



A Quarterly Fiscal Database Fit for Macroeconomic Analysis*

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Abstract

The study of the macroeconomic effects of tax changes and public spending plans has regained footing recently. Nevertheless, in many occasions, the shortcomings of available official data pose limits to the type of approach analysts can pursue. While this issue receives traditionally limited attention, it is of utmost relevance for policy makers and academics alike. Against this framework, in this paper we construct a quite disaggregated quarterly fiscal database of Spanish seasonally-adjusted public finance variables for the period 1986Q1-2015Q4, in national accounts terms. Following a recent strand of the literature, we pose special emphasis on the models and data ingredients used. The later includes a rich set of input fiscal data taken from budgetary accounts. We illustrate the use of our data by providing key stylized facts on the cyclical properties of fiscal policies over the past three decades.

Keywords: Fiscal data, fiscal policies, mixed-frequencies, time-series models.

JEL Classification: E62, E65, H6, C3, C82

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1. Introduction

Fiscal policy is at the forefront of the economic policy debate in Europe nowadays. Thus, it is not surprising to see that an enormous amount of papers has been recently devoted to study of the macroeconomic impact of fiscal policies, the sustainability of public debt, or the properties and design of fiscal consolidations, mostly from an aggregate point of view. Nevertheless, in particular for European countries, data limitations tend to constrain the scope of certain studies. Most notably, the type of analyses mentioned rest crucially on the availability of quarterly fiscal series of sufficient length and quality. Official statistics do not always cater for all the needs of such studies (see, *e.g.* European Commission 2007; or Paredes *et al.*, 2014). This is not a minor issue. Sometimes researchers have to resort to the use of mechanical interpolation techniques that may certainly have a bearing on the reported results. As claimed for example by Dilnot (2012), public policy analysis should not be undertaken lightly without thinking carefully and then finding out the numbers. In a recent paper, Paredes *et al.* (2014) reduced part of the existing fiscal data gap in the EU by building a quarterly fiscal database for the euro area as a whole that has proven to be a useful tool for the profession¹.

The analysis of the macroeconomic effects of fiscal policies requires the availability of long time series, to properly account for business cycle phases that are corrected for the influence of seasonal factors, as these are quite pronounced in public finance variables. Nevertheless, in the case of Spain, quarterly government finance statistics for the General Government sector are only available for the period starting in 1995Q1, in nominal, non-seasonally-adjusted terms. For this reason, in this paper, we decided engage in the construction of a quarterly fiscal database for Spanish government accounts for the period 1986Q1-2015Q4, solely based on intra-annual fiscal information.

From a methodological standpoint, we use multivariate, state-space mixed-frequencies models, along the lines of the seminal work of Harvey and Chung (2000). The models are estimated with annual and quarterly national accounts fiscal data and a set of monthly indicators. For the latter, the raw ingredients we use are closely linked to the ones used by national statistical agencies to provide their best estimates (intra-annual fiscal data, mostly on a public accounts basis), and our method preserves full coherence with official national accounts data. The potential of our database (*QESFIP*, henceforth) is proven by the fact that a number of recent papers could not have been completed as they stand had our set of data not been developed (see, in particular, Ricci-Risquete *et al.*, 2015, 2016; Andrés *et al.*, 2017; Lamo *et al.*, 2016; Martínez and Zubiri, 2014; Hernández de Cos and Moral Benito, 2016; European Commission, 2012)².

In order to illustrate the usefulness of *QESFIP*, we provide one specific application, relevant from a policy point of view: we compute stylized facts on the cyclical properties of fiscal policies over the past three decades. This is warranted, as only a few studies have dealt, either directly or indirectly, with the hurdle of computing stylized facts on fiscal policies (see Dolado *et al.*, 1993; Marín, 1997; Ortega, 1998; Esteve *et al.*, 2001; André and Pérez, 2005). The topic is clearly relevant from the current, crisis-related perspective, against the back-

ground of the renewed support for activist, counter-cyclical fiscal policies that re-appeared right after the post-Lehman slump (*e.g.* Bouthevillain *et al.*, 2009), and that has been regaining footage recently³.

We analyze the cyclical properties of the main components of the revenue and the expenditure sides of the budget. We look at the unconditional correlation between filtered/detrended series via various ways of filtering. As in Lamo *et al.* (2013) we distinguish between the fluctuations around the trend that are driven by unpredictable or irregular components of the series (irregular shocks, ad-hoc policy measures, etc.) from those that look at the cyclical components (mixture of systematic autocorrelation properties of the filtered series and irregular factors). We find this particularly relevant as in our case the irregular components are quite likely to reflect policy induced fluctuations, i.e, the dynamics of the series due to policy measures⁴.

The rest of the paper is organized as follows. In Section 2 we describe the main elements of our database. In Section 3 we turn to provide stylized facts on cyclical fiscal policies. Finally, in Section 4 we provide the main conclusions of the paper. We also provide to appendices in which we discuss some technical details about the econometric methodology used to compute the database (Appendix A) and the detrending techniques used to calculate the stylized facts (Appendix B).

