Q-ESFIPDB: A quarterly dataset of Spanish public finance variables fit for economic analysis*

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Abstract

The analysis of fiscal policy and its macroeconomic impact is currently at the forefront of economic analysis. In most European countries, nevertheless, the in-depth study of these issues has been limited by the absence of quarterly fiscal data. In the case of Spain, even though the Central Government sector is well covered in National Accounts terms, statistics pertaining to the aggregate of interest, the General Government sector, are more limited. Indeed the available series are limited to the period starting in 2000Q1, are only provided in nominal, non-seasonally adjusted terms, and left aside a number of relevant fiscal aggregates. Against this framework, the aim of this paper is to provide a comprehensive database of quarterly fiscal variables suitable for macroeconomic analysis built up following state-of-the-art modeling techniques, and using as input all available sources of fiscal data: (i) the database covers the period 1986Q1-2010Q4; (ii) it presents both non-seasonally adjusted and seasonally adjusted series; (iii) it covers a broad number of fiscal aggregates. By focusing solely on intra-annual fiscal information for interpolation purposes we are able to capture genuine intra-annual "fiscal" dynamics in the data. In particular we take into account the well-known fact that tax collection can decouple from the evolution of theoretical macroeconomic tax bases. Using our database we provide a number of applications that highlight its usefulness for policy analysis and applied research: (i) we run SVAR models and provide estimates of the impact of changes in fiscal aggregates on macroeconomic variables; (ii) we also compare the obtained SVAR results with those obtained with alternative datasets and previous studies; (iii) we provide some stylized facts on the cyclical properties of fiscal policies on the basis of public finance variables.

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1 Introduction

The appropriate assessment of the impact of fiscal policies at national level is restricted by the limitations of available quarterly data for the relevant fiscal variables in national accounts terms. The whole fiscal surveillance process at the European level is designed on the basis of annual data. The fact that budgetary plans are prepared following an annual budgetary cycle, typically in the framework of annual models, and the discretionary nature of many government measures set up for the entire year, have traditionally limited the interest in high-frequency fiscal data. Nevertheless, a recent strand of the literature has shown that intra-annual fiscal data, when modeled appropriately, contains an extremely valuable and useful information for forecasting annual fiscal aggregates, enabling earlier detection of episodes of fiscal deterioration (or improvement) than traditional methods.[1]

Our paper follows closely Paredes, Pedregal and Pérez (2009), that present a quarterly fiscal database for the euro area aggregate, in particular as regards the methodological approach and the scope of the paper. At the same time it presents a number of specificities as regards, first, some statistical and accounting issues (related to the quite decentralized structure of the general government sector in Spain) and, second, the stronger focus on empirical applications. Thus, the issue addressed in this project is the construction of a quarterly fiscal database for Spain for the period 1986Q1-2010Q4, solely based on intra-annual fiscal information, on the basis of multivariate, state-space mixed-frequencies models.[2] The models are estimated with annual and quarterly national accounts fiscal data and government monthly cash accounts data.[3] With this project we aim at filling-in a gap in the literature analyzing the impact of fiscal policies on the macroeconomy and related fiscal policy issues. Previous studies use mostly annual data, and the few using quarterly figures rely on non-publicly available figures.[4] An exception is the REMS database (see Boscá et al., 2007), companion to the REMS model — a DSGE model currently used within the Ministry of Economy and Finance to carry out policy simulations — which is a quarterly database for Spain that includes a fiscal block with quarterly variables. Being a extremely valuable contribution, however, the fiscal block included in the broader REMS database is obtained by means of simple interpolation of annual fiscal figures, for which the quarterly dynamics may presumably differ significantly from actual developments at this frequency. We will analyze the dynamics properties of this dataset vs our own in a subsequent Section of the paper.

We provide a quite disaggregated set of nominal fiscal variables for the General Govern-

[1] See Pérez (2007), Silvestrini et al.(2008), Onorante et al.(2010), or Pedregal and Pérez (2010).

[2] Along the lines of Harvey and Chung (2000), Moauro and Savio (2005), Proietti and Moauro (2006).

[3] Quarterly government finance statistics for Spain are available for the period starting in 2000Q1, in nominal, non-seasonally adjusted terms, see European Commission (2002a, 2002b, 2006). The data started to be published by the European Central Bank in August 2004 (only for the euro area aggregate, see ECB, 2004), and subsequently by Eurostat itself. For further details see European Commission (2007) and Pedregal and Pérez (2010).

[4] In particular these these papers make use of the quarterly data set compiled by Estrada et al. (2004). This dataset is the one used to estimate and simulate Banco de España's quarterly macroeconometric model (MTBE henceforth) and thus the interpolation procedure applied and the indicators used were selected with this purpose in mind. Except for public consumption, standard interpolation techniques (Denton method in second relative differences with relevant indicators) were applied to pre-seasonally-adjusted figures; in addition, the available quarterly GFS nominal, non-seasonally adjusted series starting in the period 2000Q1 figures were not used in the interpolation procedure.

ment sector in ESA95 terms,[5] seasonally and non-seasonally adjusted, in order to make the database a usable input for the estimation of macroeconomic models, forecasting exercises or for applied empirical studies. Seasonally and non-seasonally adjusted series, are consistently and jointly estimated within our models. The issue of seasonal adjustment of quarterly fiscal variables in Europe is an important one, as signalled in European Commission (2007). [6]

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. 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, the breakdown between government wage and non-wage consumption expenditure, and government employment. The net lending of the government, a key policy variable, can be computed as the difference between total revenues and total expenditures.

Our database makes use of only intra-annual fiscal information. This is a relevant point for further research devoted to the integration of interpolated intra-annual fiscal variables in more general macroeconomic studies, because it allows us to capture genuine intra-annual "fiscal" dynamics in the data. This is very important because although government revenues and expenditures (e.g. unemployment benefits) may be endogenous to GDP or any other tax base proxy (e.g. private consumption for indirect tax collection) the relationship between these variables is at most indirect and extremely difficult to estimate. The decoupling of tax collection from the evolution of macroeconomic tax bases (revenue windfalls/shortfalls) is by now a proved stylised fact. We instead use directly fiscal data for interpolation purposes, which overcomes the problem of modelling an indirect relationship which is time-varying. Indeed, intra-annual fiscal data taken from public accounts' sources represent the most relevant piece of direct information on intra-annual fiscal developments; the quasi-accounting relationship between public accounts' figures and national accounts' figures has to be modelled to account for differences in cash vs accrual methodology and central vs general government data.

Using our database we provide a number of applications that highlight its usefulness for policy analysis and applied research: (i) we run SVAR models and provide estimates of the impact of changes in fiscal aggregates on macroeconomic variables; (ii) we also compare the obtained SVAR results with those obtained with alternative datasets and previous studies; (iii) we provide some stylized facts on the cyclical properties of fiscal policies on the basis of public finance variables.

[5]ESA95: European System of National Accounts.

[6]The main aim of our project is to provide interpolated, raw (non-seasonally adjusted) fiscal data. Given that the type of models that we use encompasses the estimation of a seasonal component, we also provide model-consistent, seasonally-adjusted series. Nevertheless, seasonal adjustment is not a key issue of our paper. In this respect, some empirical applications making use of our data, like those that may incorporate seasonally-adjusted macroeconomic data (by some standard method like TRAMO/SEATS, see for example Gómez and Maravall, 1996) may call for the seasonal adjustment of our raw data with methods that are comparable to those applied to the other variables incorporated in the analysis

Our VAR simulations show high persistence of public expenditure shocks. Spending shocks yield positive effects on GDP in the short term but negative in the longer term, mainly due to the higher real interest rates weighing on economic activity. By government spending component, higher government consumption and in particular expenditure on wages and salaries are found to entail negative output responses, whereas purchases of goods and services lead to the opposite result. No significant reaction by GDP is detected following higher public investment though. When comparing VAR impulse response functions, it is observed that in general REMS data always lead to more sizeable and less precise responses of all variables.

The rest of the paper is organized as follows. Section 2 details the sources and availability of fiscal data in Spain. Section 3 presents the econometric models we use to compile our dataset (Q-ESFIPDB). Then, section 3 describes some stylized facts related while section 5 applies Q-ESFIPDB and compare its performance to that observed for existing alternatives. Finally, section 6 concludes.

2 Sources of fiscal data

In this section we describe the availability of fiscal data in Spain. Table 1 provides a summary of the material presented in this section.

As in Paredes, Pedregal and Pérez (2009), to compile our dataset we tried to 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. In this respect, we chose intra-annual data from the public accounts along the lines of the statement of the manual that quarterly data shall be based on direct information available from basic sources, such as for example public accounts or administrative sources.

