The Role of Public Wages in Fiscal Consolidation Processes

Pablo Hernández de Cos Enrique Moral-Benito*

February 3, 2014

Abstract

We investigate the role of adjustments in the public wage bill on the success of fiscal consolidation processes and its impact on private sector aggregates. For this purpose, we exploit a panel of OECD countries over the 1980-2007 period. Based on Bayesian Model Averaging methods, we first identify cuts in the public wage bill (in terms of both compensation per employee and number of employees) as the most robust determinant of successful fiscal consolidations. Second, using cross-country panel regressions we find that the impact of public wages/employment on the labor costs of the private sector might be the main channel through which cuts in public wages affect private activity. Finally, we discuss the implications of both findings from a policy-oriented perspective.

JEL Codes: H30, H62.

Keywords: Fiscal policy, Budget Deficit, Public Wages.

1 Introduction

In the aftermath of the economic and financial crisis several EU countries face substantial fiscal consolidation needs. Despite there is a broad consensus that fiscal consolidation must take place, as it is well-known, the devil is in the details. The specific design of fiscal consolidation measures is of great relevance, not only because it affects the success of the adjustment in its own, but also because the way how fiscal consolidation is achieved has implications for the prospects for macroeconomic recovery. In particular, the main concerns are twofold: on the one hand, the consolidation pace must ensure a persistent reduction in deficits; on the other hand, it should

*We are grateful for the comments from Stéphane Carcillo, Martin Larch, Matteo Salto, and participants at the conference "Government wage bill: determinants, interactions and effects" organised by the European Commission. Corresponding author: Enrique Moral-Benito. Email: enrique.moral@gmail.com. Postal address: Banco de España, c/ Alcalá 48, 28014, Madrid, Spain. Phone: (+34)913385687. Fax: (+34)913385486.

ideally be growth enhancing, or, at least, should not harm significantly economic growth. Needless to say, both concerns are closely interrelated: only a growth-friendly fiscal consolidation will successfully reduce deficits in the long run as, otherwise, lower growth and the resulting rise in unemployment would increase deficits still further.

Along these lines, the composition of the fiscal adjustment is of high importance. For instance, Perotti (1996) shows that the composition of fiscal consolidation matters for the success of fiscal adjustments. More concretely, the literature has somehow concluded that consolidations based on expenditure cuts are more likely to be less harmful for growth than consolidations based on tax increases (see, for instance, Alesina and Ardagna, 1998; Ardagna, 2004). One rationale for this result is based on the supply side of the economy. In particular, if the consolidation is based on public wages/employment it will make the labor market less tight and weakens unions' power lowering pressure on the equilibrium wage with positive consequences for the economy. On the other hand, the expectations view emphasizes that if agents believe that the consolidation is credible and avoids a default on government debt regardless of the composition of the adjustment, they can ask for a lower premium on government bonds eventually generating a reduction in interest rates charged to consumers and firms and triggering a consumption/investment boom.

In this paper, we investigate with some detail the specific role of cuts in the public wage bill in achieving the two objectives mentioned above. For this purpose, we adopt a two-step strategy: we first aim to disentangle the most relevant public budget components in explaining past experiences of successful consolidations. We find that cutting in public wages is a crucial ingredient in this respect. In a second step, we explore the channels through which cuts in the public wage bill might affect private activity.

In our first step, we empirically identify the components of the public budget that most significantly increase the probability of success of fiscal consolidations in a panel of OECD countries. Given the lack of a theoretical model of reference, the typical approach in the literature is based on a regression of a dummy variable identifying successful consolidations on a set of candidate determinants (see e.g., Giudice et al., 2007). Since conclusions emerging from these exercises typically depend on the set of variables included in the regression, we consider Bayesian Model Averaging techniques in order to overcome the model selection challenge. Regarding the role of the public wage item, we confirm the finding in Hernandez de Cos and Moral-Benito (2013) that consolidations based on public wage cuts are better suited for obtaining persistent reductions in primary deficits. Additionally, we find that this result is true for both reductions in the number of public employees and cuts in the compensation per employee in the public sector.

Among others, Alesina et al. (2002) describe a channel that might explain this result through the effects of public employment/wages on economic activity. On the one hand, a decrease in government employment reduces the probability of finding a job if not employed in the private sector, and a decrease in government wages decreases the worker's income if employed in the public sector. In both cases, the reservation utility of the union members goes down and the wage

demanded by the union for private sector workers decreases, increasing profits, investment and competitiveness.

Having these considerations in mind, in our second step, we explore the connection between public wages and private sector activity using our panel of OECD countries. In particular, we consider regressions of certain macroeconomic aggregates (i.e. labor productivity, labor costs in the private sector, private investment, private consumption, and the current account) on the expenditure items of the public budget, namely, wage expenditures, non-wage expenditures, subsidies, and transfers. In these regressions, we also control for total revenues as a share of GDP and a measure of "private GDP" (obtained as the ratio of total GDP less government consumption divided by the capital stock).[1] Our main interest is on the regression of private labor costs on public wages/employment, as this can be interpret as a test of the labor market channed discussed in Alesina et al. (2002). However, in a sort of placebo tests we also consider other macroeconomic aggregates as well as other items of the public budget.

According to our results, cuts in public wages significantly reduce the labor costs of the private sector in the current year providing further evidence in favor of the labor market channel; however, other expenditure items (e.g. transfers, subsidies, and non-wage expenditures) are not significantly related to the economic activity variables we consider. Moreover, the public wage bill appears to be contemporaneously unrelated to private investment and consumption, the current account, and labor productivity. Theoretically, fiscal policy actions (e.g. reducing the public wage bill) might have an effect on private profits and the resulting higher profits would generate higher investment in the private sector (see Abel and Blanchard, 1986). The aforementioned labor market channel implies that higher profits are the result of lower labor compensation per employee in the private sector as a consequence of the lower public wage bill (see Alesina et al., 2002). Therefore, we argue that our findings give support to these hypotheses because the process of wage moderation and increasing profits might easily take more than a year; thus, the time elapsed between the cut in public wages and the increase in profits should preclude us to find a contemporaneous effect of public wages on other aggregates of the private sector such as private investment. Finally, since the increase in private investment and profits should lead to a boost in economic growth, this channel is also crucial for explaining the key role of cuts in the public wage bill as a determinant of success in reducing deficit-to-GDP ratios.

Importantly, in all the exercises above we disentangle the potentially different effects of reducing the public wage rate versus reducing the number of public employees; however, our estimates reveal that both policy actions are expected to have a very similar effect on private labor costs

[1]We follow Alesina et al. (2002) in considering this particular measure of private activity. According to these authors, the labor market channel is rationalized on the basis of the effects of fiscal policy and wages on profits and investment as in the q model of Abel and Blanchard (1986). In this framework, both profits and investment are considered as a share of the capital stock; hence, private activity should also be considered as a share of capital stock.

(as argued by Alesina et al., 2002) and also as determinants of successfuls fiscal consolidations.

The remainder of the paper is organised as follows. Section 2 describes the empirical approach considered in the two steps of our empirical analysis as well as the dataset employed. In Section 3 we present our empirical results and Section 4 provides some dicussion and policy implications of these findings. Finally, some concluding remarks are presented in Section 5.

2 Empirical Approach

2.1 Fiscal Consolidations and the Public Wage Bill: Bayesian Model Averaging

In the first part of this paper we follow Hernandez de Cos and Moral-Benito (2013) and consider Bayesian Model Averaging (BMA) in an attempt to shed light on the role of the public wage bill during successful fiscal consolidations. To be more specific, we extend the analysis in Hernandez de Cos and Moral-Benito (2013) by considering the two components of the public wage bill separately, namely, the number of public employees and the compensation per employee in the public sector.

There is a large literature on the determinants of success of fiscal consolidation programs. More concretely, the typical approach in this literature is to construct a successful consolidation dummy that takes the value one for those country-years in which the consolidation succeeded in terms of deficit/debt reduction (see data section), and zero otherwise. Then, the researcher runs a regression of this dummy on a set of macro and fiscal variables capturing the environment in which the successful consolidation took place. Depending on the t-statistics of this regression, she concludes which are the most relevant characteristics surrounding a successful fiscal consolidation.

In broad terms, researchers aim to disentangle the importance of four competing explanations of successful consolidations proposed in the literature: (i) the country's fiscal situation prior to the consolidation, proxied by, for example, the government debt as a share of GDP in the previous year (e.g. Perotti, 1999); (ii) the size of the adjustment proxied by the change in primary deficit during the episode (e.g. Giavazzi and Pagano, 1996; Giavazzi et al., 2000); (iii) the composition of the adjustment in terms of the change in the different items of the public bill as a share of the whole change in the primary deficit (e.g. Alesina and Perotti, 1995; McDermott and Wescott, 1996); (iv) the macroeconomic situation captured through the output gap or the growth rate of GDP (e.g. Lambertini and Tavares, 2003).