2. Main elements of the database

2.1. Overview

In the case of Spain, Quarterly General Government figures on an ESA-2010 basis are available for the period 1995 onwards, in non-seasonally adjusted terms, and are released by the accounting office IGAE. Unfortunately, this information is not available for previous years. There is one exception to this general pattern: aggregate public consumption. Nominal and real government consumption expenditure (seasonally and non-seasonally adjusted) are available on a quarterly basis since the 1970s. These data can be obtained from the Quarterly National Accounts published by the national statistical institute (INE).

Two existing databases have been built in previous studies to overcome the shortcomings of official statistics. A first quarterly dataset is the one compiled by Estrada *et al.* (2004). This database is the one used to estimate and simulate Banco de España's quarterly macro-econometric model (MTBE henceforth) and thus the interpolation procedure applied and the indicators used were selected with this specific purpose in mind⁵. Except for public consumption, standard interpolation techniques –Denton method in second relative differences with relevant indicators– were applied to pre-seasonally-adjusted figures. This is a valid approach given the stated uses of the MTBE model and the generated quarterly fiscal dataset is fully consistent with model definitions. Beyond these considerations, it is worth mentioning that this is a non-public private dataset. A second information source is the REMS data-

base (Boscá *et al.*, 2007), companion to the REMS model (see Boscá *et al.*, 2011) –a DSGE model used within the Ministry of Economy and Finance to carry out policy simulations. The REMS database includes a large set of macroeconomic, financial and monetary variables, and a group of public sector variables. Nonetheless, the quarterly non-financial fiscal variables in that block are obtained from annual data by simple quadratic interpolation.

In our paper we decide to move one step beyond existing alternatives for a number of reasons. First, we have constructed a new dataset following a proven and transparent methodology, the one used by Paredes *et al.* (2014) to build up the euro area fiscal database that is disseminated jointly with ECB's Area Wide Model general macroeconomic database⁶. In this respect, given that we only use publicly available information, our database is to be made freely available upon request.

Beyond this quite relevant transparency consideration, a second reason is related to the nature of the inputs used in the interpolation exercise. Our database is built by using only intra-annual fiscal information, i.e. general economic indicators are not used. This is relevant for subsequent research devoted to the integration of interpolated intra-annual fiscal variables in more general macroeconomic studies, because it allows to capture genuine intra-annual “fiscal” dynamics in the data. While government revenues and expenditures (e.g. unemployment benefits) may be endogenous to GDP or any other tax base proxy, the relationship between these variables is at most indirect and extremely difficult to estimate (see Morris *et al.*, 2009; Paredes *et al.*, 2014).

A third feature of our approach is that, as in Paredes *et al.* (2014), we follow to the extent possible some of the principles outlined in the manual on quarterly non-financial accounts for general government: use of direct information from basic sources (public accounts' data), computation of “best estimates”, and consistency of quarterly and annual data. As regards the coherence of quarterly data with annual rules, the discussion in European Commission (2006) shows that there is some room for econometric estimation of intra annual fiscal variables.

2.2. Some details

As mentioned above, the variables of interest are quarterly general government accounts on an ESA 2010 basis, and seasonally adjusted. Quarterly, non seasonally adjusted figures are available from 1995 onwards. Annual data following previous national accounts vintages are available since the early 1970s, and are used as anchors for the backcasting exercise. As regards short-term indicators, we use national accounts and cash data for different revenue and expenditure items available for the different sub-sectors and public entities, at quarterly and monthly frequencies, mainly from IGAE, the Tax Agency, the National Statistical Institute (INE), and the Ministry of Employment (State Secretary of the Social Security). For the Central government and the Social Security subsectors, short-term public finance statistics present a wide coverage of budgetary categories. The availability of data for the sub-national governments is more limited⁷.

Regarding the econometric approach taken, the basic model is of the Unobserved Component Model class known as the Basic Structural Model (Harvey, 1989), that decomposes a set of time series in unobserved though meaningful components from an economic point of view (mainly trend, seasonal and irregular). Given that the data used are sampled at different frequencies (annual, quarterly and monthly) we use a mixed-frequencies formulation, with temporal aggregation. The modeling approach follows closely Paredes *et al.* (2014) and Pedregal and Pérez (2010). For further details see Appendix A.

QESFIP includes a quite disaggregated set of nominal fiscal variables for the General Government sector in ESA terms, seasonally and non-seasonally adjusted. The issue of seasonal adjustment of quarterly fiscal variables in Europe is an important one, as signalled in European Commission (2007)⁸. On the revenue side of government accounts the database covers total government revenue, direct taxes (with a proxy for the breakdown between direct taxes paid by households and firms), social security contributions (with a proxy for the breakdown between contributions paid by employers and others), and total indirect taxes (breaking down VAT and others). On the expenditure side, it covers total expenditure, social payments (of which also unemployment benefits), interest payments, subsidies, government investment and government consumption. Given the relevance of the latter variable (part of the demand side of GDP), we provide the breakdown between nominal and real government consumption, as well as the split between government wage and non-wage consumption expenditure. The net lending of the government, a key policy variable, can be computed as the difference between total revenues and total expenditures. We also provide quarterly public debt for the period of reference. As an illustration, Figure 1 displays the main fiscal aggregates of the Spanish General Government sector over the period 1986Q1-2015Q4,

