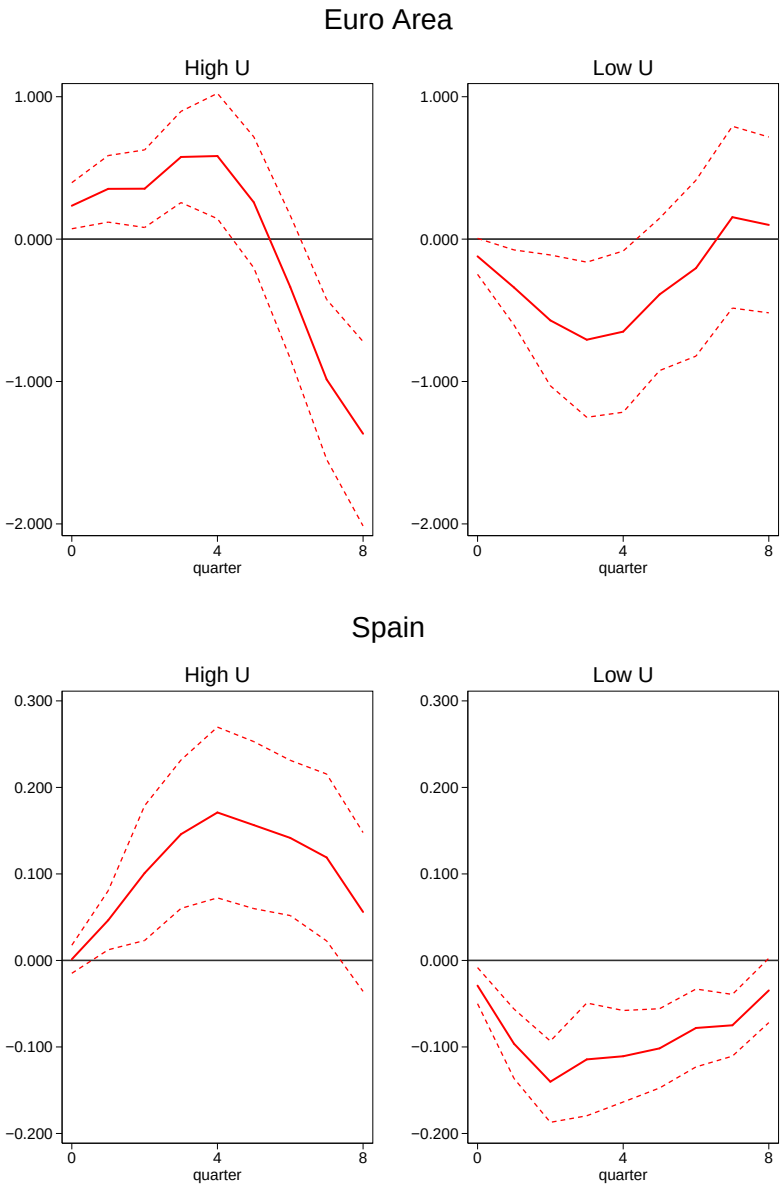
The following general and robust results can be highlighted. First, we find crowding-out

of private employment by public employment in "good times", both in cases of the euro area aggregate and Spain, and for the two measures of "good times" (economic expansion and low unemployment; in all cases the estimated multipliers are negative. When the unemployment rate is used to define the state of the economy, i.e. when unemployment slack is low the estimated responses of private employment are in general statistically significant, and the negative multiplier after eight quarters is above one or slightly below one depending on the sample. In the case of Spain, a 1% increase in public employment leads after eight quarters to a fall of private employment of 0.75%. Given that the number of private employees is much higher than the number of public employees, this leads to a net reduction of employment of around 0.2% over that period. In the case of the euro area aggregate, in turn, the cumulative (negative) multiplier after eight quarters is higher, -2.83%. Using GDP growth as indicator for the state of the economy, in economic expansion even though the estimated signs of the responses are also negative, results are weaker and not significant from an statistical point of view.