The papers by Ardagna (2004) — henceforth A04 —, Alesina and Ardagna (1998) — henceforth AA98 —, and Giudice et al. (2007) — henceforth G07 — are good examples of this approach. All the three papers regress the successful consolidation dummy on a set of regressors aiming to capture some of the four hypothesis described above. However, there is no agreement on which regressors / hypothesis must be included in the empirical model (i.e. there is model uncertainty), so that each of the three papers considers a different model. The consideration of alternative

models which are equally plausible a priori given the lack of theoretical guidance represents a concern because the results could crucially depend on the covariates included. In order to illustrate this issue, we borrow Table 1 from Hernandez de Cos and Moral-Benito (2013). This table presents the results obtained when replicating the regressions in the papers by A04, AA98, and G07. From our purposes here, the key result in the table is that the effect of cuts in the public wage bill on fiscal consolidation success crucially depends on the specification considered. Using the A04 specification, cuts in public wages are a key ingredient in successful consolidations; however, according to the specifications by AA98 and G07 their effect is not statistically significant. This clearly illustrates the problem of model uncertainty, i.e., results depend very much on the particular variables included in the regression.

In order to overcome this challenge, there is consensus in the literature that BMA represents the most promising approach. The basic intuition of BMA is based on avoiding the model choice problem. In particular, instead of selecting a single model, BMA estimates all possible models resulting from different combinations of regressors, and identifies the most relevant factors in the success of fiscal consolidation programs as those explaining the highest fraction of the variation in the data.

In contrast to classical estimation, model averaging copes with model uncertainty by allowing for all possible models to be considered, which consequently reduces the biases of parameters.

Formally, consider a generic representation of a linear regression of the form:

$$\Psi = \theta X + \vartheta \tag{1}$$

where Ψ is the dependent variable of interest (the successful consolidation dummy in our case), and X represents a set of covariates (such as public wages, the level of government debt, the size of the consolidation...). Imagine that there are potentially very many empirical models, each given by a different combination of explanatory variables (i.e. different vectors X), and each with some probability of being the 'true' model. This is the starting idea of the BMA methodology. Note that, while model averaging can be interpreted from a frequentist viewpoint, its roots are based on the Bayesian paradigm. See Moral-Benito (2013) for an overview of model averaging methods.

Using the Bayesian jargon, a model is formally defined by a likelihood function and a prior density. Suppose we have K possible explanatory variables. We will have 2^K possible combinations of regressors, that is to say, 2^K different models - indexed by M_j for $j = 1, ..., 2^K$- which all seek to explain y -the data-. M_j depends upon parameters θ^j. In cases where many models are being entertained, it is important to be explicit about which model is under consideration. Hence, the posterior for the parameters calculated using M_j is written as:

$$g\left(\theta^j|y, M_j\right) = \frac{f\left(y|\theta^j, M_j\right) g\left(\theta^j|M_j\right)}{f\left(y|M_j\right)} \tag{2}$$

and the notation makes clear that we now have a posterior, a likelihood, and a prior for each model. The logic of Bayesian inference suggests that we use Bayes' rule to derive a probability statement about what we do not know (*i.e.* whether a model is correct or not) conditional on what we do know (*i.e.* the data). This means the posterior model probability can be used to assess the degree of support for M_j. Given the prior model probability $P(M_j)$ we can calculate the posterior model probability using Bayes Rule as:

$$P(M_j|y) = \frac{f(y|M_j)\,P(M_j)}{f(y)} \tag{3}$$

Since $P(M_j)$ does not involve the data, it measures how likely we believe M_j to be the correct model before seeing the data. $f(y|M_j)$ is often called the marginal (or integrated) likelihood, and is calculated using (2) and a few simple manipulations. In particular, if we integrate both sides of (2) with respect to θ^j, use the fact that $\int g(\theta^j|y, M_j)\,d\theta^j = 1$ (since probability density functions integrate to one), and rearrange, we obtain:

$$f(y|M_j) = \int f\left(y|\theta^j, M_j\right) g\left(\theta^j|M_j\right) d\theta^j \tag{4}$$

The quantity $f(y|M_j)$ given by equation (4) is the marginal probability of the data, because it is obtained by integrating the joint density of (y, θ^j) given y over θ^j. The ratio of integrated likelihoods of two different models is the Bayes Factor and it is closely related to the likelihood ratio statistic, in which the parameters θ^j are eliminated by maximization rather than by integration.

Moreover, considering θ a function of θ^j for each $j = 1, ..., 2^K$, we can also calculate the posterior density of the parameters for all the models under consideration:

$$g(\theta|y) = \sum\nolimits_{j=1}^{2^K} P(M_j|y)\,g(\theta|y, M_j) \tag{5}$$

If one is interested in point estimates of the parameters, one common procedure is to take expectations across (5):

$$E(\theta|y) = \sum\nolimits_{j=1}^{2^K} P(M_j|y)\,E(\theta|y, M_j) \tag{6}$$

Following Leamer (1978), we calculate the posterior variance as:

$$\begin{aligned} V(\theta|y) &= \sum\nolimits_{j=1}^{2^K} P(M_j|y)\,V(\theta|y, M_j) \\ &+ \sum\nolimits_{j=1}^{2^K} P(M_j|y)\left(E(\theta|y, M_j) - E(\theta|y)\right)^2 \end{aligned} \tag{7}$$

Inspection of (7) shows that the posterior variance incorporates both the estimated variances of the individual models as well as the variance in estimates of the θ's across different models. Hence, the uncertainty at the two different levels mentioned above is taken into account.

Moreover, the BMA methodology allows constructing a ranking of variables ordered by their robustness. In this paper, robustness as determinants of successful fiscal consolidations. In order to construct our measure of robustness, we estimate the posterior probability that a particular

variable h is included in the regression, and we interpret this probability as the likelihood that the variable belongs to the true empirical model. In other words, variables with high posterior probabilities are considered as *robust* determinants of success when a fiscal adjustment is carried out. This is called the *posterior inclusion probability* for variable h, and it is calculated as the sum of the posterior model probabilities of all of the models including that variable:

$$\text{posterior inclusion probability} = P\left(\theta_h \neq 0|y\right) = \sum\nolimits_{\theta_h \neq 0} P\left(M_j|y\right) \tag{8}$$

As an indication of our ignorance, we assume that all the possible models are equally probable a priori so that $P(M_j = 1/2 \ \ \forall \ \ j = 1, ..., 2^K$. This prior on the model space also implies a prior on the regressors, in particular, it implies that all regressors have a prior inclusion probability equal to 0.5. It is usual in the model averaging literature to impose a threshold to determine which variables are robust. More concretely, a commonly-used threshold is the prior inclusion probability, i.e. those regressors with posterior inclusion probability higher than the prior inclusion probability are labeled as robust because the data supports their inclusion in the model.

On the other hand, we make use of the Schwarz asymptotic approximation to the Bayes Factor, and therefore replace equation (3) by:

$$P(M_j|y) = \frac{P(M_j) N^{\frac{-k_j}{2}} SSE_j^{-\frac{N}{2}}}{\sum_{i=1}^{2^K} P\left(M_i\right) N^{\frac{-k_i}{2}} SSE_j^{-\frac{N}{2}}} \tag{9}$$

where SSE_j is the sum of squares for model j, and N is the number of observations. Therefore, instead of equation (6) we will use:

$$E\left(\theta|y\right) = \sum_{j=1}^{2^K} P\left(M_j|y\right) E\left(\theta|y, M_j\right) = \sum_{j=1}^{2^K} P\left(M_j|y\right) \widehat{\theta}^j_{OLS} \tag{10}$$

where $\widehat{\theta}^j_{OLS}$ is the OLS estimate for model j. Equation (10) is true if we either assume diffuse priors on the parameter space for any given sample size, or have a large sample for any given prior on the parameter space. Equations (9) and (10) are the basis of the BACE approach described in Sala-i-Martin et al. (2004) in the context of growth regressions.

2.2 The Public Wage Bill and Private Sector Activity: Cross-Country Panel Regressions

Having established the role of public wages on the success of fiscal consolidations in a first step, we now turn to the issue of understanding the channels that might explain the importance of cuts in the public wage bill as a part of consolidation programs. Four main arguments have been advanced by key policymakers for focusing cuts on public sector pay and employment in the current consolidation environment. The first is that it is "fair" for public sector workers to take pay cuts because they have much more job security than private sector workers. The second is

that it is the most effective way to achieve short-run improvements in the fiscal position. The third is that, if the underlying problem facing the country is one of national competitiveness, public sector wage cuts are the best way to drive down overall wages and prices and thus improve competitiveness. The fourth is that the state sector is simply too big and/or it is in the interests of longer-run efficiency or productivity to shrink the state.