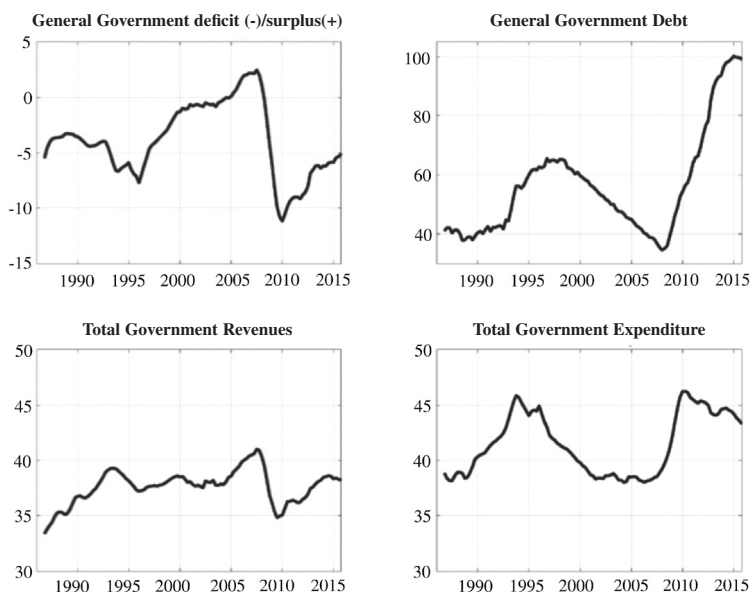


Figure 1: Main Government finance variables. Percent of nominal GDP

Note: Dashed lines represent nominal GDP (year-on-year growth rates of a 4-quarter moving sum).

namely the budget balance and its decomposition between revenues and expenditures, and the ratio of public debt to nominal GDP.

3. Stylized facts on cyclical fiscal policies

In Tables 1 and 2, we report dynamic cross-correlation functions. We look at the unconditional correlations between detrended series at the standard business cycle frequencies. The underlying assumption to detrending filters is that aggregate seasonally-adjusted economic time series can be decomposed into a trend component, T_t , the so-called cyclical component, C_t , that fluctuates around the trend, and an unpredictable random component (or irregular component), ε_t , *i.e.*

$Y_t = T_t + C_t + \varepsilon_t$. Most of the detrending filters take out the trend component from the original time series, so that both the cyclical and irregular components $C_t + \varepsilon_t$ are taken as a measure of the cycle. To try to isolate the systematic autocorrelation properties of the filtered series C_t from the irregular fluctuations or nonsystematic behavior of the series, ε_t , we use univariate ARIMA filters to extract (“pre-whiten”) the later from the detrended components $C_t + \varepsilon_t$.

Following standard practice we measure the co-movement between two series using the cross correlation function (CCF thereafter). Each row of the tables displays the CCF between a given detrended fiscal variable at time $t+k$, and detrended GDP at time t . In selecting this statistic, we follow the common practice in the related literature that shows results for Spain (Dolado *et al.*, 1993; Marín, 1997; Esteve *et al.*, 2001; André and Pérez, 2005; Lamo *et al.*, 2013), and other works in the general literature of fiscal policies’ stylized facts. Following the standard discussion in the literature, it is said that the two variables co-move in the same direction over the cycle if the maximum value in absolute terms of the estimated correlation coefficient of the detrended series (call it dominant correlation) is positive, that they co-move in opposite directions if it is negative, and that they do not co-move if it is close to zero. A cut-off point of 0.20 roughly corresponds in our sample to the value required to reject at the 5% level of significance the null hypothesis that the population correlation coefficient is zero. Finally, the fiscal variable is said to be lagging (leading) the real economic activity variable if the maximum correlation coefficient is reached for negative (positive) values of k .

For the sake of robustness, we show results for the mean of a set of standard filters, as applied to seasonally-adjusted time series: (i) first difference filter; (ii) linear trend; (iii) Hodrick-Prescott filter for two alternative values of the band-pass parameter (the standard 1600, that is a fair approximation of the cycles of France and Italy, while a higher value would be more appropriate for countries with more volatile cycles like Spain, as shown by Marcet and Ravn, 2004); (iv) Band-Pass filter (with two different band-pass parameters, capturing fluctuations between 2 and 8 years and between 2 and 12 years, an observation closer to average euro area countries business cycle duration). For additional details see Appendix B.