More importantly, the manual exposes that the quarterly data and the corresponding annual data have to be consistent, a constraint that our database fulfils. As regards the coherence of quarterly data with annual rules, the discussion in European Commission (2002a, 2002b, 2006) shows that there is some room for econometric estimation of intra annual fiscal variables. This is the case for two main reasons. Firstly, ESA95 does not consider the quarterly aspects of taxes and social payments with sufficient precision to ensure clarity of interpretation in all situations; this is because, when discussing non-financial accounts, the ESA95 guiding documents occasionally take a perspective which assumes an annual reference period is in mind, thus remaining silent on which quarter within a particular annual reference period is involved. Secondly, it is also the case that many accounting or legal events are annual events by definition (e.g. a tax levied in a complete year); this fact does not present a problem for the statistician compiling annual data (there is no need to establish the amount and time of recording to a particular annual reference period), but do pose problems for the compiler of quarterly data, that needs to attribute revenue and expenditure not merely to a reference year but also to quarters within that year.

2.1 The General government sector

Full quarterly general government accounts on an ESA95 basis are available from 2000 onwards, but only on non-seasonally adjusted terms. These are released by the IGAE. Unfortunately, this information is not available for previous years. However, annual ESA95 data consistent with the quarterly figures start in 1995. On the other hand, annual ESA79 figures are available from 1985 to 1998. Therefore, we extended our annual ESA95 dataset backwards by means of the annual growth rates of ESA79 figures. The corresponding annual values are used as an anchor for the interpolation procedure.

There is one exception for this general pattern. Nominal and real total public consumption expenditure (seasonally and non-seasonally adjusted) are available on a quarterly basis since 1995 in ESA95 terms. These data are obtained from the Quarterly National Accounts published by the INE. Moreover, the INE also offers the quarterly data for the same variables between 1985 and 1998 on an ESA79 basis. Therefore, both datasets were linked with the year-on-year growth rates of the ESA79 series in order to avoid the methodological discontinuity.

Finally, 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 as indicators to interpolate the quarterly ESA95 missing values. Quarterly and monthly fiscal variables (indicators) are also taken from the IGAE and the Ministry of Labour and Immigration (State Secretary of the Social Security), as described bellow.

2.2 Central government and Social Security sectors

For the Central government and the Social Security subsectors, short-term public finance statistics in Spain are published timely, with a broad coverage of budgetary categories. For the former, monthly figures in ESA95 (NA) standards covering all the relevant revenue and expenditure details are published within one month while for the latter monthly cash figures are made available with a short delay and cover both the Social Security System and the Public Employment System. At the same time, quarterly NA-ESA95 figures for the overall general government sector are made available with a delay of up to 90 days.

2.3 Regional and local governments

As described by Fernández-Caballero, Pedregal and Pérez (2011), there are currently two pieces of available information on intra-annual regional government's spending developments in Spain. On the one hand, the Spanish government started to disseminate on December 2010 regional governments' detailed budgetary accounts' (cash) figures following a regular quarterly calendar. The data refer to the aggregate of the sub-sector and to all individual regions, include a significant disaggregation of spending items and are homogeneous across regions. Nevertheless, these figures still present some shortcomings that limit its usefulness for real-time economic analysis. On the other hand, some regional governments disseminate information through their institutional web pages, on the basis of which the authors of the previously quoted paper build up a dataset that we borrow in this paper.

Differently from the spending side of the budget, the revenue side is well covered. On the one hand, taxes shared by the central, regional and local governments are published by the IGAE at the monthly frequency with a lag of just one month. On the other hand, quarterly ceded (own) taxes are published quarterly.

3 Econometric models and definition of the variables

The exposition in this section follows closely Pedregal and Pérez (2010). The starting point of the modelling 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 (1) 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.

$$\begin{bmatrix} \mathbf{z}_t \\ \mathbf{u}_t \end{bmatrix} = \mathbf{T}_t + \mathbf{S}_t + \mathbf{e}_t \tag{1}$$

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. Generally, unobserved components of the same type are allowed to interact but those from different types are independent. For instance, trends are interrelated, but do not depend on seasonal components. The full model is a standard BSM that may be written in State-Space form as (see Harvey, 1989)

$$\mathbf{x}_t = \mathbf{\Phi x_{t-1}} + \mathbf{E w_t} \tag{2}$$

$$\begin{bmatrix} \mathbf{z}_t \\ \mathbf{u}_t \end{bmatrix} = \begin{bmatrix} \mathbf{H} \\ \mathbf{H}^u \end{bmatrix} \mathbf{x}_t + \begin{bmatrix} \epsilon_t \\ \mathbf{v}_t \end{bmatrix} \tag{3}$$

where $\epsilon_t \sim N(0, \Sigma_\epsilon)$ and $\mathbf{v}_t \sim N(0, \Sigma_{\mathbf{v}_t})$

The system matrices $\mathbf{\Phi}$, $\mathbf{E}$, $\mathbf{H}$ and $\mathbf{H}^u$ in equations (2)-(3) include the particular definitions of the components and all the vector noises have the usual Gaussian properties with zero mean and constant covariance matrices (ϵ_t and $\mathbf{v}_t$ are correlated among them, but both are independent of $\mathbf{w}_t$). 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, giveno the fact that our objective variables are observed at different frequencies, an accumulator variable has to be included

$$C_t = \begin{cases} 0, & t = \text{first quarter} \\ 1, & \text{otherwise} \end{cases} \tag{4}$$

so that the previous model turns out to be

$$\begin{bmatrix} \mathbf{z}_t \\ \mathbf{x}_t \end{bmatrix} = \begin{bmatrix} C_t \otimes \mathbf{I} & \mathbf{H\Phi} \\ \mathbf{0} & \mathbf{\Phi} \end{bmatrix} \begin{bmatrix} \mathbf{z}_{t-1} \\ \mathbf{x}_{t-1} \end{bmatrix} + \begin{bmatrix} 1 & \mathbf{HE} \\ \mathbf{0} & \mathbf{E} \end{bmatrix} \begin{bmatrix} \epsilon_t \\ \mathbf{w}_t \end{bmatrix} \tag{5}$$

$$\begin{bmatrix} \mathbf{z}_t \\ \mathbf{u}_t \end{bmatrix} = \begin{bmatrix} \mathbf{I} & \mathbf{0} \\ \mathbf{0} & \mathbf{H}^u \end{bmatrix} \begin{bmatrix} \mathbf{z}_t \\ \mathbf{x}_t \end{bmatrix} + \begin{bmatrix} \mathbf{0} \\ \mathbf{I} \end{bmatrix} \mathbf{v}_t \tag{6}$$

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 widespread general tools to perform all necessary operations in a State Space framework are the Kalman Filter (KF, Kalman, 1960, Kalman and Bucy, 1961) and the Fixed Interval Smoothing (FIS, Bryson and Ho, 1969) algorithms.[7] Finally, it is worth mentioning that 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 sub-sectoral 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, $\mathbf{z}$ comprises total government revenues in National Accounts terms, a variable that is available at the annual frequency from 1986-1999 and at the quarterly frequency from 2000Q1-2010Q4, while $\mathbf{u}$ 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.

More specifically, the variables contained in the quarterly fiscal database are the following. On the revenue side of government accounts, the database includes total government revenue, direct taxes, social security contributions, and total indirect taxes. On the expenditure side, it incorporates total expenditure, social payments, unemployment benefits, interest payments, subsidies, government investment and government consumption, the latter in nominal and real terms, a government wage consumption expenditure, government employment, and purchases of goods and services (non-wage final government consumption). The net lending of the general government (public deficit), a key policy variable, is

[7] In any case, as highlighted in Paredes, Pedregal and Pérez (2009), despite the generality and advantages of the KF and FIS algorithms, there are other alternative algorithms for the estimation of the state vector, most of them equivalent (see e.g. Young and Pedregal, 1999). That is the case of the Bayesian algorithm (West and Harrison, 1989) or the Wiener-Kolmogorov-Whittle classical filter, still used by some approaches to signal extraction (e.g. Gómez and Maravall, 1998). For a discussion along these lines see Pedregal and Young (2002) and references therein.

computed as the difference between total revenues and total expenditures, while public debt is also presented. The list of variables and the corresponding acronyms are displayed in Table 2.