The first potential mechanism would be better understood exploiting data at the micro level given individual heterogeneity difficult to capture at the aggregate level. The second argument is quite obvious and purely mechanical, but probably not enough from an social viewpoint, especially if not assessed against other effective expenditure-reducing measures. Regarding the fourth argument, we must acknowledge that estimating the optimal size of the public sector (and its impact on aggregate productivity) is certainly beyond the scope of the current paper. All in all, we focus here in the understanding and plausibility of the third channel mentioned above.

More concretely, the aim in this second part of the paper is to investigate the relationship between the components of the public budget, especially the public wage bill, and some drivers of economic growth from the private sector, especially private labor costs. In order to improve national competitiveness and boost growth through cuts in the government wage bill, the labor market represent the main channel. Investment decisions by firms are driven by the expected present value of the net marginal product of capital, which in turn is a negative function of real wages. Fiscal consolidations obtained through expenditure cuts can then reduce wage pressures and so increase short-run investments.

In order to further investigate this channel, we follow Alesina et al. (2002) and consider a simple econometric framework as follows:

$$Y_{it} = \alpha Y_{it-1} + \gamma PGDP_{it} + \lambda R_{it} + \phi_j X_{it,j} + \eta_i + \delta_t + \epsilon_{it} \tag{11}$$

where i and t refer to countries and years, respectively; Y_{it} is the macroeconomic aggregate of interest, which may be labor productivity, labor costs in the private sector, private investment, private consumption, or the current account; $pGDP_{it}$ refers to a measure of "private GDP", obtained as the ratio of total GDP less government consumption divided by the capital stock; R_{it} refers to total revenues as a share of GDP; and, $X_{it,j}$ is the j-ism expenditure item of the public budget, including, wage expenditures, non-wage expenditures, subsidies, and transfers. Despite wage expenditures is our main variable of interest, we also consider other components of the public budget to compare the differences in the estimated effects as a sort of placebo test. We include a set of year dummies (δ_t) in order to account for potential interdependencies across countries; we also include a set of country dummies (η_i) in the model to control for cross-country heterogeneity potentially correlated with the regressors.

We are aware of the difficulties in giving a causal interpretation to the coefficients in equation (11). On the revenue side, it is evident that the higher the private consumption, the higher the tax base and thus higher government revenues will follow. Therefore, in order to address

this concern we focus on spending components of the public budget that, albeit also correlated with macroeconomic aggregates of the private sector, present a less straightforward relationship. Following Alesina et al. (2002), we also control for R_{it} and $PGDP_{it}$ in equation (11). This is so because a given fiscal policy on the expenditure side may be accompanied by a tax measure that, if not accounted for, will bias our estimates; also, by including $PGDP_{it}$ in our regressions we take into account shocks to private activity that might simultaneously affect some items of the public bill and macroeconomic aggregates.

More importantly, we also consider two alternative identification strategies in order to estimate the effect of the j-ism expenditure item of the public bill ($X_{it,j}$) on the macroeconomic aggregates (Y_{it}) in (11), as ϕ_j is the main coefficient of interest. In addition to the exogeneity assumption, we also consider a partial endogeneity assumption (in the panel data terminology, partially endogenous regressors are also known as predetermined or weakly exogenous regressors). While exogeneity rules out the possibility of feedback effects from the macroeconomic aggregates to the items of the public budget, partial endogeneity (or predeterminedness) allows for such feedback effects; for instance, private consumption in year t is allowed to affect tax revenues and government spending in the current and subsequent years $(t, t+1, t+2, ...)$.

The two alternative identifying assumptions can be formalized as follows:

$$E\left(\epsilon_{it} \mid Y_i, Z_i, \eta_i, \delta_t\right) = 0 \qquad \text{(EXOGENEITY)} \tag{12}$$

$$E\left(\epsilon_{it} \mid Y_i^{t-1}, Z_i^t, \eta_i, \delta_t\right) = 0 \qquad \text{(PREDETERMINEDNESS)} \tag{13}$$

where $Y_i = (Y_{i1}, ..., Y_{it}, ..., Y_{iT})'$, $Z_i = (z_{i1}, ..., z_{it}, ..., z_{iT})'$, $Y_i^{t-1} = (Y_{i1}, ..., Y_{it-1})'$, $Z_i^t = (z_{i1}, ..., z_{it})'$, and $z_{it} = (PGDP_{it}, R_{it}, X_{it,j})'$.

Note that the key difference between the two alternative identification assumptions (namely, exogeneity and predeterminedness) is given by the elements (Y_i, Z_i) versus (Y_i^{t-1}, Z_i^t) in the conditioning set. In the exogeneity case, Z_i implies that the full path of private GDP and fiscal policy variables is independent of the shock to the macroeconomic aggregate Y in period t for a given country i. In contrast, in the predeterminedness assumption, only past observations of the fiscal variables are independent of the current macroeconomic shock while future observations are allowed to be affected by current macroeconomic shocks, i.e., there are feedback effects from the macroeconomic variables to the fiscal policy variables. Additionally, note that an analogous reasoning applies to the case of the lagged dependent variable (Y_{it-1}) which, given the dynamics of the model, is endogenous by construction. Finally, correlation between the country-specific effects (η_i) and the right-hand-side variables (Y_{it-1} and Z_{it}) is also allowed.

In order to estimate the model under the exogeneity assumption (13) we make use of a panel OLS estimator with country-specific effects. On the other hand, in order to accomodate the predeterminedness assumption (13) several estimators are available in the literature. The most common approach to handling the presence of fixed effects and predetermined regressors is to first-difference the data and use the panel IV or GMM estimators suggested in Anderson and

Hsiao (1982) and Arellano and Bond (1991). The intuition behind both estimators is based on using lagged levels of the variables as instruments of their first differences.[2] More concretely, Anderson and Hsiao (1982) propose to use one lag as instrument, while, in order to gain efficiency in the estimates, Arellano and Bond (1991) suggest a particular combination of all available lags as instruments.

In a panel setting in which neither T is small nor N is large (as it is our case with around 20 countries and 20 time periods) the proliferation of reduced form coefficients is a concern in the Arellano and Bond's (1991) estimator. Intuitively, with $N = 20$ and $T = 20$, some reduced form equations would be linear projections with $N = 20$ observations and $T - 1 = 19$ regressors. All in all, our preferred option is the first-differenced GMM approach developed by Arellano and Bond (1991) but based on the time-series approach in Anderson and Hsiao (1982); hence, we consider one moment condition per time period so that the number of lagged instruments does not grow with T, the number of time periods in our sample.

As a final remark, we acknowledge an important limitation of this dynamic panel estimator. While it allows us to accommodate regressors' endogeneity with respect to the permanent component of the error term (i.e. the country-specific effects) as well as feedback from the dependent variable (private sector aggregates) to the regressors (items of the public bill), it is based on the assumption that past realizations of the right-hand-side variables are exogenous with respect to transitory shocks. Despite its relevance, this issue is very difficult to handle due to the lack of readily available instrumental variables. The reason is that it is difficult to find a set of variables related to the items of the public bill but not directly related to the private sector aggregates. Therefore, we see this issue in this setting as a challenging topic for future research.

2.3 Data

The data used in this paper are from the OECD Economic Outlook No. 84.[3] The sample includes annual information from 1980 to 2007 for 21 OECD countries, namely, Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and the United States.

In order to conduct the BMA empirical analysis outlined in section 2.1 we consider a dummy of successful fiscal consolidations. More concretely, we follow Hernandez de Cos and Moral-Benito (2013) and use the presistence criterion for defining successful consolidations. This criterion iden-

[2]Another alternative is the use of the so-called system-GMM estimator introduced by Arellano and Bover (1995) and Blundell and Bond (1998) that also exploits first differences of the variables as instruments for the equation in levels. However, this estimator requires the additional assumption of mean stationarity of the variables, which in the case of GDP growth is very restrictive.

[3]This dataset was also used in Hernandez de Cos and Moral-Benito (2013). We thank Silvia Ardagna for kindly sharing the data.

tifies as successful those consolidations in which the primary cyclically adjusted budget balance improves by at least three percentage points of GDP over three consecutive years (i.e. between $t-2$ and t, between $t-1$ and $t+1$ or between t and $t+2$), and in each year the change in the primary cyclically adjusted budget balance cannot be below -0.5 percentage points of GDP.

We acknowledge that how to define a successful consolidation is not straightforward, and the literature has considered different criteria. For instance, according to the debt based criterion, successful fiscal adjustments are those in which the cumulative reduction of the debt-to-GDP ratio three years after the beginning of the adjustment is greater than 4.5 percentage points. While the successful episodes identified from the two definitions are not exactly the same, there is a large overlapping.