Table 1
STYLIZED FACTS ON FISCAL POLICIES. I. CORRELATIONS BETWEEN
CYCLICAL COMPONENTS OF THE FISCAL VARIABLE
(IN REAL TERMS) AND REAL GDP. PANEL A. MAIN AGGREGATES

		σ_y	-4	-3	-2	-1	0	1	2	3	4	
Total government revenues (TOR)												
Detrended	86Q1-15Q4	2.06	0.49	0.55	0.60	0.56	0.53	0.45	0.31	0.21	0.11	Pro-cyclical Lead
Pre-whitened	86Q1-15Q4	2.91	0.02	0.01	0.20	0.20	0.27	0.19	0.05	-0.12	-0.19	Pro-cyclical Cont.
Total government expenditures (TOE)												
Detrended	86Q1-15Q4	1.53	-0.04	0.00	0.09	0.11	0.19	0.23	0.26	0.33	0.39	Pro-cyclical Lag
Pre-whitened	86Q1-15Q4	2.49	0.01	-0.07	0.04	-0.09	0.00	-0.03	-0.13	-0.15	-0.01	Count-eye Lead
Net lending (+) / net borrowing (-) (DEF)												
Detrended	86Q1-15Q4	1.24	0.41	0.42	0.41	0.36	0.27	0.17	0.03	-0.11	-0.24	Pro-cyclical Lead
Pre-whitened	86Q1-15Q4	1.78	0.12	0.17	0.20	0.20	0.08	0.10	0.09	0.07	-0.08	Pro-cyclical Lead

Notes: Variables are transformed in real terms (GDP deflator) before filtering. Quarterly real GDP and GDP deflator are taken from the Banco de España database. The table shows averages over the five detrending methods used.

Turning to the results, Table 1 shows the strong and pro-cyclical behavior of total government revenue in Spain, a result that is consistent with the evidence based on annual data for Spain for the 1960-1990 period (see Esteve *et al.*, 2001), and also with the existing results for the euro area aggregate (see Paredes *et al.*, 2014), and G7 countries (Fiorito, 1997). Total revenue mimics the business cycle behavior in upturns and downturns, reflecting the operation of automatic stabilizers, in a broadly contemporaneous manner –the contemporaneous correlation is very close to the dominant one. The dominant correlation is high, 0.6. When we filter out the dynamics of the series due to systematic autocorrelation to end up with the irregular component, the correlation is somewhat disperse and weaker but still high. This indicates that the unpredictable component of the series is responsible for an important part of the pro-cyclicality of the real public revenue series. As regards relative volatility, government revenues are much more volatile than GDP, around two times, on average, a figure higher than the one for the euro area. This may reflect the fact that a number of taxes, most notably corporate taxes, property taxes and other indirect taxes, tend to follow boom-bust dynamics and do react to the cycle more than proportionally (Morris and Schuknecht, 2007). In addition, the progressive structure of the income tax also causes excess volatility of income taxes relative to the business cycle. The latter becomes more clear when looking at the results by government revenue components⁹, as the standard deviation of the cyclical component of direct taxes (mixture of household and corporate taxes) is around 5 times higher than the one of real GDP, while that of indirect taxes is around 4 times as high, while the relative volatility of Social Security contributions with respect to GDP is broadly 1.5. In this respect, it is not surprising that indirect taxes are less volatile than direct taxes, given that, for example, tax bases such as households' income and corporate profits are more volatile than private sector consumption. Also, social contributions rely on personal income, but at proportional rates and applied to censored tax bases. This creates a lower relative volatility¹⁰.

Compared to the results of Esteve *et al.* (2001) and Marín (1997), with data up the 1990s, our results by components show robust evidence of pro-cyclicality of revenue components.

Table 2
STYLIZED FACTS ON FISCAL POLICIES. II MAIN EXPENDITURE AGGREGATES.
CORRELATIONS BETWEEN CYCLICAL COMPONENTS OF THE FISCAL VARIABLE
(IN REAL TERMS) AND REAL GDP

		σ_y	-4	-3	-2	-1	0	1	2	3	4	
Social transfers other than unemployment benefits (THN - UNB)												
Detrended	86Q1-15Q4	0.89	-0.37	-0.27	-0.16	-0.06	0.04	0.12	0.16	0.24	0.25	Count-cyc Lead
Pre-whitened	86Q1-15Q4	1.60	0.06	-0.02	-0.12	-0.14	-0.06	-0.04	0.05	0.09	0.03	Not significant
Unemployment benefits (UNB)												
Detrended	86Q1-15Q4	6.22	-0.44	-0.47	-0.48	-0.50	-0.39	-0.33	-0.17	0.00	0.15	Count-cyc Lead
Pre-whitened	86Q1-15Q4	7.01	-0.01	-0.01	-0.15	-0.36	-0.12	-0.22	-0.15	0.06	0.00	Count-cyc Lead
Government consumption (GCR)												
Detrended	86Q1-15Q4	1.27	0.02	0.15	0.31	0.40	0.45	0.43	0.40	0.39	0.45	Pro-cyclical Lag
Pre-whitened	86Q1-15Q4	1.54	-0.21	-0.19	0.17	0.11	0.37	0.08	-0.05	-0.11	0.04	Pro-cyclical Cont.
Government investment (GIN)												
Detrended	86Q1-15Q4	6.90	0.33	0.40	0.45	0.48	0.48	0.47	0.46	0.44	0.44	Pro-cyclical Lag
Pre-whitened	86Q1-15Q4	8.83	-0.07	0.02	0.16	0.22	0.11	0.01	-0.07	-0.11	0.01	Not significant

Notes: Variables are transformed in real terms (GDP deflator) before filtering. Quarterly real GDP and GDP deflator are taken from the Banco de España database. The table shows averages over the five detrending methods used.