A final remark is worth mentioning. 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,$\mathbf{z}$ encompasses just one time series (annual/quarterly), and $\mathbf{u}$ the set of indicators corresponding to the latter variable, with a maximum of five indicators. The alternative would have been to run models in which $\mathbf{z}$ would have included several variables and thus $\mathbf{u}$ would have been a matrix with indicators by blocks for each component of $\mathbf{z}$. Examples of models that would have made sense include a joint model for TOR and TOE, as in Pedregal and Pérez (2010), i.e. $\mathbf{z}=$ {TOR, TOE }, a joint model for the revenue side of the governments accounts, i.e. $\mathbf{z}=$ { TOR, DTX, SCT, TIN, OTOR }, or a joint model for the expenditure side, i.e. $\mathbf{z}$ = {TOE, THN, GCN, GIN, INP, SIN, OTOE }. We preferred to use for interpolation purposes more parsimonious models, and thus disregarded the alternative approach, quite valid in different frameworks (like forecasting).

4 Some stylized facts of the database

Figures 1, 2, and 3 display the main aggregates containted in the database. On the one hand, figure 1 presents quarter-on-quarter growth rates of total government revenue and its main components in nominal terms (all seasonally-adjusted). In the first years covered by our dataset, between 1986 to 1988 following Spain's accession to the European Community and the commencement of a new cyclical expansion, there was a change in direction in Spanish fiscal policy. This period was characterized by the reduction of the budget deficit from 5.8% in 1985 to 3.4% in 1988, essentially due to the growth of government revenue. In fact, public revenue as a percentage of GDP increased by 2.2 percentage points while public expenditure fell by only 0.2 percentage points. Moreover, there was a significant improvement in the primary balance, which swung from -3.8% in 1985 to a small surplus in 1988, enabling public debt to be whittled down to 41.7% in 1988. Despite this redaction in the expenditure-to-GDP ratio, public outlays registered very dynamic growth rates which prevailed for some years, until the early nineties (see Figure 2). Such expansion is linked to the phasing-in of the Welfare State in Spain.

This period of fiscal restraint came to an end in 1989, when the budget deficit started growing again to reach 7% at the height of the economic crisis in 1993. The primary balance followed a similar path to the deficit. After small surpluses between 1987 and 1989, it moved into deficit in 1990, rising to 1.8% of GDP in 1993. Both public revenues and expenditures increased significantly, reaching 42.8% and 49.8% of GDP, respectively, in 1993. Finally, there was only a slight increase in public debt, to 45.9% of GDP, primarily as a consequence of the strong growth in GDP between 1989 and 1991 (11% in nominal terms), and despite the increase in the cost of debt during this period. In the following years however, public debt rocketed to exceed 60% of GDP in 1993, as a consequence of the sizeable budget deficits and the fall in nominal GDP growth due to the economic crisis and the prohibition on monetary financing of the deficit as of 1994, under the Treaty on European Union. At the same time, the interest burden rose, reaching 5.2% of GDP in 1993.

The second half of the nineties, especially since 1996, is characterized by a protracted period of fiscal consolidation due to the commitment to meet the convergence criteria set out in the Treaty on European Union to regulate access to the Third Stage of EMU. Accordingly, public deficits displayed a declining trend that spread until 2007, when an unprecedented surplus of some 2% of GDP was recorded. Such steady and protracted reduction of general government deficits came hand in hand with a prolonged period of economic recovery.

However, not all the period between 1996 and 2007 can be duly labeled as "fiscal consolidation". As figures 1 and 2 show, the reduction in the public deficit was mainly the result of a drop in spending in the second half of the nineties, which fell by more than 5.5 points of GDP. However, this trend of expenditure retrenchment was reverted in the following years. In fact, after 2004 nominal government expenditure displayed growth rates above those of nominal GDP. Still, deficit reduction continued as a result of the buoyancy of tax revenues, which benefited largely from the tax-friendly growth composition to a large extent linked to the disproportionate development of the construction sector, especially related to the construction of dwellings.

The figures also show the strong drop in revenues since the onset of the financial crisis current crisis, in particular on indirect taxes (TIN) and direct taxes (DTX), while social contributions (SCT) and Social security contributions (SCT) were more resilient. The crisis period followed after a long period of revenue buoyancy, more muted since the mid-nineties than in the late 1980s and early 1990s, though. Indirect taxes showed the highest volatility, presenting not only the most extreme values, but also less persistence in its average behavior.

On the other hand, figure 2 focuses on the main expenditure aggregates, while figure 3 zooms government consumption, and the two decompositions presented in our paper: between its wage and non-wage components, and between its nominal and real components (the latter related to public employment), being the price component, the deflator, a residual that could be computed. The decade of 1986-1995 show the strongest growth rates, after which the accession to EMU implied a substantial deceleration in expenditure, that was followed by some two decades of sustained and substantial nominal spending growth. The last part of the sample clearly reflects the most recent (and ongoing) fiscal consolidation episode.

5 Applications

5.1 Cyclical properties of fiscal variables in Spain

In Table 3, we report dynamic cross-correlation functions. We look at the unconditional correlations between detrended series at the standard business cycle frequencies. Following standard practice we measure the co-movement between two series using the cross correlation function (CCF thereafter). Each row of this table displays the CCF between a given detrended fiscal variable at time t+k, and detrended GDP at time t. For the sake of robustness, we show results for a set of standard filters[8] as applied to seasonally-adjusted time

[8] The selected filters are: (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

series. The results do not have to be taken as a systematic tabulation of stylized facts, but rather as an illustration of some properties of the database, given that we focus on the correlations of the main fiscal aggregates (in real terms) with real GDP.

Each row of this table displays the CCF between a measure of detrended real GDP at time t, and a detrended fiscal variable at time t+k. 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.

The results in the table show the strong and pro-cyclical behaviour of total government revenue in Spain, as it is the case for the euro area aggregate (see Paredes et al., 2009), which follows the business cycle behaviour in upturns and downturns, reflecting the operation of automatic stabilisers. In addition, public revenues are much more volatile than GDP, close to 3 times, on average, a figure higher than the one for the euro area. This reflects 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). Finally, it is worth mentioning that the dominant correlation corresponds to the second lag in the leading side of the CCF, reflecting that tax receipts are particularly endogenous with respect to the business cycle while at the same time showing a leading behavior. Given this, not-quite-surprising feature of government revenues, most studies look at the cyclical properties of government spending (see Frankel, Vegh and Vuletin, 2011, 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 (see discussion on revenue windfalls above), and thus governments use the surplus to increase spending proportionately as a consequence of political pressure or just following certain social-welfare-improving objectives.

As expected, in Table 3 total expenditure (TOE) appears pro-cyclical as well, but lagged, in line with available evidence for the euro area obtained with annual data (see Lamo et al., 2007); this behaviour can be rationalized on the basis of the political economy arguments mentioned in the previous paragraph. The lag detected with quarterly data implies that TOE follows GDP with a -minimum- delay of 1 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. The pro-cyclical pattern of TOE is due to the government consumption component. By contrast, social payments (THN) reflects a counter-cyclical pattern, due to unemployment benefits (UNB); unemployment-

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).

related benefits increase in downturns and decrease in upturns, reflecting its role of automatic stabilizers. 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.

5.2 The macroeconomic impact of fiscal policy shocks in Spain

The Q-ESFIPDB aims to provide researches with a usable, publicly-available quarterly database to overcome the so far existing constraints to conduct proper analysis of the effects of fiscal policy. This constraint has prevented many researches to accomplish such an analysis as interpolated series often raise concerns about the reliability of the results drawn with them. As explained above, these concerns stem mainly from the fact that interpolating fiscal series with the macroeconomic variables we are finally interested in generates an endogenous bias that may contaminate the results.

On the other hand, the importance a proper assessment of the effects of discretionary fiscal shocks increases in view of the ongoing (and expected) sizeable fiscal consolidation packages to comply with the commitments with the EU to cut public deficits and reduce debt in the coming years. Presumably, these fiscal packages will entail non-negligible macroeconomic effects policy-makers should be aware of.

Previous attempts to assess the effects of fiscal shocks in the Spanish economy were De Castro (2006) and De Castro and Hernández de Cos (2008). Essentially, these papers find that government expenditure expansionary shocks are found to have positive effects on output in the short-term though at the cost of higher inflation and public deficits and lower output in the medium and long term. In turn, tax increases are found to drag economic activity in the medium term. More recently, De Castro and Fernández (2011) show that government spending causes real appreciation jointly with current account deterioration, for which Spanish data are deemed to be consistent with the "twin deficits" hypothesis.

Thus, on the basis of similar econometric models and identification schemes, we provide newly updated estimates of the macroeconomic effects of a set of fiscal shocks with Q-ESFIPDB. Moreover, in order to frame our results, we also compare them with those already obtained with the MTBE fiscal database and those that would derive from the use of the REMS database.