Note that we isolate successful consolidations from the pool of all the fiscal consolidations identified by Alesina and Ardagna (2010), who define a fiscal consolidation episode in a given year if the cyclically adjusted primary balance (CAPB) improves by at least 1.5% of GDP. Given our panel of 21 countries and 28 years, there are 588 country-year observations in our dataset. According to the definitions above, we have in our sample a total of 17 successful consolidations out of a total of 99 fiscal consolidation years. Some examples of successful consolidations included in our sample are those of Denmark in 1984, Finland in 1998, and Canada in 1995. All in all, our first-step results (on the identification of the main determinants of successful consolidations) are based on cross-country regressions with 99 observations, the number of consolidations identified in our sample. In this respect, having only 17 episodes of successful consolidations is not a big concern because they imply a "rate of success" of 17% in our probit-type regressions, which is relatively high. We acknowledge that the overall sample of 99 consolidation episodes is rather limited and it might represent a concern in terms of degrees of freedom for estimation.[4]

In order to form the model space (i.e. the set of right-hand-side variables), the potential determinants of successful consolidations are those considered in Hernandez de Cos and Moral-Benito (2013) and detailed in the Appendix A.1. Our main motivation for considering these candidate determinants is based on previous literature, which typically aims at disentangling the importance of four competing explanations of successful consolidations, the country's fiscal situation prior to the consolidation, the size of the adjustment, the composition of the adjustment, and the macroeconomic situation. However, we acknowledge that the BMA results will be conditional on the model space considered, which is restricted to the 17 variables in Appendix A.1. Along these lines, it might well be that some variables omitted in our analysis such as structural reforms (see e.g. Duval, 2008) are simultaneously affecting the probability of consolidation success and the developments of our right-hand-side variables. We acknowledge that this represents a limitation

[4]One possibility to address this concern might be to consider an alternative definition of fiscal consolidation (e.g. reducing the threshold of 1.5% of GDP) in order to increase the sample size. However, we think that this approach would imply a substantial deviation from a widely-used and well-established definition that it is not worth assuming.

of our study and thus the results must be interpreted with caution in this respect.

Regarding the data used in the cross-country panel regressions explained in section 2.2, we consider both fiscal and macro variables. The fiscal variables considered are primary spending, total revenues, wage expenditures, non-wage expenditures, subsidies, and transfers (note that we follow Alesina et al., 2002 so that all the variables belonging to the public bill are cyclycally adjusted as a share of trend GDP). In the panel regressions, we also consider five macro variables, labor productivity, labor costs in the private sector, private investment, private consumption, and the current account balance (see Appendix A.2. for more details).

3 Results

3.1 Fiscal Consolidations and the Public Wage Bill

The results on the main determinants of successful fiscal consolidations when applying the BMA approach outlined in section 2.1 are presented in Table 2. The Table summarizes the posterior distributions of the parameters corresponding to the all the variables included in our dataset as potential determinants of success in fiscal adjustment processes (see Appendix A.1.).

In particular, columns (1), (3), and (5) of Table 2 report the posterior inclusion probability (PIP) of each variable. To judge the effectiveness of a regressor in explaining the success of fiscal consolidations, we can interpret the results following a rule of thumb proposed by Kass and Raftery (1995). According to this rule, the evidence of a regressor having an effect is weak, positive, strong, or decisive if the posterior inclusion probabilities lie between 50-75%, 75%-95%, 95%-99% or are greater than 99%, respectively; if the posterior inclusion probability is smaller than 50% there is no evidence at all of the regressor having a significant effect. This is why an alternative rule of thumb is often used, if the posterior probability is larger than the prior probability (typically 50%) we conclude than the regressor exert a significant effect on the dependent variable. On the other hand, we should keep in mind that the PIP ranking is interesting per se because it orders the variables by their relative importance in the contribution to the model fit. Those variables with higher PIP are the ones that contribute most to explaining the dependent variable's variation, in our case the successful consolidation episodes.

Columns (2), (4), and (6) of Table 2 present the ratio of mean to standard deviation of the coefficients' BMA posterior distributions.[5] While the exact distribution of the ratio of BMA posterior mean to posterior s.d. reported in these columns is not known, several interpretations of this ratio are available in the literature. Raftery (1995) suggests that for a variable to be considered as effective the ratio of mean/s.d. (in absolute value) must exceed 1, which from a frequentist viewpoint implies that the regressor improves the power of the regression. Masanjala

[5]Note that the mean and standard deviations are conditional of the variable being included in a model; however, unconditional versions of these moments can be easily recovered.

and Papageorgiou (2008) are more stringent and consider a threshold value of the mean/s.d. ratio of 1.3, which approximately corresponds to a 90% confidence interval in frequentist approaches. Finally, Sala-i-Martin et al. (2004) set this threshold at 2 since they argue that having a mean/s.d. ratio of 2 in absolute value indicates an approximate 95% Bayesian coverage region that excludes zero.

While both measures, the PIP and the ratio of posterior mean to posterior s.d., have been discussed in the literature, it is also true that BMA researchers have traditionally considered PIPs as the key measure to identify regressors robustly related to the dependent variable of interest. This is so because, intuitively, PIPs summarize the contribution of each regressor in explaining the variation of the dependent variable, while the posterior ratio is only an imperfect and non-Bayesian summary of the full posterior distribution, that ideally should be analyzed in detail for each regressor.

Overall, the results in Table 2 indicate that only the reductions in the public wage bill appear to be the robustly correlated with successful fiscal consolidations. Looking at columns (1) and (2), only the change in wage expenditures has a PIP larger than 50%, which indicates that it is the only variable —among those considered in this paper— having an effect on the likelihood of success of fiscal consolidation programs in terms of persistence of the deficit reductions. Moreover, it is also the variable with the highest ratio of posterior mean to posterior standard deviation; in particular, its ratio of mean/s.d. is clearly larger than 2, which confirms the statistical significance of the estimated effects.[6] Interestingly enough, no other variable among the 17 included in the analysis has a PIP larger than 50%; we interpret this fact as evidence of the difficulties in empirically explaining the success of fiscal consolidation programs. Finally, it is worth mentioning that, in spite of having a PIP lower than 50%, the GDP growth rate has a mean/s.d. ratio larger than 2 and positive, which indicates that economic growth might also be a key ingredient accompanying successful consolidations.

We now turn to the results when separately considering the two components of the wage expenditures item, namely, the number of public employess (public employment) and the compensation per employee in the public sector (public wage). Columns (3) and (4) of Table 2 present the results. Both components present the largest PIPs among the considered variables and they are both larger than 50%. This finding indicates that both policy tools (reducing the number of public employees or cutting the public wage rate) are equally effective for reducing budget deficits; as argued by Alesina et al. (2002), in both cases the reservation utility of the union members goes down and the wage demanded by the union for private sector workers decreases, increasing profits, investment and competitiveness. With respect the remaining regressors, while PIPs are now larger for all of them in comparison to column (1), they are all below the 50% threshold. Regarding the mean/s.d. ratios, both components of the public wage bill have a ratio larger

[6]Note that the items of the public budget are expressesed in growth rates, thus the negative ratio of mean to s.d. indicates that cuts in public wage expenditures increase the likelihood of success.

than 1.3, which approximately corresponds to a 90% confidence interval in frequentist approaches according to Masanjala and Papageorgiou (2008). Also, the GDP growth rate again has a ratio larger than 2 confirming the result in column (2) commented above.

As a final exercise, we present in columns (5) and (6) the BMA results when forcing the components of the public wage bill to be included in all models under consideration. Therefore, the number of estimated models is $2^{16} = 65,536$ instead of $2^{18} = 262,144$, and the PIP of the public wage bill variables is 100% by definition. In this exercise we aim to investigate whether other regressors are robust once wage expenditures are accounted for. However, we observe that, even if public wage expenditures are not considered in the BMA estimation exercise, no variable arises as a robust determinant of successful consolidations.

As a final remark, we acknowledge an important limitation of the approach considered in this section. While it allows us to handle model uncertainty, it is based on the assumption that the right-hand-side variables are strictly exogenous; hence, feedback from successful consolidations to the regressors is not allowed. Despite its relevance, this issue is typically neglected in the literature mainly due to the lack of additional variables that could constitute good instruments. On the one hand, it is very hard to find a set of variables related to the items of the public budget but not directly related to the success of the consolidation programs; on the other hand, the lack of enough time-series observations precludes the use of lagged levels of the regressors as instruments.