Most existing studies look at the cyclical properties of government spending (see Franke, Vegh and Vuletin, 2013, and the references quoted therein). Indeed, an important reason for the usual finding of pro-cyclical spending is precisely that government receipts get increased in booms, typically beyond expectations, and thus governments use the surplus to increase spending proportionately as a consequence of political pressure or just following certain social-welfare-improving objectives. We show the cyclical properties of total government expenditure in Table 1, and those of its components in Table 2. As expected, in Table 1 total expenditure appears pro-cyclical, but lagged; this behavior can be rationalized on the basis of the political economy arguments mentioned before. The lag detected with quarterly data implies that total expenditure follows GDP with a –minimum– delay of one year. Budgetary patterns on the spending side tend to be quite persistent, in particular as regards sizeable items like public wages or public employment. For example, only in the period following an economic downturn are fiscal consolidation measures implemented, while in expansions, fresh government revenues tend to expand the public sector wage bill with some delay. When the pre-whitened cyclical co-movements are considered, the correlation between the shocks is barely significant.

The pro-cyclical pattern of total expenditures is due to the government consumption component (GCR), in line with available evidence for the euro area obtained with annual

data (see Lamo *et al.*, 2013). The pro-cyclicality of public consumption in the case of Spain is a result already obtained in previous works for samples covering up to the beginning of the 2000s (Dolado *et al.*, 1993; André and Pérez, 2005; Marín, 1997; Ortega, 1998; Esteve *et al.*, 2001). Co-movements among unanticipated components are also pro-cyclical and explain a significant portion of the co-movement among cyclical components. Within government consumption the pro-cyclical, lagged co-movement is explained by the wage bill, while the correlation of the cycle of real GDP and that of non-wage government consumption is weaker, though still positive. For the whole sample, there is a positive cyclical co-movement of public employment and real GDP, but this is weaker than the one of the wage bill, suggesting that public wages (per employee) would be the part of the wage bill displaying the strongest correlation. Interestingly, when the inertia of the series is removed (pre-whitening), the cyclical correlation of public wage bill/public employment shocks/discretionary policies and real GDP shocks tend to be less significant and disperse. At the same time, the correlation of shocks to non-wage government consumption with real GDP shocks is negative (counter-cyclicality). Again, these results as regards pre-whitened series might be an indication that the components of government consumption are usually used to adjust budgetary outcomes, with no clear pattern of individual components, while at the end the aggregate ends up being pro-cyclical. Government investment (again in Table 2) also displays a marked pro-cyclical co-movement. Nevertheless, when the inertia of the cycles is taken out, there remains no clear cyclical pattern. As in the case of government consumption, this might be an indication that shocks to government investment are used to meet budgetary outcomes, as also highlighted by Esteve *et al.* (2001).

By contrast, social payments reflects a counter-cyclical pattern, mainly due to the properties of unemployment benefits; unemployment-related spending increase in downturns and decrease in upturns, reflecting a role of automatic stabilization. The latter evidence is consistent with an interpretation whereby employment losses at the beginning of a cyclical downturn tend to be associated with new unemployed receiving full-entitlement benefits (given that downturns do occur after a good times period), coupled with the fact that the average duration of the entitlement tends to be lower than the number of quarters the economy is below trend.

Besides the counter-cyclical pattern, it is apparent that unemployment spending leads the cycle, *i.e.* employment destruction may start somewhat ahead of a real GDP downturn. The dominant correlation for the whole sample is higher than the one obtained with the pre-crisis sample, given the sizeable increase of unemployment-related spending during the most recent crisis. As regards other social payments in cash, that include contributory and non-contributory pensions as well as other social transfers like temporary disability, the estimated cyclical correlation is weaker than the one estimated for unemployment benefits. When the inertia of the series is removed, the correlation among pre-whitened series shows no particular pro- or counter-cyclical behavior, most likely reflecting the fact that decisions on pensions are relatively erratic: in good times they are increased above determinants like inflation or wages due to equity and/or electoral considerations, while in bad times their growth tend to be moderated on the back of fiscal consolidation needs.

As regards the relative volatility of real public expenditure over real GDP, it is higher than one, as in the case of public revenue, but of an order of magnitude considerably lower, being around 1.5 as compared to 2 in the case of total expenditures. In both cases the magnitude of the relative volatility is considerably higher than in the euro area aggregate case (see Paredes *et al.*, 2014). This is an issue that may deserve further attention, given the findings in the literature on the detrimental effects of fiscal policies volatility on economic growth (see Afonso and Furceri, 2010).