5.2.1 Definitions and methodology

The baseline VAR includes quarterly data on public expenditure ($g_t = GCN + GIN$), net taxes ($t_t = TOR - THN - INP$) and GDP (y_t), all in real terms,[9] the GDP deflator (p_t) and the three-year interest rate of government bonds (r_t). All variables are seasonally adjusted and enter in logs except the interest rate, which enter in levels. The VARs were estimated for the period 1986:Q1 to 2010:Q4, except for the REMS data because the sample covers only until 2009. The GDP volume and its deflator have been taken from the Quarterly

[9] The nominal variables have been deflated by the GDP deflator in order to obtain the corresponding real values.

National Accounts (National Institute of Statistics, INE) while the three-year bond rate has been obtained from the Banco de España database. The SVAR approach in this paper is completely standard and follows as such the seminal contributions of Blanchard and Perotti (2002) and Perotti (2004). For further details see Appendix I.

5.2.2 The effects of government expenditure shocks

Figure 4 displays the responses of government spending variables and GDP to a positive expenditure shock.[10] The expenditure shock turns out to be very persistent and only becomes insignificant after almost five years. The high persistence of public expenditure shocks is in line with the existing evidence for other OECD countries (Perotti, 2004; Galí et al., 2007). The increase of government expenditure raises GDP, which peaks in the 5th quarter after the shock. In the longer term, however, our results show that the GDP response dwindles steadily and becomes significantly negative after four years, which might be due to the higher real interest rates that weighs on economic activity. This evidence is also in line with the negative medium-term output responses obtained for some other OECD countries (Perotti, 2004; Mountford and Uhlig, 2002). Net-tax revenues display a non-significant increase and turn negative in the medium term following the decline in economic activity.

The different components of government spending lead to quite dissimilar reactions, in particular GDP. In general, higher government consumption leads to negative output responses. This is explained due to the sizeable negative and significant GDP fall following an increase in expenditure on wages and salaries, which can be explained by the potentially negative effects on private investment profitability stemming from higher personnel spending by the general government sector (Alesina et al., 2002). By contrast, purchases of goods and services seem to entail positive effects on GDP. The results so far are in line with those in De Castro and Hernández de Cos (2008). However, and admittedly to our surprise, public investment shocks lead to no significant reaction by GDP. Though this contrasts with the findings in De Castro and Hernández de Cos (2008), the third column of Figure 4 shows that such result is highly dependent on the sample period, especially is the last two years in the sample. The sizeable investment packages implemented to smooth the effects of the crisis were accompanied by a collapse in economic activity. By contrast, when the sample period is constrained to end in the last quarter of 2007 public investment shocks lead to significant GDP increases, in accordance with previous empirical evidence for Spain. In general, the last three years affect substantially output responses to the shocks to the different government spending components. The third column of Figure 4 shows that output responses to personnel spending become positive when skipping the last three years. Accordingly, output responses to public consumption shocks are positive too.

Figure 5 compares the responses of government spending, GDP and net taxes to shocks to our variable of public expenditure obtained with the Q-ESFIPDB with the MTBE and REMS datasets. The three databases yield a similar degree of persistence of the spending shocks, although with some differences in their dynamics. The most remarkable difference among these datasets is that REMS data always lead to more sizeable and less precise

[10] Impulse responses are reported for five years and the one-standard deviation confidence bands have been obtained by Monte Carlo integration methods with 500 replications.

responses of all variables. In turn, impulse responses of government spending in the Q-ESFIPDB are more sizeable than in the MTBE. Moreover, the peak response is observed in the fifth quarter after the shock, whereas in the MTBE the peak response takes place on impact. REMS data lead to responses similar to the Q-ESFIPDB, although they are estimated more imprecisely. Responses of net taxes differ substantially across databases. As opposed to the non-significant (positive) reaction with the Q-ESFIPDB, net taxes collapse with the REMS data while rise significantly in the short term with MTBE data. Although the increase with the MTBE data might be claimed to owe to the positive output reaction, the latter appears too muted to justify such a clear increase.

Likewise, GDP responses also display salient dissimilarities across databases: while in both the Q-ESFIPDB and the MTBE output rises in the short term and dwindles after the third year, GDP never increases with REMS data in response to the shock.[11] Despite its most sizeable reaction, cumulative output multipliers[12] 4 quarters after the shock gauged with the Q-ESFIPDB amount to around 0.8, lower than the estimated multiplier of 1.03 with MTBE data (see Table **??**). The estimated output multiplier with the Q-ESFIPDB is though in line with other estimates for the EMU or the US (see Burriel *et al.*, 2010). In turn, MTBE-based output multipliers amount to slightly above 1 and around 1.4 in the fourth and eight quarters after the shock, respectively.[13] By contrast, cumulative multipliers with REMS data turn out to be always negative, which does not fit empirical evidence. The last three years are highly influential on the estimates of output multipliers. When the sample is restricted to finish in 2007Q4 we can observe that cumulative output multipliers one year after the shock amount to around 1.3, well above the estimations for the whole sample period. Again, this evidence is fully consistent with the values obtained in De Castro (2006) and De Castro and Hernández de Cos (2008) with the MTBE dataset.

Figure 6 presents the responses of the main three variables to a shock to net taxes. These are compared with the results obtained with the other two databases. The persistence of net tax shocks is similar in the Q-ESFIPDB and the MTBE datasets. The shock remains significant for around two years and a half, while with REMS data the shock still remains significant five years after. In all cases, government spending declines and recovers later on, standing significantly above the baseline in the medium term. This positive reaction of expenditure seems in line with the tax-and-spend view of fiscal policy.[14] Finally, GDP rises in response to higher net taxes. Admittedly, this result is at odds with almost any theoretical model. This is observed with the three datasets. Moreover, this pattern is also observed in the short term by Perotti (2004), De Castro and Hernández de Cos (2008) or Heppke-Falk et al. (2006), among others, which probably reveals the difficulty to identify net tax shocks properly. In any case, these results might also be contaminated by developments in the last years of the sample, characterized by a sizeable downturn in economic activity jointly with significant tax cuts.

[11]Though not shown here, interest rates go up in all cases.

[12]The cumulative dynamic multiplier at a given quarter is obtained as the ratio of the cumulative response of GDP and the cumulative response of government expenditure.

[13]See De Castro (2006) and De Castro and Hernández de Cos (2008).

[14]De Castro et al. (2004) provide some evidence supporting this view for Spain.

6 Conclusions

In this paper we provide a comprehensive database of quarterly fiscal variables suitable for macroeconomic analysis built up on the basis of a 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 1986Q1-2010Q4, 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 database we also provide in the paper a number of applications that highlight its usefulness of macroeconomic analysis and policy. Firstly, we run SVAR models and provide estimates of the impact of changes in fiscal aggregates on macroeconomic variables. Firstly, we provide some stylized facts on the cyclical properties of fiscal policies on the basis of public finance variables. Secondly, we run SVAR models and provide estimates of the impact of changes in fiscal aggregates on macroeconomic variables. Finally, we also compare the obtained SVAR results with those obtained with alternative datasets and previous studies.

References

Alesina, A., Ardagna, S., Perotti, R. and Schiantarelli, F. (2002) Fiscal policy, profits and investment. *American Economic review*, 92, pp. 571-589.

Álvarez, L.J. and Burriel, P. (2010) Micro-Based Estimates of Heterogeneous Pricing Rules: The United States vs. the Euro Area. *The Scandinavian Journal of Economics*, 112(4), pp. 697-722.

Blanchard, O. J. and R. Perotti (2002) An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output. *Quarterly Journal of Economics*, 117, 1329-1368.

Bryson A. E. Jr. and Y. C. Ho (1969), *Applied optimal control: optimization, estimation, and control*, Waltham, MA: Blaisdell.

Burriel, P.., F. de Castro, D. Garrote, E. Gordo, J. Paredes and J. J. Pérez (2010). Fiscal policy shocks in the euro area and the US: an empirical assessment. *Fiscal Studies*, 31(2), pp. 251-285.