By contrast, when unemployment is high (high slack in the economy) we find evidence in support of crowding-in of public employment over private employment both in the case of Spain and the euro area aggregate. Indeed, for the euro area aggregate, a 1% increase in public employment, when unemployment is high, leads after four quarters to an increase of private employment of 1.52%, while in the case of Spain the estimated multiplier is 0.30% after four quarters and 0.88% after eight quarters. These results reinforce the most recent theoretical literature that highlights the crucial role of unemployment slack to determine the crowding-out/-in of public employment over private sector employment. Again, in the case of economic recession (i.e. using GDP growth as indicator for the state of the economy) even though responses are estimated to be mostly positive, results are not significant from an statistical point of view. The only exception is the impact effect in the case of Spain, which is negative though quantitatively small, i.e. an 1% increase in public employment decreases on impact private employment by 0.05%. This latter result further highlights the relevance of the unemployment rate level to ascertain the crowding-out/-in of private employment by public employment.

The dynamic behavior of the response is also relevant, as illustrated in Figure 3. The

Figure 3: Local projections: response of private employment to a public employment shock



positive impact in the high-unemployment state (crowding-in) is evident for the first year (four quarters) both in the cases of Spain and the euro area aggregate. After six quarters the response becomes negative (crowding-out) for the euro area, while in the case of Spain the response is not statistically different from zero after eight quarters. This means that for the euro area as a whole the crowding-in result is short-lived. A broadly similar, but opposite in sign behavior is visible in the low-unemployment state.

Table 3: *Local projections. Public employment shock: response of private sector employment and real GDP*

PANEL A. RESPONSE OF PRIVATE SECTOR EMPLOYMENT.

EURO AREA

	A.1. $z_t \equiv$Real GDP				A.2. $z_t \equiv$Unemp. rate		
Regime	Impact	4q	8q	Regime	Impact	4q	8q
Recession	0.23	0.72	0.84	High U	0.24	1.52***	1.04
	(0.28)	(1.05)	(1.82)		(0.16)	(0.51)	(1.11)
Expansion	-0.17	-0.64	-2.27	Low U	-0.12	-1.74**	-2.83**
	(0.13)	(0.49)	(1.48)		(0.126)	(0.77)	(1.41)

SPAIN

	A.3. $z_t \equiv$Real GDP				A.4. $z_t \equiv$Unemp. rate		
Regime	Impact	4q	8q	Regime	Impact	4q	8q
Recession	-0.05*	0.19	0.18	High U	0.001	0.30**	0.88***
	(0.03)	(0.14)	(0.27)		(0.016)	(0.12)	(0.23)
Expansion	-0.012	-0.03	0.11	Low U	-0.03	-0.38***	-0.75***
	(0.009)	(0.09)	(0.19)		(0.02)	(0.09)	(0.13)

PANEL B. RESPONSE OF REAL GDP.

EURO AREA

	A.1. $z_t \equiv$Real GDP				A.2. $z_t \equiv$Unemp. rate		
Regime	Impact	4q	8q	Regime	Impact	4q	8q
Recession	0.18*	-0.06	-0.44	High U	0.09**	0.60***	0.01
	(0.11)	(0.30)	(0.45)		(0.05)	(0.17)	(0.34)
Expansion	0.068**	0.298**	0.148	Low U	0.019	-0.626*	-0.568
	(0.033)	(0.149)	(0.406)		(0.053)	(0.368)	(0.547)

SPAIN

	A.3. $z_t \equiv$Real GDP				A.4. $z_t \equiv$Unemp. rate		
Regime	Impact	4q	8q	Regime	Impact	4q	8q
Recession	-0.005**	0.007	0.02	High U	0.008**	0.05***	0.12***
	(0.002)	(0.015)	(0.03)		(0.004)	(0.01)	(0.02)
Expansion	0.002	0.013	0.04	Low U	-0.01***	-0.05***	-0.08***
	(0.004)	(0.012)	(0.02)		(0.003)	(0.01)	(0.01)