By component, social payments other than unemployment benefits, and government consumption, are the most stable components, with relative cyclical variabilities around one, while unemployment spending and government investment display volatilities six or more times the volatility of real GDP. In addition, subsidies (transfers to firms), being presumably decided on an occasional basis, are the most volatile component within the public expenditure categories considered. The relative stability of government consumption is consistent with the fact that the provision of public goods should be broadly independent of the business cycle. Yet, as signalled by Fiorito (1997), government consumption does not only include such public goods as defense, justice, etc., but also accommodates merit goods such as health or education that are partially supplied by private units and that also involve purchases from private firms.

Within government consumption, the standard deviation of the wage component is half that of the non-wage component, and within the wage component public employment is the only government spending item with a relative volatility below one. The latter reflects the broad stability of most public employees in Spain, that enjoy a per-life civil-servant status.

Finally, as regards government net lending, *i.e.* the difference between total revenues and total expenditures, it is pro-cyclical. It can be said that the government balance act as a shock absorber, but it is less volatile than expenditures and receipts. The pro-cyclicality found is in line with the results for the G7 countries of Fiorito (1997), and of Galí and Perotti (2003) for Europe. As discussed in Lamo *et al.* (2013), from a theoretical point of view, our results would render some empirical support to models that predict pro-cyclical fiscal policies. Among these are political economy models that tend to rationalize pro-cyclicality on the grounds that bureaucrats, or governments in general, maximize the available budget for wage-related public spending, which creates boom-bust-like dynamics as government revenue windfalls in good times are spent in full, while fiscal consolidation needs in adverse economic circumstances force a cut in wage and non-wage government spending (see the references in the introductory section, Fernández de Córdoba *et al.*, 2012, and the references quoted therein). Another branch of models exploits market imperfections to justify the existence of pro-cyclicality in fiscal policies (see, among others, Mendoza and Oviedo, 2006). Also, a classical explanation is the one of Alesina and Tabellini (2005), in which "less-than-benevolent" governments would have incentives to appropriate rents and as such voters would demand more public goods and fewer taxes to prevent the latter from happening when the economy is doing well.

4. Conclusions

In this paper we provide a comprehensive database of quarterly fiscal variables suitable for macroeconomic analysis built up on the basis of state-of-the-art macroeconometric models. All models are multivariate, state space mixed-frequencies models, estimated with available national accounts fiscal data (mostly annual) and, more importantly, monthly and quarterly information taken from all available sources of fiscal data.

The database spans over the period 1986Q1-2015Q4, and covers a wide number of fiscal aggregates, suitable for macroeconomic analysis. All the time series included are presented in gross (non-seasonally adjusted) and seasonally adjusted terms. We focus solely on intra-annual fiscal information for interpolation purposes. This approach allows us to capture genuine intra-annual “fiscal” dynamics in the data, so that we avoid two important problems that are present in fiscal time series interpolated on the basis of general macroeconomic indicators: (i) the endogenous bias that arises if the so interpolated fiscal series were used with macroeconomic variables to assess the impact of fiscal policies; (ii) the well-known decoupling of tax collection from the evolution of macroeconomic tax bases (revenue windfalls/shortfalls).

On the basis of our quarterly fiscal database we provide in the paper an application that highlights its usefulness for macroeconomic analysis and policy, namely stylized facts on the cyclical properties of fiscal policies. We find that total revenues in Spain display a pro-cyclical behavior, that can be to a large extent explained by discretionary changes in policy (unpredictable component), and that are much more volatile than GDP most likely due, on the one hand, to the fact that a number of taxes, most notably corporate taxes, property taxes and other indirect taxes, tend to follow boom-bust dynamics and, on the other hand, to the progressive structure of the income tax. Some studies have hinted at pro-cyclical revenues as a source of pro-cyclical government spending. In fact, we find that total expenditure appears pro-cyclical as well, but lagged. The pro-cyclical pattern of total expenditures is due to the government consumption and investment components. Social transfers, particularly unemployment-related expenditure, on the contrary, present a distinct counter-cyclical behavior. Public spending, overall, is found to be more volatile than real GDP, and higher than comparable euro area reference variables.

Appendix A: Methodology to compute the quarterly fiscal database

The exposition in this section follows closely Pedregal and Pérez (2010). The starting point of the modeling approach is to consider a multivariate Unobserved Components Model known as the Basic Structural Model (Harvey, 1989). A given time series is decomposed into unobserved components which are meaningful from an economic point of view (trend, T_t , seasonal, S_t , and irregular, e_t). Equation (A1) displays a general form, where t is a time sub-index measured in quarters, z_t denotes the variable in ESA95 terms expressed at an annual

and quarterly sampling interval (depending on availability) for our objective time series, and u_t represents the vector of quarterly indicators.