Coenen, G., K. Christoffel and A. Warne (2008), The New Area-Wide Model of the Euro Area: A Micro-Founded Open-Economy Model for Forecasting and Policy Analysis, ECB Working Paper No. 944.

de Castro, F. (2006) The macroeconomic effects of fiscal policy in Spain. *Applied Economics*, 38, pp. 913-924.

de Castro, F., González-Páramo, J.M., Hernández de Cos, P. (2004) Fiscal consolidation in Spain: Dynamic interdependence of public spending and revenues. *Investigaciones Económicas* XXXVIII (1), 193-207.

de Castro, F and P. Hernández de Cos (2008) The economic effects of fiscal policy: the case of Spain. *Journal of Macroeconomics*, 30, 1005-1028.

de Castro, F and L. Fernández (2011) The Effects of Fiscal Shocks on the Exchange Rate in Spain. Banco de España Working Paper No. 1121.

Estrada, A., J.L. Fernández, E. Moral,and A.V. Regil (2004) A quarterly macroeconometric model of the Spanish economy. Banco de España Working Paper No. 0413.

European Commission (2002a), Reg. (EC) No 1221/2002 of the European Parliament and of the Council of 10 June 2002 on quarterly non-financial accounts for general government.

European Commission (2002b), *ESA95 manual on government deficit and debt, Methods and Nomenclatures series*, European Commission, Luxembourg.

European Commission (2006), *Manual on quarterly non-financial accounts for general government*, European Commission, Luxembourg.

European Commission (2007). Quarterly government accounts and fiscal surveillance, pp 103-106 in *Public Finances in EMU*, European Commission, Brussels.

Fagan, G., J. Henry and R. Mestre (2001), An area-wide model (AWM) for the euro area, European Central Bank Working Paper Series, 42, January.

Fagan, G., J. Henry and R. Mestre (2005), An area-wide model (AWM) for the euro area, *Economic Modelling*, 22, 39-59.

Fernández-Caballero, L., Pedregal, D.J., and Pérez, J.J. (2011) Monitoring sub-central government spending in Spain. Banco de España Working Paper No. 1127.

Galí, J., D. López-Salido and J. Vallés (2007) Understanding the effects of government spending on consumption. *Journal of the European Economic Association*, 5, 227-270.

Gómez, V. and A. Maravall (1996), Programs TRAMO (Time series Regression with Arima noise, Missing observations, and Outliers) and SEATS (Signal Extraction in Arima Time Series). Instructions for the User, Banco de España Working Paper No. 9628.

Harvey, A. (1989) *Forecasting Structural Time Series Models and the Kalman Filter*. Cambridge University Press. UK.

Harvey, A. and Chung, C. (2000) Estimating the underlying change in unemployment in the UK. *Journal of the Royal Statistical Society, Series A*, 163, pp. 303-339.

Heppke-Falk, K.H., J. Tenhofen and G.B. Wolff (2006) The macroeconomic effects of exogenous fiscal policy shocks in Germany: a disaggregated SVAR analysis. Deutsche Bundesbank. Discussion Paper Series 1: Economic Studies No 41/2006.

Kalman, R. E. (1960), A new approach to linear filtering and prediction problems, *Journal of Basic Engineering*, 82, 35–45.

Kalman, R. E and R. S. Bucy (1961), New Results in Linear Filtering and Prediction Theory, *Journal Of Basic Engineering*, 83, 95-108.

Lamo, A., J. J. Pérez and L. Schuknecht (2007), The cyclicality of consumption, wages and employment of the public sector in the euro area, ECB Working Paper No. 757.

Marcet, A. and M. Ravn (2004), The HP-filter in cross-country comparisons, CEPR DP 4244

Moauro F. and Savio G. (2005), Temporal Disaggregation Using Multivariate Structural Time Series Models. *Econometrics Journal*, 8, 214-234.

Morris, R. and L. Schuknecht (2007), Structural balances and revenue windfalls - the role of asset prices revisited, ECB Working Paper No 737.

Mountford, A. and H. Uhlig (2009) What are the effects of fiscal policy shocks?. *Journal of Applied Econometrics*, 24(6), 960-992.

Onorante, L., Pedregal, D.J., Pérez, J.J. and Signorini, S. (2009), The usefulness of infra-annual government cash budgetary data for fiscal forecasting in the euro area, forthcoming in *Journal of Policy Modeling*.

Paredes, J., Pedregal, D.J., and Pérez, J.J. (2009) A quarterly fiscal database for the euro area based on intra-annual fiscal information. Banco de España Working Paper, No. 0935.

Pedregal, D. J. and Pérez, J. J. (2010), Should quarterly government finance statistics be used for fiscal surveillance in Europe?. *International Journal of Forecasting*, 26 (4), 794-807.

Pedregal, D.J., Young, P.C. (2002), *Statistical Approaches to Modeling and Forecasting Time Series*, in: Clemens, M., Hendry, D. (Eds.), Companion to Economic Forecasting, Blackwell Publishers, Oxford, pp. 69-104.

Pérez, J. J. (2007), Leading Indicators for Euro Area Government Deficits, International Journal of Forecasting 23, 259-275.

Perotti, R. (2004) *Estimating the effects of fiscal policy in OECD countries.* Proceedings, Federal Reserve Bank of San Francisco.

Proietti T. and Moauro, F. (2006) Dynamic factor analysis with non-linear temporal aggregation constraints. *Journal of the Royal Statistical Society Series C, Royal Statistical Society*, 55, pp. 281-300.

Silvestrini A., Salto M. , Moulin L., and Veredas D. (2008), Monitoring and forecasting annual public finance deficit every month: the case of France. *Empirical Economics*, 34, 493-524.

Young, P. C. and D. J. Pedregal (1999), Recursive and En-Block approaches to signal extraction, *Journal of Applied Statistics*, 26, 103-128.

Appendix I: SVAR approach.

The reduced-form baseline VAR is specified in levels. $X_t \equiv (g_t, t_t, y_t, p_t, r_t)$ is the vector of endogenous variables and $D(L)$ is an autoregressive lag-polynomial. The benchmark specification includes a constant and a deterministic time trend. In order to assess the differences between our database on the one hand, and the MTBE and REMS datasets on the other, we applied the same specification to the three cases. The vector $U_t \equiv (u_t^g, u_t^t, u_t^y, u_t^p, u_t^r)$ contains the reduced-form residuals, which in general will present non-zero cross-correlations. The baseline VAR includes four lags of each endogenous variable according to the information provided by LR tests, the Akaike information criterion and the final prediction error.

We apply the identification strategy proposed by Blanchard and Perotti (2002) and Perotti (2004), which exploits decision lags in policy making and information about the elasticity of fiscal variables to economic activity. Their strategy relies on the assumption that the reduced-form residuals of the g_t and t_t equations, u_t^g and u_t^t, can be thought of as linear combinations of three types of shocks: a) the automatic responses of spending and net taxes to the rest of macroeconomic variables in the system, b) systematic discretionary responses of fiscal policy to the same set of macro variables and c) random discretionary fiscal policy shocks, which are the truly uncorrelated structural fiscal policy shocks whose effects are the purpose of our analysis.

The innovations model can be written as $\Gamma U_t = BV_t$, where $V_t \equiv (e_t^g, e_t^t, e_t^y, e_t^p, e_t^r)$ is the vector containing the orthogonal structural shocks. Accordingly, the reduced-form residuals are linear combinations of the orthogonal structural shocks of the form $U_t = \Gamma^{-1}BV_t$. The respective matrices Γ and B can be written as:

$$\Gamma = \begin{pmatrix} 1 & 0 & -\alpha_{g,y} & -\alpha_{g,p} & -\alpha_{g,r} \\ 0 & 1 & -\alpha_{t,y} & -\alpha_{t,p} & -\alpha_{t,r} \\ -\gamma_{y,g} & -\gamma_{y,t} & 1 & 0 & 0 \\ -\gamma_{p,g} & -\gamma_{p,t} & -\gamma_{p,y} & 1 & 0 \\ -\gamma_{r,g} & -\gamma_{r,t} & -\gamma_{r,y} & -\gamma_{r,p} & 1 \end{pmatrix}$$

and

$$B = \begin{pmatrix} 1 & \beta_{g,t} & 0 & 0 & 0 \\ \beta_{t,g} & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

As we are interested in analysing the effects of "structural" discretionary spending shocks e_t^g on the rest of the variables of the system, estimations for the $\alpha_{i,j}$'s and $\beta_{i,j}$'s are needed. In general, approving and implementing new measures in response to specific economic circumstances typically takes longer than three months. Hence, one key assumption in this approach is that quarterly variables allow setting discretionary contemporaneous responses of fiscal variables to changes in underlying macroeconomic conditions to zero. Therefore, the coefficients $\alpha_{i,j}$'s only reflect the automatic responses of fiscal variables to the rest of the variables of the system, the first source of innovations aforementioned.