3.2 The Public Wage Bill and Private Sector Activity

The potential nonstationarity of the variables we consider in this section is cause of concern because it might lead to spurious correlations given the presence of a common stochastic trend. Therefore, our first step is to test for the presence of a unit root in each panel series. For this purpose, we employ the panel unit root test proposed by Im et al. (2003). For all the series considered the test statistic fails to reject the null of a unit root. Individual tests for each country yield a similar verdict - they fail to reject the null in the overwhelming majority of cases. After taking first differences, however, the panel tests reject the null of nonstationarity for each of the variables. From this we decide to estimate the empirical model outlined in section 2.2 in first differences.

Table 3 presents the results of our basic specifications in equation (11) under the assumption of exogeneity. In columns (1) and (2) labor productivity is the dependent variable; we can see that both overall government primary spending (G) and public wage expenditures (GW) show a negative and marginally significant correlation with aggregate labor productivity, which might suggest a potential positive effect from reducing the public wage bill along the lines of gaining national competitiveness. Columns (3) and (4) show the estimates when considering compensation per employee in the private sector as dependent variable, our main specification of interest in the paper. While overall public spending is not significantly related to the private

wage rate (WP), public wage expenditures present a positive a highly significant correlation with this variable, providing further evidence in favour of the labour market channel in Alesina et al. (2002). In the remaining columns of Table 3, we consider alternative macroeconomic aggregates as a sort of placebo test since there is the possibility that both public and private aggregates are correlated due to some factors/shocks not included in our empirical model. In particular, we consider private consumption (PCONS), private investment (PINV) and the current account balance (CA) in columns, (5)-(6), (7)-(8), and (9)-(10) respectively. It is reasuring for our purposes that public wage expenditures are not significantly related to any of these private aggregates; we interpret this as evidence that the significant correlation between public wage expenditures and the compensation per employee in the private sector is not driven by omitted factors causing both private and public aggregates.

Table 4 presents the GMM counterparts of the OLS estimates reported in Table 3. As discussed in section 2.2, under the exogeneity assumption there is the concern that feedback effects from private activity to the public budget (through either tax revenues or expenditures) might bias the estimated effects of the different items of the public bill on private activity. Indeed, this seems to be the case of labor productivity since once we account for feedback from labor productivity to public wage expenditures the effect of the latter on the former becomes statistically indistinguishable from zero. Interestingly enough, the effect remains positive and significant in the case of compensation per employee in the private sector as reported in column (4). We interpret this estimate as evidence that the direction of causality go from the public to the private sector in this case, especially in times of fiscal consolidation (see e.g. Lamo et al., 2012). At least we can safely conclude that the positive and significant correlation we find is "net of" feedback effects from private to public compensation per employee. To be more concrete, our estimate of the GW coefficient in column (4) indicates that a 1 percentage point reduction in the public wage bill would generate a fall in the private sector wage rate of 0.3 pp. We are aware that this hypothesis crucially depends not only upon the composition of adjustment (expenditure cuts, particularly the wage bill, versus tax increases) but also on institutional factors such as the functioning of the labor market.

Regarding the appropriateness of our econometric specification, AR(2) tests on residuals in the first-differenced GMM estimations indicate that there is no further serial correlation in the specifications considered. On the other hand, Hansen tests of overidentifying restrictions do not reject joint consistency of the moment conditions in any specification presented.[7]

[7]Hansen p-values are close to 1, which is usually considered as an indication of overfitting in GMM estimates. However, given our time-series perspective a la Anderson and Hsiao (1982), we do not expect this to be the case in spite of having T relatively large. Our interpretation of these high values is that we might have redundant moment conditions in these specifications; for the sake of intuition, consider the simplest case where you have a just-identified model, the GMM objective function is 0 by construction and thus the hypothetical Hansen p-value would be 1. If you add one additional moment restriction that is a linear combination of the original moments, the model is no longer just-identified and we would have one over-identifying restriction, but the corresponding Hansen p-value would still be equal to 1. In our setting, this sort of redundant moments arises because for each

In Table 5 we aim to disentangle the potentially different effects of the two alternatives to reduce overall wage expenditures in the public sector, namely, reductions in the number of public employees, and cuts in the public wage rate. Theoretically, both alternatives should have the same effect, the reservation utility of the union members goes down and the wage demanded by the union for private sector workers decreases. Indeed, this is basically our main finding in Table 5. We see in columns (3) and (4) that both coefficients are positive and statistically significant; moreover, the magnitude of the effects is very similar and statistically indistinguishable according to both OLS and GMM estimates. It is important to remark that, while the effect on the compensation per employee in the private sector is the same, the potential implications of the two alternatives might substantially differ in terms of public sector efficiency (see discussion below). Turning to the other macroeconomic aggregates, we again find no effect on private consumption, private investment and the current account. Also, the hypothesis that cuts in public wages and/or public employment might increase labor productivity is not sharply at odds with the data as found in Tables 3 and 4. However, the channels explaining this result remain unexplored and statistical significance is marginal.

Table 6 tentatively explores the potential long-run effects of cuts in the public wage bill on compensation per employee in the private sector. In particular, we consider the same empirical model (see equation 11) but splitting our data into 5-, 8-, and 10-year periods instead of exploiting annual data. By doing so, the reduction in the number of time series observations available for estimation preclude us from considering GMM estimates, and thus, we focus here on OLS estimates. While columns (1)-(3) indicate that the effect is still present over a 5-year horizon, columns (4)-(6) point to a dilution of the estimated impact after 8 years. The magnitude of the effects is a bit smaller after 5 years and almost half after 8 years when considering the wage rate and the number of employees separately (note also that we cannot include in these specifications the lagged dependent variable). After 14 years, the estimated effect is roughly zero, both economically and statistically. Finally, we also estimated the same regressions using other private sector aggregates as dependent variables, in all cases the estimated effects were statistically insignificant (these results are not reported here for the sake of brevity but are available upon request).

Table 7 reports GMM estimates of equation (11) using alternative expenditure items of the public bill as regressor of interest. In particular, we consider the same private sector indicators and three expenditure items, government non-wage bill expenditures, subsidies, and transfers. First, non-wage expenditures only have a marginally significant effect on private consumption. Second, once we take into account the feedback from private aggregates, transfers do not have any significant effect on private activity. Third, subsidies present a significant (and negative)

time period we consider a moment condition given by a linear combination of past values of the regressors as instrument for the first-differenced errors; thus, the moments for two consecutive time periods exploit basically the same set of information.

effect on labor productivity. One might argue that cutting certain subsidies can improve economic efficiency (and thus long-term economic growth) if they are focused on declining sectors potentially hampering structural change.

To sum up, our findings indicate that cuts in the public wage bill significantly reduce the labor costs of the private sector; however, public wage expenditures appear to be unrelated to private investment and consumption, the current account, and labor productivity. Importantly, this result holds for both components of the public wage bill, either cuts in the number of employees or reductions in the wage rate. Finally, other expenditure items (e.g. transfers, subsidies, and non-wage expenditures) are not significantly related to private activity.

4 Discussion and Policy Implications

In many EU countries, high or rapidly rising government debt levels leave no alternative to decisive and credible fiscal consolidation because government debts could become unsustainable, especially in the current environment of low growth, low inflation and relatively high interest rates. In particular, self-reinforcing vicious circles regarding interest rates on government bonds represent an important threat and must be taken into account in order to avoid significant increases in these interest rates that might make public debt levels unsustainable.

Therefore, it seems obvious that in many countries the need for fiscal consolidation is so large that it cannot be delayed or significantly diluted. However, there is also a danger that austerity could become self-defeating, and, thus it is crucial to develop smart fiscal consolidation measures which strike an appropriate balance between the need and danger of austerity. Crucially, it is our opinion that it is indispensable regaining credibility by means of decisive reform programmes accompanied by clearly defined medium-term consolidation plans.

Along these lines, economic growth might also help to reduce consolidation requirements, mainly for two reasons. First, progress in fiscal adjustment is directly affected by growth since government debt and budget deficits are typically reported as a percentage of GDP. Second, economic growth can also contribute to consolidation via increasing government revenues. Therefore, a crucial challenge for policymakers is to identify consolidation measures which are growth-promoting or at least less growth-retarding. In fact, Heylen et al. (2011) found only 3 out of 40 consolidation episodes between 1980 and 2008 where the government debt-to-GDP ratio was successfully reduced during periods of weak economic growth

Having the above considerations in mind, there is broad consensus in the literature that cutting public expenditures is less harmful for economic activity than raising taxes. In particular, among the different items of the public expenditures bill, we investigate in this paper the role of cuts in the wage expenditures. Our findings in section 3.1 indicate that cuts in the public wage bill is the most effective tool for achieving success when reducing public deficits as a percentage of GDP, at least this has been so in the past. In addition to the policy-oriented arguments of social fairness

and too big state sector that might foster the acceptance of policy reforms within the broad public,[8] there are two economic channels that might explain this finding, namely, the effectiveness of cuts in public wages/employment to achieve short-run improvements in the fiscal position, and the potential effects of public sector wage/employment cuts on overall wages and prices, which could improve competitiveness and foster economic growth.