$$\begin{bmatrix} z_t \\ u_t \end{bmatrix} = T_t + S_t + e_t \quad (\text{A1})$$

The general consensus in this type of multivariate models in order to enable identifiability is to build SUTSE models (Seemingly Unrelated Structural Time Series). This means that components of the same type interact among them for different time series, but are independent of any of the components of different types. In addition, statistical relations are only allowed through the covariance structure of the vector noises, but never through the system matrices directly. This allows that, trends of different time series may relate to each other, but all of them are independent of both the seasonal and irregular components. The full model is a standard BSM that may be written in State-Space form as (see Harvey, 1989)

$$x_t = \Phi x_{t-1} + E w_t \quad (\text{A2})$$

$$\begin{bmatrix} z_t \\ u_t \end{bmatrix} = \begin{bmatrix} H \\ H^u \end{bmatrix} x_t + \begin{bmatrix} \varepsilon_t \\ v_t \end{bmatrix} \quad (\text{A3})$$

where $E_t \sim N(0, \Sigma_E)$ and $v_t \sim N(0, \Sigma_v)$. The system matrices Φ , E , H and H^u in equations (A2)-(A3) include the particular definitions of the components and all the vector noises have the usual Gaussian properties with zero mean and constant covariance matrices (E_t and v_t are correlated among them, but both are independent of w_t). The particular structure of the covariance matrices of the observed and transition noises defines the structures of correlations among the components across output variables. The mixture of frequencies, and the estimation of models at the quarterly frequency, implies combining variables that at the quarterly frequency can be considered as stocks with those being pure flows. Thus, given the fact that our objective variables are observed at different frequencies, an accumulator variable has to be included

$$C_t = \begin{cases} 0, & t = \text{every January (monthly data) / first quarter (quarterly data)} \\ 1, & \text{otherwise} \end{cases} \quad (\text{A4})$$

so that the previous model turns out to be

$$\begin{bmatrix} z_t \\ x_t \end{bmatrix} = \begin{bmatrix} C_t \otimes I & H\Phi \\ 0 & \Phi \end{bmatrix} \begin{bmatrix} z_{t-1} \\ x_{t-1} \end{bmatrix} + \begin{bmatrix} I & HE \\ 0 & E \end{bmatrix} \begin{bmatrix} \varepsilon_t \\ w_t \end{bmatrix} \quad (\text{A5})$$

$$\begin{bmatrix} z_t \\ u_t \end{bmatrix} = \begin{bmatrix} I & 0 \\ 0 & H^u \end{bmatrix} \begin{bmatrix} z_t \\ x_t \end{bmatrix} + \begin{bmatrix} 0 \\ I \end{bmatrix} v_t \quad (\text{A6})$$

Given the structure of the system and the information available, the Kalman Filter and Fixed Interval Smoother algorithms provide an optimal estimation of states. Maximum likelihood in the time domain provides optimal estimates of the unknown system matrices, which in the present context are just covariance matrices of all the vector noises involved in

the model. The use of the models selected and the estimation procedures described in the previous paragraph, allows the estimation of models with unbalanced data sets, i.e. input variables with different sample lengths. This is a feature of relevance for the construction of the database at hand, given occasional differences in temporal coverage of indicators.

In our case, particular empirical specifications for each variable will be considered in the light of the available information (fiscal indicators). For instance, for the case of total government revenues, z comprises total government revenues in National Accounts terms, a variable that is available at the annual frequency from 1986-1994 and at the quarterly frequency from 1995Q1-2015Q4, while u is a matrix composed of three series (available at the quarterly frequency for the whole sample period): (i) a proxy to general government total revenues in public accounts (cash) terms; (ii) Central government total revenues and (iii) Social Security (SSS+SPEE) sector's total revenues. In order to reduce the dimensionality of our models and somewhat avoid the "curse of dimensionality" we opted for variable-by-variable models. By this we mean that, in all cases, z encompasses just one time series (annual/quarterly), and u the set of indicators corresponding to the latter variable, with a maximum of five indicators.

Appendix B: Description of detrending methods

We consider a quite standard set of detrending methods:

- First order differencing takes the cycle to be the variable in first differences. Thus it assumes that the trend is the lagged variable, or similarly the series is a random walk with no drift. Therefore y_t can be represented as: $y_t = y_{t-1} + C_t + \varepsilon_t$ where the trend is $T_t = y_{t-1}$ and an estimate of the detrended component is obtained as $y_t - y_{t-1}$.
- An alternative method of detrending is by removing a deterministic trend; the usual procedure is to take the least squares residual after regressing the series on a constant and a polynomial function of time. The implicit assumption is that the trend and cyclical components are orthogonal, and that T_t is a deterministic process which can be approximated with polynomial functions of time. These assumptions imply a model for y_t of the form: $y_t = T_t + C_t + \varepsilon_t$, $T_t = f(t)$, and we take $f(t) = a_0 + a_1t + a_2t^2$. Even though the disturbance may be serially correlated, it can be shown that the unknown parameters in $f(t)$ can be estimated efficiently by ordinary least squares.
- The Hodrick and Prescott filter (HP Filter) extracts a stochastic trend that moves smoothly over time and is not correlated with the cycle component. The HP filter depends on a smoothing parameter λ that penalizes large fluctuations. A large λ implies a higher penalty and, therefore, a smoother cycle.
- The band pass filter is a frequency domain based filter. It assumes that the trend component has the power at lower frequencies of the spectrum. The choice in this procedure is to define the limits of the frequency band, say p_l and p_u , to isolate the

cyclical component with a period of oscillation between p_l and p_u . We use an “optimal” finite sample approximation for the band pass filter as proposed by Christiano and Fitzgerald (2003). We make two choices for the cycle length between 2 and 8 years, $\{p_l, p_u\}=\{2,8\}$, and between 2 and 6 years, $\{p_l, p_u\}=\{2,6\}$, removing thus all the fluctuations that have a periodicity larger than 8(6) or smaller the 2 years.