The way fiscal variables are defined allows making further assumptions concerning the values of the $\alpha_{i,j}$'s. Specifically, the semi-elasticities of fiscal variables to interest rate innovations are set to zero given that interest payments on government debt are excluded from both definitions. Moreover, the automatic responses of public expenditure to economic activity and the real exchange rate are also set to zero. The case of the price elasticity is different because some share of purchases of goods and services is likely to respond to the price level. Thus, we set the price elasticity of government expenditure to -0.5.

Output and price elasticities of net taxes, $\alpha_{t,y}$ and $\alpha_{t,p}$, are estimated at 0.64 and 0.87, respectively, fully in line with those in de Castro and Hernández de Cos (2008). These are obtained as weighted averages of the elasticities of the different net-tax components, including transfers, computed on the basis of information like statutory tax rates and estimations of the contemporaneous responses of the different tax-bases and, in the case of transfers, the relevant macroeconomic aggregate to GDP and price changes.

Furthermore, given that our main interest lies on expenditure shocks we assume that spending decisions are prior to tax ones, which implies a zero value for $\beta_{g,t}$. This allows us to retrieve e_t^g directly and use it to estimate $\beta_{t,g}$ by OLS, which completes the identification of the first two equations. For the remaining shocks the sequential ordering u_t^y, u_t^p and u_t^r is imposed. The corresponding structural shocks are estimated by instrumental variables in turn, using e_t^g and e_t^t as instruments for u_t^g and u_t^t, respectively. In any case, since we are interested in studying the effects of fiscal policy shocks, the ordering for the remaining variables is immaterial to the results. Impulse response functions are reported jointly with 68 % confidence bands obtained by Monte Carlo integration methods with 1000 replications.

7 Figures and tables

Figure 1: The quarterly fiscal database: total revenue and total revenue components (smoothed estimates). Year-on-year growth rates of seasonally-adjusted figures in nominal terms.

Figure 2: The quarterly fiscal database: total expenditure and total expenditure components (smoothed estimates). Year-on-year growth rates of seasonally-adjusted figures in nominal terms.

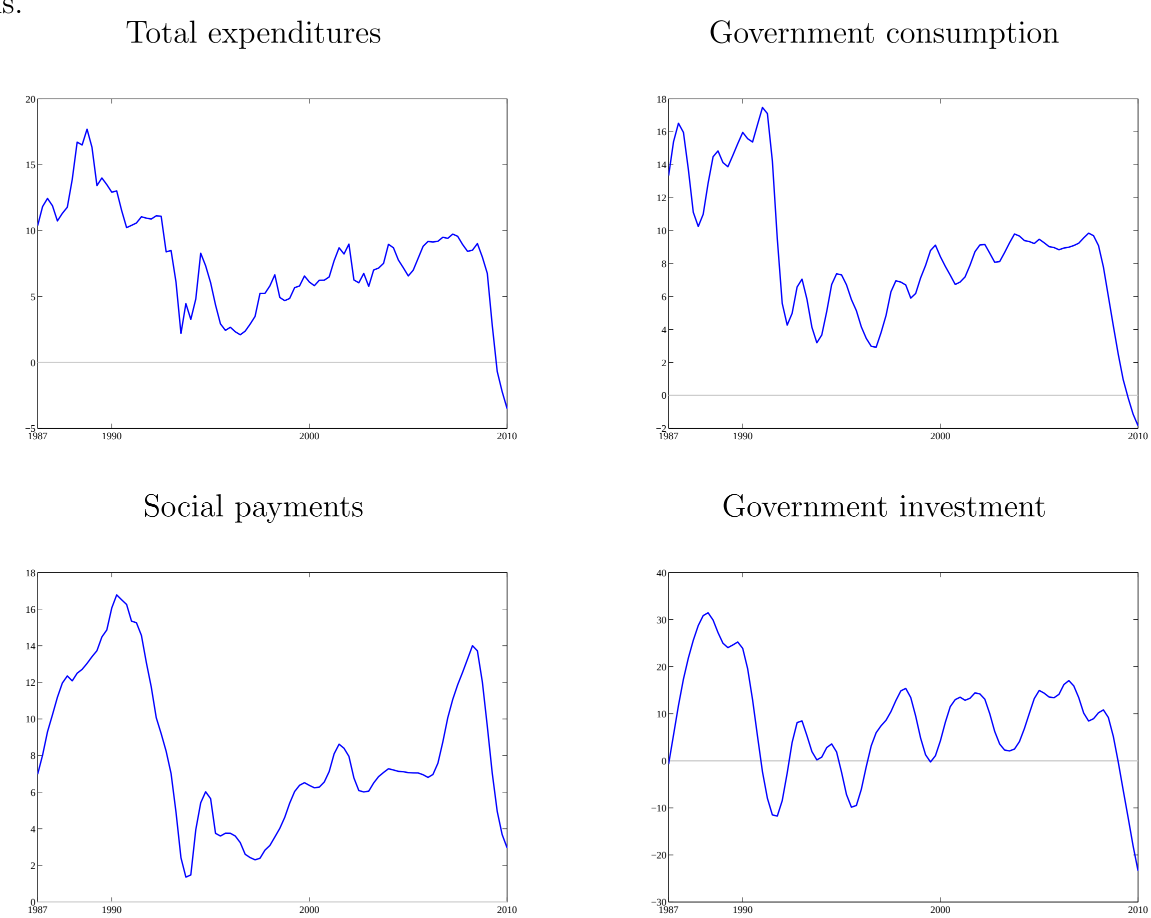

Figure 3: The quarterly fiscal database: decomposition of government consumption (smoothed estimates). Year-on-year growth rates of model-consistent seasonally-adjusted figures in nominal terms.