With respect to the first channel, public sector wage bills account for more than 20% of total public spending, and around 10% of GDP in the EU27. Therefore, in purely mechanical terms (i.e. excluding feedback effects), an across-the-board public sector wage cut of 5% reduces public spending by around 1%. Turning to the competitiveness channel, we find robust evidence in section 3.2 that cuts in the public wage bill, both in terms of wage cuts and number of staff reductions, are translated to the private sector by means of reductions in private labor cost. For instance, a reduction of 5% in the public wage rate would imply a fall of around 1.5% in the private labor costs. This confirm the labor market channel discussed in Alesina et al. (2002). According to this view, reductions in public wages and/or employment put downward pressure on private sector wages, which is consistent with competitive or unionized labor-market models. Then, workers in the private sector may react by increasing the labor supply or accepting lower wages, thus leading to increasing profits, investment and economic growth.

The appealing of these arguments for the policy-maker must be balanced with an important caution remark. The main objective should be to improve the efficiency of government interventions in such a way as to achieve the same policy outcome with fewer resources, and, as efficiency potentials differ from country to country, a comprehensive review of all potential measures regarding cuts in the public wage bill should be taken. In particular, in cases where the public administration is lacking efficiency, in-depth analysis of the appropriate level of staffing and of wages should be part of the consolidation agenda. For instance, it is often argued that, since the knock-on effects of wage cuts on aggregate demand are likely to be relatively high, the negative demand effects could be reduced by concentrating cuts among the highly paid and exempting the low paid. Despite it is difficult to generalise across European countries, there is ample evidence in the literature that the public wage premium is higher for low-skilled and "low paid" workers while for high-skilled and "highly paid" workers the conditional public-private wage gap is even negative (see e.g. Hospido and Moral-Benito, 2013). Therefore, concentrating the public wage cuts among high-skilled workers might generate undesirable effects in terms of worsening of public sector efficiency as the "better" public workers move to the private sector.

[8]This argument refers to the fact that it is "fair" for public sector workers to take pay cuts because they have much more job security than private sector workers. Also, the optimal size of the public sector represents an economic issue clearly beyond the scope of the present paper.

5 Concluding Remarks

Fiscal consolidation has become necessary in many EU countries following the rise in deficits and debt caused by the financial and economic crisis. How to successfully consolidate budgets is closely related to avoiding the negative growth consequences of fiscal adjustments. Indeed, over the 1980-2008 period, only 3 out of 40 consolidation episodes where the government debt-to-GDP ratio was successfully reduced were accompanied by weak economic growth (see Heylen et al., 2011).

Economic growth might help to reduce consolidation requirements by directly affecting debt- and deficit-to-GDP ratios through the denominator, and also by increasing government revenues. Therefore, a crucial challenge for policymakers is to identify consolidation measures which are growth-promoting or at least less growth-retarding. In particular, successful fiscal consolidation implies that the private sector compensates the public sector.

In this paper we argue that the public wage bill might play a crucial role in achieving these objectives. On the one hand, we find that cuts in the public wage rate and/or reductions in the number of public employees are the most robust determinant of successful fiscal consolidations. This might be due to either the effectiveness of cuts in public wages/employment to achieve short-run improvements in the fiscal position, or the potential effects of public sector wage/employment cuts on overall wages and prices, which could improve competitiveness and foster economic growth. In order to further investigate this second channel, we run cross-country regressions of private sector aggregates of different expenditure items of the public budget. We find that wage expenditures is the only item significantly affecting private activity; in particular, we observe that reducing public wage expenditures generates reductions in the compensation per employee in the private sector and thus might improve competitiveness, increasing profits, investment and economic growth as hypothesized by Alesina el al. (2002).

References

[1] Abel, A. and O. Blanchard (1986) The Present Value of Profits and Cyclical Movements in Investment. Econometrica, 54: 249273.

[2] Alesina, A. and S. Ardagna (1998) Tales of Fiscal Adjustments. Economic Policy, 13: 489-545.

[3] Alesina, A. and S. Ardagna (2010) Large Changes in Fiscal Policy: Taxes versus Spending. Tax Policy and the Economy, Editor: R. Brown, vol. 24. NBER.

[4] Alesina, A., S. Ardagna, R. Perotti, and F. Schiantarelli (2002) Fiscal policy, profits, and investment. American Economic Review 92:571-589.

[5] Alesina, A., and R. Perotti (1995) Fiscal Expansions and Adjustments in OECD countries. Economic Policy, 21: 205-248.

[6] Anderson, T, and C. Hsiao (1982) Formulation and estimation of dynamic models using panel data. Journal of Econometrics 18:47-82.

[7] Ardagna, S. (2004) Fiscal Stabilizations: When Do They Work and Why. European Economic Review, 48: 1047-1074.

[8] Arellano, M., and S. Bond (1991) Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. Review of Economic Studies 58: 277-297.

[9] Arellano, M., and O. Bover. 1995. Another Look at the Instrumental Variable Estimation of Error-Components Models. Journal of Econometrics, 68: 29-52.

[10] Blundell, R., and S. Bond (1998) Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. Journal of Econometrics, 87: 115-143.

[11] Duval, R. (2008.) Is there a role for macroeconomic policy in fostering structural reforms? Panel evidence from OECD countries over the past two decades. European Journal of Political Economy, 24: 491-502.

[12] Giavazzi, F., T. Jappelli, and M. Pagano (2000) Searching for non-linear effects of fiscal policy: evidence for industrial and developing countries. European Economic Review, 44: 1269-1289.

[13] Giavazzi, F., and M. Pagano (1990) Can Severe Fiscal Contractions Be Expansionary? Tales of Two Small European Countries. NBER Macroeconomics Annual, pp. 95-122, MIT Press.

[14] Giudice, G., A. Turrini, and J. in't Veld (2007) Non-Keynesian Fiscal Adjustments? A Close Look at Expansionary Fiscal Consolidations in the EU. Open Economies Review, 18: 613-630.

[15] Hernandez de Cos, P. and E. Moral-Benito (2013) What drives a successful fiscal consolidation? Applied Economics Letters 20:748-753.

[16] Heylen, F., A. Hoebeeck, and T. Buyse (2011) Fiscal Consolidation, Institutions and Institutional Reforms: A Multivariate Analysis of Public Debt Dynamics, Working Paper no. 2011/763, Universiteit Gent.

[17] Hospido, L. and E. Moral-Benito (2013) The Public Sector Wage Gap in Spain: Evidence from Income Tax Data. Mimeo, Banco de España.

[18] Kaas, R. and A. Raftery (1995) Bayes Factors. Journal of the American Statistical Association. 90: 773-795.

[19] Im, K., M. Pesaran, and Y. Shin (2003) Testing for unit roots in heterogenous panels. Journal of Econometrics 115:53-74.

[20] Lambertini, L., and J. Tavares (2003) Exchange Rates and Fiscal Adjustments: Evidence from the OECD and Implications for EMU. Boston College Working Paper 576.

[21] Lamo, A., J. Pérez, and L. Schuknecht (2012)Public or private sector wage leadership? An international perspective. Scandinavian Journal of Economics 144: 228-244.

[22] Leamer, E. 1978. Specification Searches. New York: John Wiley and Sons.

[23] Masanjala, W., and C. Papageorgiou (2008) Rough and Lonely Road to Prosperity: a Reexamination of the Sources of Growth in Africa using Bayesian Model Averaging Journal of Applied Econometrics, vol. 23, pp. 671-682.

[24] McDermott, J., and R. Wescott (1996) An Empirical Analysis of Fiscal Adjustments. IMF Working Paper No.96/59.

[25] Moral-Benito, E. (2013) Model Averaging in Economics: An Overview. Journal of Economic Surveys, forthcoming.

[26] Perotti, R. (1996) Fiscal Consolidation in Europe: Composition Matters. American Economic Review, 86: 105-110.

[27] Perotti, R. (1999) Fiscal Policy In Good Times And Bad. The Quarterly Journal of Economics, 114: 1399-1436.

[28] Raftery, A. (1995) Bayesian Model Selection for Social Research. Sociological Methodology, 25: 111-163.

[29] Sala-i-Martin, X., G. Doppelhofer, and R. Miller (2004) Determinants of Long-Term Growth: A Bayesian Averaging of Classical Estimates (BACE) Approach. American Economic Review, 94: 813-835.