- As regards the procedure to isolate the pure irregular component of the time series of interest, we follow the traditional approach of pre-whitening the series of interest, by means of ARIMA specifications, as in André *et al.* (2002). Let's assume a given cyclical component C_t is representable by a linear model of the general ARIMA class $\Phi(B)C_t = \Theta(B)\varepsilon_t$ where ε_t is a white noise variable, and $\Phi(B)$ and $\Theta(B)$ are polynomials in the lag operator B . Pre-multiplying C_t by an estimate of $\Theta^{-1}(B)\Theta(B)$ provides a pre-whitened version of C_t , which is an estimate for ε_t , a white noise variable representing the purely stochastic component of C_t . If the series y_t follows the above mentioned ARIMA process, the dynamic properties of the detrended series, call it y_t^F can be studied by means of expression $y_t^F = F(B)(\Theta(B)/\Phi(B))\varepsilon_{t\lambda}$ where $F(B)$ is the filter applied to detrend the series. Thus, obtaining an estimate $\hat{\Pi}(B)$ of $\Pi(B)$ it is possible to generate the pre-whitened series $\varepsilon_t = \hat{\Pi}^{-1}(B)y_t^F$. If properly applied this method should be independent of the filtering procedure as correlations would be computed among irregular components.

Notes

1. Many recent papers have used this database, such as, among others, Ricci-Risquete *et al.* (2015, 2016), Albonico *et al.* (2016), and the significant number of references quoted in Paredes *et al.* (2014).
2. For the sake of completeness, we have also back-casted the database to incorporate the period 1970Q1-1985Q4. Nevertheless, the absence of reliable monthly indicators for those years made us rely on a more mechanical type of interpolation. Thus, the quality of that part of the sample is much lower than the one of the headline dataset. This said, a companion MsExcel file with the whole database covering the period 1970Q1-2015Q4 is available upon request.
3. See, *e.g.* Buti and Rodríguez-Muñoz (2016).
4. An alternative way of looking at the correlation of discretionary fiscal policy shocks and macroeconomic variables is to consider the traditional dynamic SVAR approach to the computation of so-called fiscal multipliers. In this literature some identification assumptions are used to compute the macroeconomic effects of fiscal shocks, moving beyond the computation of correlations to the estimation of causal impacts (conditional correlations) of non-systematic fiscal policies. For the case of Spain, previous papers that cover this issue are de Castro and Hernández de Cos (2008), European Commission (2012), de Castro and Fernández-Caballero (2013), Hernández de Cos and Moral Benito (2016), Martínez and Zubiri (2014), or Lamo *et al.* (2013).
5. The interpolation relies heavily on Central Government variables. The available quarterly nominal, non-seasonally adjusted General Government series are not used in the interpolation procedure.
6. See “The AWM database”, September 2010, available at the official AWM site at the Euro Area Business Cycle Network (<http://www.eabcn.org/data/awm/index.htm>).
7. See Fernández-Caballero, Pedregal and Pérez (2010).

8. The type of models that we use encompass the estimation of seasonal components, and so it is possible to recover model-consistent seasonally-adjusted series. Nevertheless, the companion database we provide in Excel format includes seasonally-adjusted series based on the well-known program TRAMO-SEATS (Gómez and Maravall, 1996), given that this is the standard method used by many National Statistical Institutes to seasonally-adjust macroeconomic time series.
9. Not shown for the sake of brevity, but available from the authors upon request.
10. In the case of Spain, the fact that unemployment benefits pay social contributions may create some extra volatility relative to real GDP in downturns.

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Resumen

El estudio de los efectos macroeconómicos de reformas fiscales y/o revisión de programas de gasto público ha ganado relevancia en los últimos años. Sin embargo, en muchas ocasiones las características de los datos disponibles limita el enfoque que los analistas pueden utilizar. Aunque se trate de un tema que tradicionalmente ha recibido poca atención, es claro que tiene una gran relevancia para decisores públicos y académicos. Así, en este artículo construimos una base de datos trimestral de variables relativas a las finanzas públicas para el periodo 1986Q1-2015Q4, en términos de contabilidad nacional, ajustadas estacionalmente y con un alto nivel de desagregación. Siguiendo una tendencia reciente de la literatura, ponemos especial énfasis en los modelos y datos primarios usados. Incluimos un variado conjunto de indicadores fiscales primarios tomados de las cuentas presupuestarias (de caja). Además, ilustramos el uso de nuestra base de datos obteniendo hechos estilizados de las propiedades cíclicas de las políticas fiscales implementadas en las tres últimas décadas.

Palabras clave: datos/indicadores fiscales, políticas fiscales, análisis series temporales, modelos de frecuencias mixtas.

Clasificación JEL: E62, E65, H6, C3, C82

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