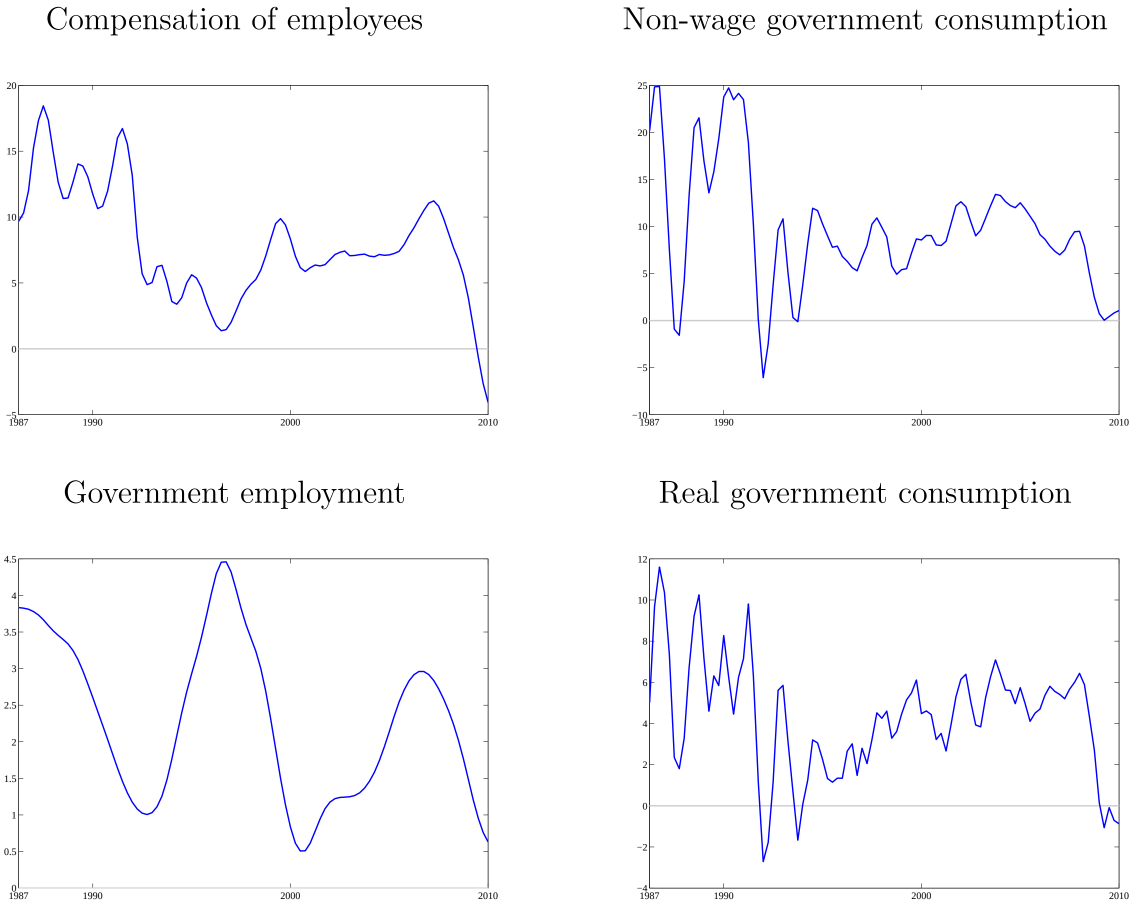

Figure 4: Responses to an increase in different government spending components

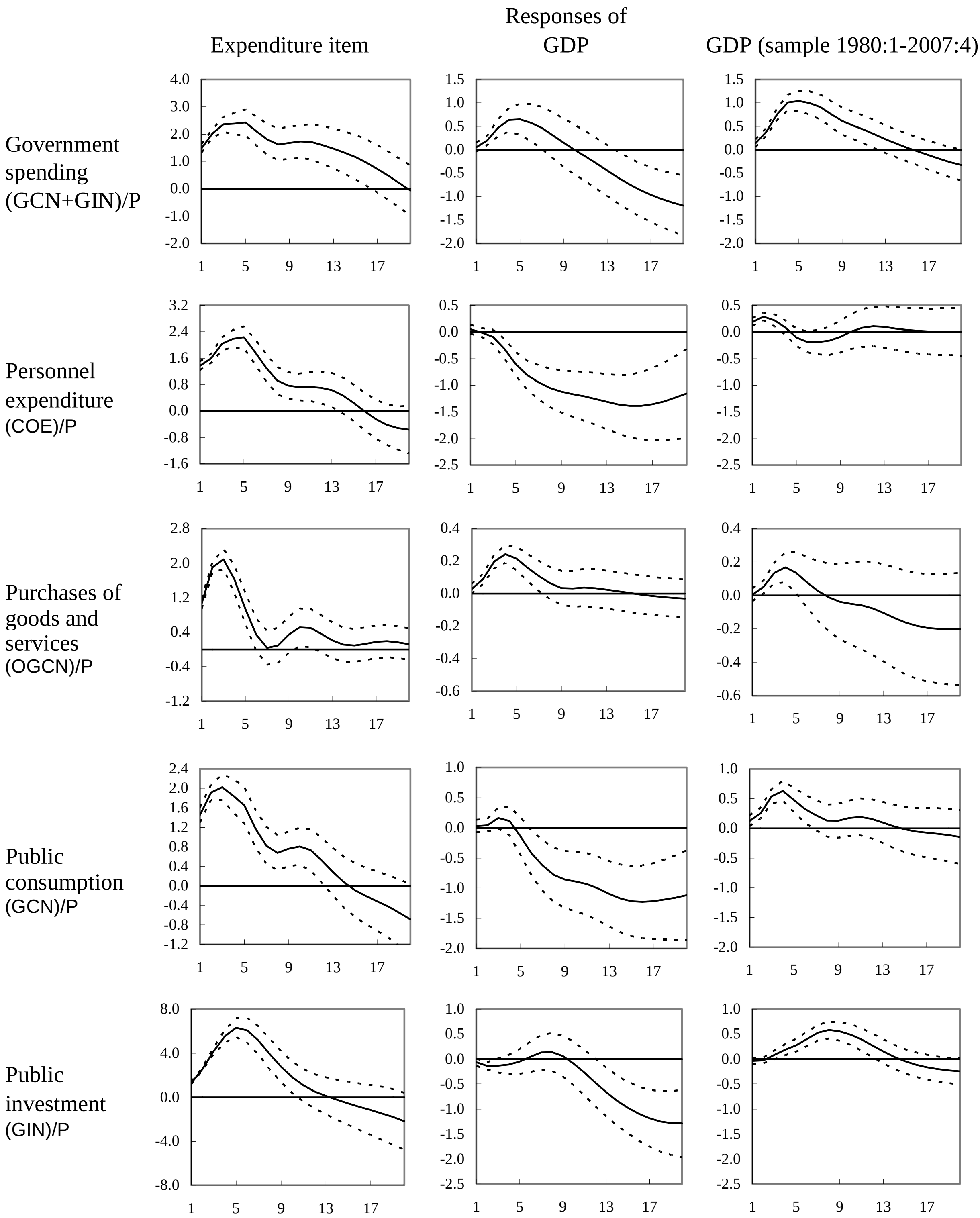

Figure 5: Responses to an increase in government spending with the different databases