[a] Standard errors in parentheses. Statistical significance: ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

The effects of public wage shocks on private sector wages are presented in Table 4. Looking first at the Euro area aggregate, when the unemployment rate is high a decrease in public sector wages leads to a decrease in private sector wages; in cumulative terms, the effect of a 1% negative shock reduces private wages by 0.87% after four quarters. When $z = GDP$, response of private wages is smaller and loses statistical significance. In times of low unemployment, the positive impact is also present and similar in magnitude. This evidence for the euro area sample is in line with the prescription of extant theories. Wages in the public and private sectors move in the same direction, with changes depending on the state of the economy being just a matter of the size of the impact of the public wage shock.

Turning now to the Spanish case, an economy that has presented historically a significant degree of downward real wage rigidity, the response of private wages is not statistically significant during periods of high unemployment or economic recession, when public wage cuts are more likely. In good times (economic expansion or low unemployment rate), an unexpected increase in public wages presents the potential of pushing down private sector wages, probably as a result of its negative impact on output discussed below. In our view, the differences in the multipliers reported in Table 4 between both samples confirm the difficulties in identifying the linkages between public and private wages across countries highlighted in section 3.

We also show in tables 3 and 4 (panel B in each table) the responses of real GDP to public employment and public wages shocks, conditional on the selected variables of control. We present these estimates in order to better link our work to the literature on the macroeconomic impact of fiscal shocks, that has mainly focused on the real GDP impact of such shocks. In periods of hight unemployment, an increase in public employment (Table 3, panel B) leads to an increase in GDP for both the euro area aggregate and Spain, with multipliers after four quarters of 0.6 and 0.05, respectively. After eight quarters the multiplier for Spain increases to 0.12, while for the euro area taken as a whole is shorter-lived, as it loses significance, reflecting some negative effect on GDP of the shock during the second year. These results are in line with the cumulative and dynamic responses discussed above for private employment. When real real GDP is used as the variable defining the state of the economy, the results are not significant for both samples. Along these lines, bear in mind

that in times of "economic recession" we found that private employment did not react to the public employment shock in the two considered cases. These results reflect the relevance of implementing public employment policies as a reaction to adverse economic conditions only in times of unemployment slack, and not merely as a counter-cyclical tool. In the case of wages, the impact of a (positive) public wages' shock on GDP (Table 4, panel B) in times of high unemployment is positive for the euro area aggregate but negative for Spain, which might be at the root of the negative public-private wages interaction discussed above, i.e. in this latter case, an unexpected increase in public wages cause a fall in output and private wages.

With respect to output multipliers in times of low unemployment, the following results can be highlighted. First, the crowding-out of private employment by public employment has a parallel in the response of GDP in both samples, with a larger but less significant reaction in the euro area case. Indeed, in the latter case, the cumulative multiplier after four quarters is -0.63, being non-statistically significant afterward. For Spain the responses are more significant but quantitatively weaker (-0.05 after four quarters and -0.08 after eight quarters). Second, a public wages shock during good times reduces GDP in the case of Spain, especially when good times are defined in terms of GDP growth (the cumulative multiplier after four quarters is around -0.5 in this case). Turning to the euro area aggregate, output responses to a public wages shock are positive but not significant in times of low unemployment and significant during economic expansions.

6 Policy discussion and conclusions

Some policy lessons can be drawn from this study, that includes descriptive evidence, a deep description of the relevant theoretical and empirical literature, and some empirical exercises.

First, we find evidence that in expansions public employment may crowd-out private employment. In recessions, though, an unexpected increase in public employment leads to higher private employment, even though the positive effect is relatively short-lived, turning negative after 4-6 quarters. From a policy point of view, and in the framework of the "economic growth-vs-fiscal consolidation" debate, these results would advise against aggressive

Table 4: *Local projections. Public wages shock: response of private sector wages and real GDP.*

PANEL A. RESPONSE OF PRIVATE SECTOR WAGES.