Table 1: Characteristics of Sucessful Fiscal Consolidations

	AA98	A04	G07
Dependent variable is the successful consolidation dummy			
GDP growth		12.47	
(t-ratio)		(4.67)	
Government debt in $t-1$		-0.02	-0.23
(t-ratio)		(-0.17)	(-1.58)
Deficit level in $t-1$		0.34	
(t-ratio)		(0.31)	
Consolidation Size	1.91	2.52	2.44
(t-ratio)	(0.61)	(0.90)	(0.76)
Δ wage expenditures	-0.03	-0.41	0.01
(t-ratio)	(-0.18)	(-2.07)	(0.05)
Δ interest rate			-0.01
(t-ratio)			(-0.22)
Δ exchange rate			0.01
(t-ratio)			(0.32)
Output gap			0.02
(t-ratio)			(0.82)
R^2	0.01	0.29	0.06
Obs.	73	73	73

Source: Hernandez de Cos and Moral-Benito (2013).

Table 2: The Determinants of Successful Consolidations

	PIP	P.Mean/S.d.	PIP	P.Mean/S.d.	PIP	P.Mean/S.d.
	(1)	(2)	(3)	(4)	(5)	(6)
GDP growth rate	0.26	2.23	0.47	2.19	0.22	1.65
ΔExchange rate	0.14	0.28	0.29	0.19	0.16	0.24
ΔInterest rate	0.15	0.40	0.30	0.25	0.17	0.20
Government debt level	0.16	0.98	0.33	0.99	0.18	0.83
Deficit level	0.16	-0.83	0.31	-0.54	0.19	-1.11
Consolidation size	0.16	-0.61	0.32	0.07	0.19	-0.73
ΔTransfers	0.19	1.43	0.35	0.42	0.23	1.51
ΔNonwage expenditures	0.19	-1.51	0.39	-0.94	0.20	-1.24
ΔWage expenditures	0.69	-4.39				
ΔSubsidies	0.15	-0.28	0.30	-0.04	0.17	-0.35
ΔGovernment investment	0.16	0.71	0.34	0.24	0.18	0.43
ΔIncome taxes	0.22	-1.81	0.38	-0.45	0.27	-1.94
ΔBusiness taxes	0.22	1.77	0.39	0.64	0.28	1.98
ΔS.s. contributions	0.19	-1.35	0.33	-0.36	0.23	-1.62
ΔIndirect taxes	0.17	1.00	0.38	0.74	0.19	0.76
ΔOther taxes	0.16	0.72	0.31	0.37	0.17	0.31
Output gap	0.17	0.93	0.32	0.60	0.19	1.06
ΔPublic wage			0.61	-1.55	1.00	-3.96
ΔPublic employment			0.64	-1.59	1.00	-4.18
Prior Inclusion Probability	0.5		0.5		0.5	
Number of models estimated	$131,072$		$262,144$		$65,536$	

Notes: PIP refers to the posterior inclusion probability of a particular regressors. Given the prior inclusion probability is equal for all the variables (i.e. 0.5). P. Mean refers to the posterior mean conditional on inclusion of a given regressor in the empirical model, which is a weighted average of model-specific coefficient estimates with weights given by the model-specific R-squares. P. Std. is the square root of the posterior variance which is a weighted average of model-specific variances also including the variance of the estimates across different models. The sample is formed by 73 country-year pairs in which a consolidation took place. In column (1), the $131,072$ estimated models come from all the possible combinations of the 17 regressors ($2^{17} = 131,072$).

Table 3: Public Wage Expenditures and the Private Sector — OLS estimates

Dep. Variable	LPROD	LPROD	WP	WP	PCONS	PCONS	PINV	PINV	CA	CA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$LPROD_{t-1}$	0.555***	0.581***								
	(0.076)	(0.074)								
WP_{t-1}			0.113*	0.064*						
			(0.042)	(0.029)						
$PCONS_{t-1}$					0.393***	0.416***				
					(0.051)	(0.045)				
$PINV_{t-1}$							0.124*	0.139*		
							(0.053)	(0.064)		
CA_{t-1}									-0.061***	-0.063***
									(0.009)	(0.011)
PGDP	0.050	0.064***	-0.025	-0.006	0.416***	0.379***	1.204***	1.061***	-0.063	-0.031
	(0.026)	(0.021)	(0.012)	(0.014)	(0.055)	(0.058)	(0.126)	(0.196)	(0.068)	(0.057)
R	-0.034	-0.056	0.018	0.021	-0.018	0.010	0.595	0.625	-0.315	-0.396
	(0.052)	(0.058)	(0.018)	(0.015)	(0.102)	(0.110)	(0.493)	(0.483)	(0.310)	(0.356)
G	-0.254**		0.063		0.352*		0.211		0.136	
	(0.069)		(0.030)		(0.143)		(0.550)		(0.241)	
GW		-0.512*		0.362***		0.601		-1.190		1.186
		(0.188)		(0.070)		(0.309)		(1.148)		(1.167)
Country effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Obs.	436	414	310	294	436	414	416	395	428	406
R-sq	0.744	0.753	0.351	0.440	0.764	0.757	0.560	0.567	0.048	0.052

Notes: This Table presents the results of estimating equation (1) by panel OLS. LPROD refers to labor productivity of the total economy; WP refers to labor compensation per employee of the private sector; PCONS and PINV refer to private consumption and investment, respectively; R and G refer to Government's total revenues and expenditures, respectively; finally, GW refers to wage expenditures. Standard errors reported in parentheses are clustered at the country level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 4: Public Wage Expenditures and the Private Sector — GMM estimates

Dep. Variable	LPROD	LPROD	WP	WP	PCONS	PCONS	PINV	PINV	CA	CA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$LPROD_t - 1$	-0.042	-0.017								
	(0.073)	(0.068)								
$WP_t - 1$			-0.147***	-0.152***						
			(0.040)	(0.037)						
$PCONS_t - 1$					0.046	0.088				
					(0.074)	(0.083)				
$PINV_t - 1$							0.004	0.025		
							(0.055)	(0.064)		
$CA_t - 1$									-0.177***	-0.181***
									(0.010)	(0.010)
PGDP	0.107***	0.113***	-0.035***	-0.015	0.510***	0.449***	1.454***	1.164***	-0.103	0.104
	(0.032)	(0.033)	(0.010)	(0.014)	(0.055)	(0.049)	(0.224)	(0.337)	(0.148)	(0.083)
R	0.033	0.013	0.013	0.017	-0.069	-0.024	0.826	0.946*	-0.496	-0.654
	(0.076)	(0.077)	(0.017)	(0.014)	(0.120)	(0.123)	(0.471)	(0.452)	(0.359)	(0.419)
G	-0.201*		0.045		0.597***		0.785		-0.277	
	(0.092)		(0.025)		(0.173)		(0.467)		(0.454)	
GW		-0.511		0.304***		1.042*		-0.834		1.877
		(0.309)		(0.053)		(0.432)		(1.445)		(1.344)
Country effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
AR(2)	0.05	0.03	0.20	0.12	0.79	0.94	0.08	0.13	0.21	0.21
Hansen test	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Obs.	415	394	294	279	415	394	395	375	406	385

Notes: This Table presents the results of estimating equation (1) by panel GMM. LPROD refers to labor productivity of the total economy; WP refers to labor compensation per employee of the private sector; PCONS and PINV refer to private consumption and investment, respectively; R and G refer to Government's total revenues and expenditures, respectively; finally, GW refers to wage expenditures. AR(2) test p-value refers to the p-values from the Arellano and Bond's (1991) test for the lack of second order autocorrelation in the first-differenced errors. Hansen test reports the p-value of the tests of the null of valid overidentifying restrictions. Standard errors reported in parentheses are clustered at the country level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 5: Public Employment, Public Wages and the Private Sector

Dep. Variable	LPROD	LPROD	WP	WP	PCONS	PCONS	PINV	PINV	CA	CA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$LPROD_{t-1}$	0.583***	-0.012								
	(0.072)	(0.071)								
WP_{t-1}			0.057	-0.142***						
			(0.032)	(0.035)						
$PCONS_{t-1}$					0.421***	0.127				
					(0.045)	(0.076)				
$PINV_{t-1}$							0.132	0.027		
							(0.068)	(0.064)		
CA_{t-1}									-0.063***	-0.180***
									(0.011)	(0.011)
PGDP	0.056*	0.089*	-0.013	-0.016	0.330***	0.422***	1.007***	1.042**	-0.022	0.105
	(0.025)	(0.038)	(0.016)	(0.014)	(0.059)	(0.051)	(0.201)	(0.365)	(0.084)	(0.109)
R	-0.062	0.014	0.020	0.015	-0.019	-0.026	0.567	0.969*	-0.417	-0.677
	(0.058)	(0.074)	(0.015)	(0.014)	(0.104)	(0.113)	(0.464)	(0.444)	(0.373)	(0.443)
GW_W	-0.595*	-0.729*	0.311**	0.326***	0.125	0.871	-1.822	-1.817	1.278	2.019
	(0.222)	(0.362)	(0.076)	(0.060)	(0.366)	(0.539)	(1.254)	(1.772)	(1.376)	(1.485)
GW_E	-0.573*	-0.683*	0.330***	0.332***	0.287	0.932	-1.595	-1.635	1.260	2.035
	(0.203)	(0.338)	(0.074)	(0.058)	(0.332)	(0.506)	(1.186)	(1.620)	(1.308)	(1.475)
Estimation method	OLS	GMM	OLS	GMM	OLS	GMM	OLS	GMM	OLS	GMM
Country effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
R-sq	0.755		0.450		0.767		0.571		0.054	
AR(2)		0.07		0.14		0.87		0.15		0.20
Hansen test		0.99		0.99		0.99		0.99		0.99
Obs.	407	387	294	279	407	387	388	368	399	378