EURO AREA

	A.1. $z_t \equiv$Real GDP				A.2. $z_t \equiv$Unemp. rate		
Regime	Impact	4q	8q	Regime	Impact	4q	8q
Recession	0.04	0.21	0.97	High U	0.00	0.87***	2.45***
	(0.15)	(0.52)	(0.81)		(0.07)	(0.24)	(0.37)
Expansion	-0.01	0.38	1.46***	Low U	0.13	1.23***	2.38***
	(0.08)	(0.24)	(0.42)		(0.13)	(0.33)	(0.55)

SPAIN

	A.3. $z_t \equiv$Real GDP				A.4. $z_t \equiv$Unemp. rate		
Regime	Impact	4q	8q	Regime	Impact	4q	8q
Recession	-0.21	0.16	0.86	High U	-0.29	-0.59	-0.34
	(0.22)	(0.48)	(0.95)		(0.27)	(0.37)	(0.56)
Expansion	-0.38	-1.21***	-1.76***	Low U	-0.29	-0.96***	-1.50***
	(0.21)	(0.36)	(0.59)		(0.24)	(0.37)	(0.66)

PANEL B. RESPONSE OF REAL GDP.

EURO AREA

	A.1. $z_t \equiv$Real GDP				A.2. $z_t \equiv$Unemp. rate		
Regime	Impact	4q	8q	Regime	Impact	4q	8q
Recession	0.25*	-0.25	-0.48	High U	0.23	1.24**	1.74**
	(0.13)	(0.33)	(0.64)		(0.15)	(0.50)	(0.77)
Expansion	0.17	0.72**	2.62***	Low U	0.12	0.48	0.67
	(0.13)	(0.35)	(0.55)		(0.14)	(0.37)	(0.60)

SPAIN

	A.3. $z_t \equiv$Real GDP				A.4. $z_t \equiv$Unemp. rate		
Regime	Impact	4q	8q	Regime	Impact	4q	8q
Recession	-0.03	-0.28	0.46	High U	0.11	-0.55**	-2.19***
	(0.10)	(0.28)	(0.38)		(0.18)	(0.28)	(0.44)
Expansion	0.01	-0.54**	-2.85***	Low U	-0.04	-0.11	0.25
	(0.15)	(0.24)	(0.39)		(0.08)	(0.18)	(0.31)

[a] Standard errors in parentheses. Statistical significance: ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

policies of public employees' firing in the the midst of a recession and/or when unemployment is high, at least from a short- to medium-run perspective. At the same time, our results would also advise against policies of public labor force increase in expansions.

Second, on the wage side, we validate and extend the by now standard result that public wages may lead private sector wages in the Euro Area; indeed, we read the fact that the mechanism operates in recessions as a signal that policies of public wage restraint may set in motion a labor market adjustment that otherwise would have taken longer and would have been, consequently more costly for the economy as a whole. When fiscal and competitiveness problems exist, public wage restraint could help correcting both fiscal imbalances and – through the inter-linkage with private wages – competitiveness problems.

Third, along these lines, also in order to assess the response of GDP to public employment and wages' shocks we have learnt that it is necessary to take on board the state of the economy. Our results help to understand and qualify some evidence presented in the literature. For example Bermperoglou, Pappa and Vella (2013) find that cuts in the wage bill component identified as government employment cuts generate output losses regardless of the sample and the country analyzed, while wage cuts in contrast have, if anything, insignificant expansionary effects and achieve the largest public deficit reductions according to these authors. As regards public employment, the latter results are broadly valid in our two case studies (Spain and the euro area as a whole) in "bad times" (high unemployment, economic recession), while in times of low unemployment an increase in public employment would reduce GDP. As regards public wages, our results are not that clear-cut. Nevertheless, in this case the relevant distinction does not seem to be the good times vs bad times one, but rather the specific features of the Spanish economy versus the euro area economy as a whole. In the former case public wage cuts do have expansionary effects, while in the latter the opposite happens. Differences would have to be traced most likely to specific features of labor markets in both cases.

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