Notes: This Table presents the results of estimating equation (1) by both panel OLS and GMM but distiguising between wages and employment in the public wage bill. LPROD refers to labor productivity of the total economy; WP refers to labor compensation per employee of the private sector; PCONS and PINV refer to private consumption and investment, respectively; R and G refer to Government's total revenues and expenditures, respectively; finally, GW_W and GW_E refer to the compensation per employee of the public sector and the number of public employees. Standard errors reported in parentheses are clustered at the country level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 6: Public Wages Expenditures and Private Labor Compensation in the Long Run

Dep. Variable	Labor compensation per employee of the private sector (WP)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	5-year periods			8-year periods			14-year periods		
PGDP	-0.005	0.022*	-0.017	0.003	0.008	-0.005	0.038	0.029	0.006
	(0.018)	(0.010)	(0.016)	(0.016)	(0.012)	(0.019)	(0.039)	(0.032)	(0.040)
R	0.039	0.044	0.049	0.074	0.059	0.040	0.777*	0.274	0.175
	(0.038)	(0.028)	(0.040)	(0.063)	(0.054)	(0.052)	(0.278)	(0.201)	(0.222)
G	0.135			0.084			-0.270		
	(0.069)			(0.071)			(0.193)		
GW		0.520***			0.294*			0.136	
		(0.115)			(0.129)			(0.267)	
GW_E			0.193**			0.106			0.040
			(0.065)			(0.055)			(0.044)
GW_E			0.228**			0.130*			0.082
			(0.063)			(0.048)			(0.058)
Country effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
R-sq	0.267	0.452	0.352	0.241	0.338	0.361	0.418	0.389	0.428
Obs.	60	56	56	58	54	54	31	29	29

Notes: This Table presents the results of estimating equation (1) by panel OLS. R and G refer to Government's total revenues and expenditures, respectively; GW refers to wage expenditures; finally, GW_W and GW_E refer to the compensation per employee of the public sector and the number of public employees. Standard errors reported in parentheses are clustered at the country level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 7: Other Expenditure Items and the Private Sector — GMM estimates

Dep. Variable	LPROD	LPROD	LPROD	WP	WP	WP	PCONS	PCONS	PCONS	PINV	PINV	PINV	CA	CA	CA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
$LPROD_{t-1}$	-0.008	-0.064	-0.055												
	(0.071)	(0.068)	(0.069)												
WP_{t-1}				-0.151***	-0.152***	-0.151***									
				(0.044)	(0.039)	(0.039)									
$PCONS_{t-1}$							0.135	0.126	0.129						
							(0.095)	(0.092)	(0.094)						
$PINV_{t-1}$										0.007	0.004	0.004			
										(0.067)	(0.061)	(0.061)			
CA_{t-1}													-0.179***	-0.177***	-0.179***
													(0.010)	(0.010)	(0.011)
PGDP	0.151***	0.160***	0.152***	-0.057***	-0.050***	-0.050***	0.395***	0.362***	0.362***	1.236***	1.272***	1.260***	-0.151	-0.043	-0.020
	(0.030)	(0.027)	(0.027)	(0.012)	(0.012)	(0.012)	(0.071)	(0.066)	(0.067)	(0.345)	(0.304)	(0.310)	(0.132)	(0.082)	(0.075)
R	-0.000	-0.006	0.000	0.022	0.019	0.018	-0.001	0.036	0.034	0.965*	1.035*	1.040*	-0.520	-0.501	-0.528
	(0.071)	(0.069)	(0.070)	(0.015)	(0.014)	(0.015)	(0.113)	(0.109)	(0.110)	(0.451)	(0.438)	(0.432)	(0.376)	(0.355)	(0.353)
GOODS	-0.055			-0.096*			0.482∗			-0.142			-1.489		
	(0.166)			(0.043)			(0.218)			(0.966)			(1.459)		
TRANS		0.045			0.017			0.184			0.676			0.217	
		(0.143)			(0.021)			(0.102)			(0.405)			(0.696)	
SUBS			-0.582**			0.028			0.068			-0.582			1.552
			(0.220)			(0.066)			(0.334)			(1.513)			(1.680)
Country effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
AR(2)	0.01	0.06	0.08	0.04	0.02	0.02	0.85	0.97	0.88	0.11	0.08	0.09	0.22	0.21	0.22
Hansen test	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Obs.	394	415	415	279	294	294	394	415	415	375	395	395	385	406	406

Notes: This Table presents the results of estimating equation (1) by panel OLS. LPROD refers to labor productivity of the total economy; WP refers to labor compensation per employee of the private sector; PCONS and PINV refer to private consumption and investment, respectively; R and G refer to Government's total revenues and expenditures, respectively; finally, GOODS, TRANS, and SUBS refer to government consumption of goods and services, governement transfers, and subsidies, respectively. AR(2) test p-value refers to the p-values from the Arellano and Bond's (1991) test for the lack of second order autocorrelation in the first-differenced errors. Hansen test reports the p-value of the tests of the null of valid overidentifying restrictions. Standard errors reported in parentheses are clustered at the country level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

A Data Appendix

A.1 Data Appendix I: BMA exercise

This section describes the variables considered as potential determinants of successfull fiscal consolidations in the BMA exercise considered in the paper.

- Government debt level: government gross debt as a share of GDP.
- Deficit level: cyclically adjusted primary deficit as a share of GDP (i.e. primary expenses minus total revenue)
- Consolidation size: Change in the cyclically adjusted primary balance as a share of GDP.
- ΔWage expenditures: Growth of overall government wage bill expenditures as a share of GDP.
- ΔPublic Wage: Growth of the compensation per employee in the public sector.
- ΔPublic Employment: Growth of the number of public employees.
- ΔNon-wage expenditures: Growth of government non wage bill expenditures as a share of GDP.
- ΔSubsidies: Growth of public subsidies to firms as a share of GDP.
- ΔTransfers: Growth of public transfers as a share of GDP.
- ΔGovernment investment: Growth of gross government consumption on fixed capital as a share of GDP.
- ΔIncome taxes: Growth of direct taxes on household as a share of GDP.
- ΔBusiness taxes: Growth of direct taxes on businesses as a share of GDP.
- ΔIndirect taxes: Growth of indirect taxes as a share of GDP.
- ΔOther taxes: Growth of other taxes (different from income, business or indirect) as a share of GDP.
- ΔS.s. contributions: Growth of cyclically adjusted social security contributions paid by employers and employees as a share of GDP.
- GDP growth: Yearly growth rate of real per capita GDP for each country.
- Output gap: % of potential GDP.
- ΔInterest rate: Change in the real short-run interest rates between $t+1$ and $t-1$.
- ΔExchange rate: Change in the exchange rate between $t+1$ and $t-1$.

A.2 Data Appendix II: Cross-country regressions

This section describes the data employed in the cross-country panel regressions in the paper.

- G: Primary spending.
- R: Total revenues.
- GW: Government wage bill expenditures.
- GW_W: Compensation per employee of the public sector.
- GW_E: Public employment.
- GOODS: Government non-wage bill expenditures.
- SUBS: Subsidies to firms.
- TRANS: Transfers.
- PGDP: Private GDP computed as the ratio of total GDP less government consumption divided by the capital stock.
- LPROD: Labor productivity of the total economy.
- WP: Real labor compensation per employee in the private sector.
- PINV: Private investment as a share of capital stock.
- PCONS: Private consumption.
- CA: Current account as a share of GDP.

This document has been prepared for the workshop "Government wage bill: determinants, interactions and effects", organised by the Directorate-General for Economic and Financial Affairs of the European Commission on 11 December 2013 in Brussels.

This document exists in English only and can be downloaded from http://ec.europa.eu/economy_finance/events/2013/20131211_ecfin_workshop/index_en.htm.

More information on the European Union is available on http://europa.eu.