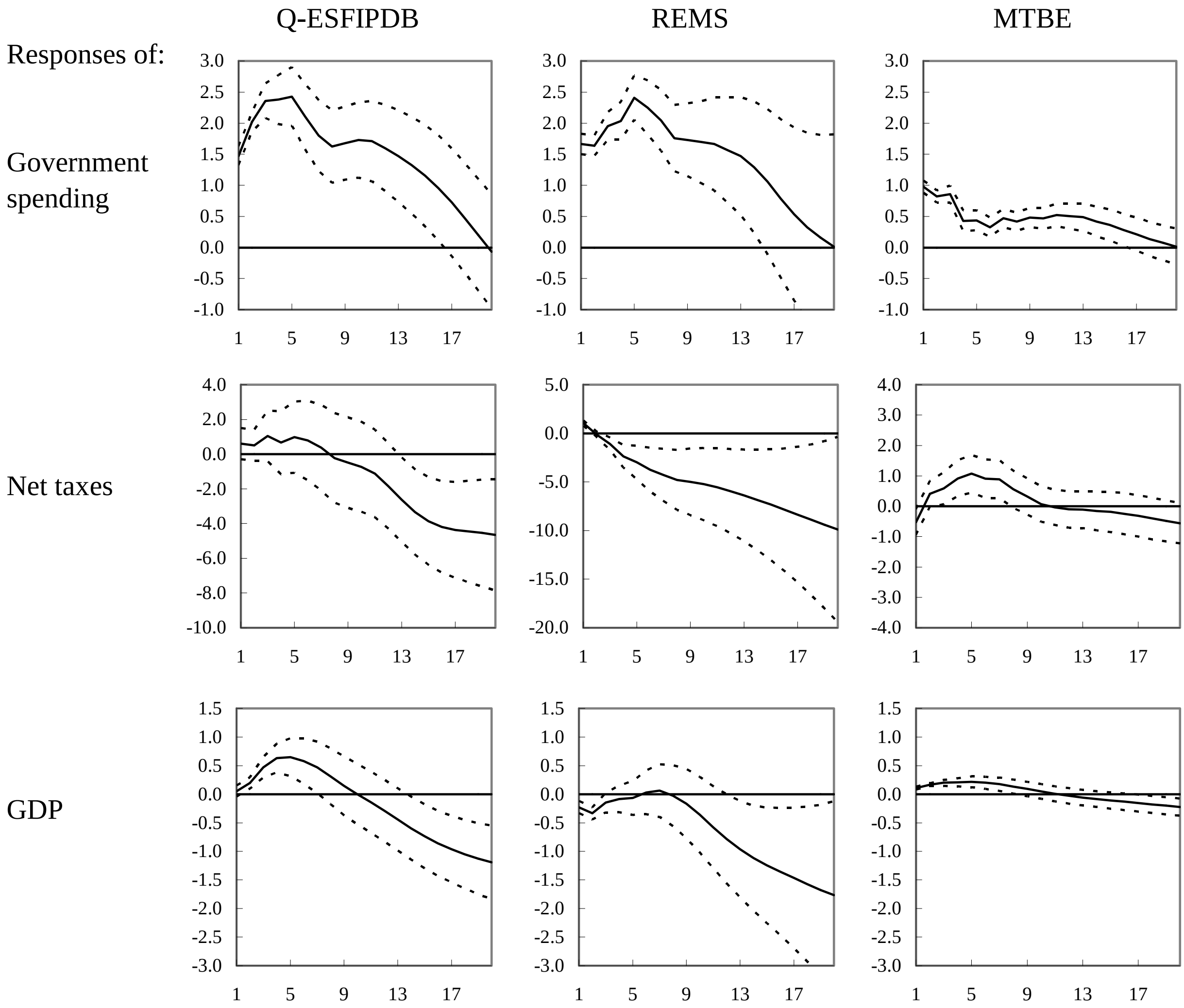

Figure 6: Responses to an increase in net taxes with the different databases

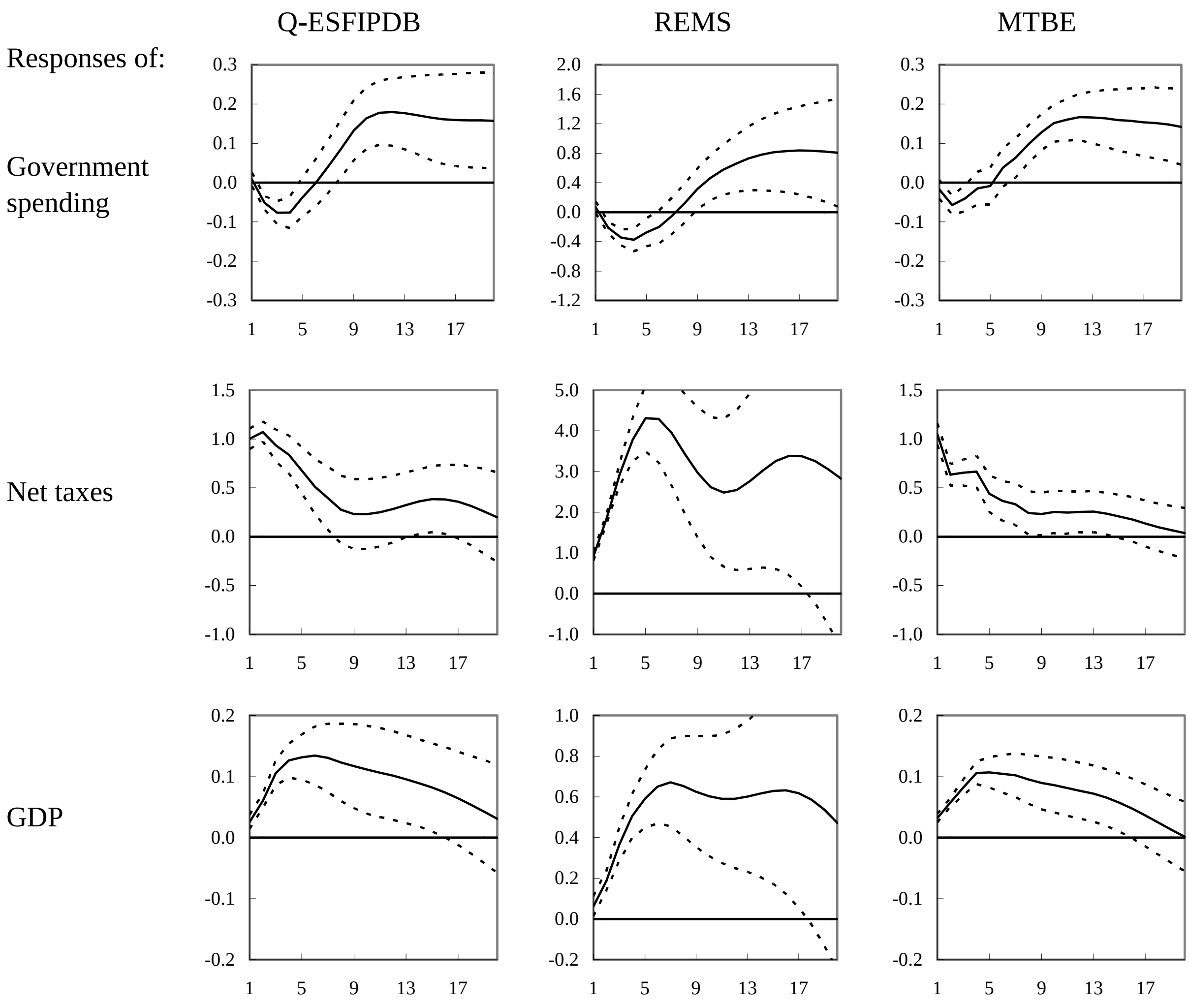

Table 1: Availability of infra-annual fiscal variables.

	Coverage	Frequency	Publication lag (approx.)	First year available	Accounting framework
Central Government	Revenue and expenditure	Monthly	1 month [a]	January 1988	Budgetary accounts
	Revenue and expenditure	Monthly	1 month [a]	January 1995	National Accounts
Social Security system	Revenue and expenditure	Monthly	1 month [a]	January 1984 [b]	Budgetary accounts
National Public Employment Service	Revenue and expenditure	Monthly	1 month [a]	January 1984 [b]	Budgetary accounts
Regional governments' homogeneous data	Revenue and expenditure	Quarterly	2 months	2010 Q4	Budgetary accounts
Other:[c]					
Andalusia	Rev. & Exp.	Quarterly	1-2 months	2008	Cash basis
Canary Islands	Rev. & Exp.	Quarterly	1 month	1990	Cash basis
Cantabria	Rev. & Exp.	Monthly	1 month	06M1/01H1	Cash basis
Castile-la-Mancha	Rev. & Exp.	Quarterly	—	1999	Cash basis
Castile-León	Rev. & Exp.	Monthly	1 month	Nov'09/91Q1	Cash basis
Catalonia	Rev. & Exp.	Monthly	1 month	2007	Cash basis
Galicia	Rev. & Exp.	Quarterly	4 months	2002 Q1	Cash basis
Madrid	Rev. & Exp.	Monthly	2 months		Cash basis
Basque Country	Rev. & Exp.	Quarterly	2 months	2004 Q2	Cash basis
General Government	Revenue and expenditure	Quarterly	3 months	2000 Q1	National Accounts

Sources: IGAE, Social Security Administration, Ministry of Economics and Finance.

[a] The publication of the December figure for the State, Social Security System and National Public Employment Service

[a] has a lag of over one month.

[b] The Social Security System and National Public Employment Service figures prior to this date were published quarterly.

[c] Fernández-Caballero et al. (2011).

Table 2: List of target, general government sector variables and acronyms for them.

Name of the variable	Acronym
Total government revenue	TOR
Direct taxes	DTX
Paid by Enterprises	DTE
Paid by Households	DTH
Other direct taxes	ODTX = DTX - (DTE + DTH)
Social security contributions	SCT
Paid by Employers	SCR
Paid by Employees	SCE
Other social contributions	OSCT = SCT - (SCR + SCE)
Total indirect taxes	TIN
Value Added taxes	VAT
Excise duties	EXD
Other direct taxes	ODTX = DTX - (DTE + DTH)
Total expenditure	TOE
Social payments	THN
of which Unemployment benefits	UNB
Interest payments	INT
Subsidies	SIN
Government investment	GIN
Nominal government consumption	GCN
Government wage consumption expenditure	COE
Non-wage final consumption expenditure	OGCN
Other expenditure	OTOE = residual from TOE
Real government consumption	GCR
Government employment	LGN
Net lending of the general government (public deficit)	DEF
Public debt	MAL

Table 3: Some stylized facts computed on the basis of the quarterly fiscal database. Sample 1986Q1-2010Q4. Quarterly real GDP and GDP deflator are taken from the MTBE database.

Fiscal variable	Rel. Std.	-4	-3	-2	-1	0	1	2	3	4	
TOR, real											
First diff.	3.0	0.40	0.43	0.54	0.44	0.42	0.38	0.23	0.20	0.12	pro-cyc. lead
Linear trend	1.8	0.63	0.73	0.80	0.84	0.85	0.84	0.80	0.75	0.68	pro-cyc. cont.
HP 1600	2.4	0.60	0.70	0.76	0.73	0.65	0.53	0.37	0.21	0.07	pro-cyc. lead
HP 3200	2.2	0.64	0.75	0.81	0.80	0.76	0.67	0.55	0.43	0.29	pro-cyc. lead
BP(1,5-8 yr.)	2.7	0.62	0.74	0.79	0.75	0.63	0.46	0.25	0.05	-0.12	pro-cyc. lead
BP(1,5-12 yr.)	2.2	0.72	0.82	0.86	0.84	0.77	0.65	0.50	0.33	0.17	pro-cyc. lead
Average	2.4	0.60	0.70	0.76	0.73	0.68	0.59	0.45	0.33	0.20	pro-cyc. lead
TOE, real											
First diff.	1.6	-0.21	-0.21	-0.11	-0.09	-0.12	-0.05	0.08	0.12	0.32	pro-cyc. lag.
Linear trend	1.5	-0.60	-0.54	-0.47	-0.38	-0.29	-0.19	-0.09	0.02	0.13	count-cyc. lead
HP 1600	1.1	-0.35	-0.35	-0.30	-0.21	-0.08	0.08	0.26	0.43	0.60	pro-cyc. lag.
HP 3200	1.0	-0.37	-0.32	-0.23	-0.11	0.05	0.20	0.35	0.50	0.64	pro-cyc. lag.
BP(1,5-8 yr.)	1.2	-0.41	-0.48	-0.51	-0.48	-0.37	-0.23	-0.02	0.22	0.45	count-cyc. lead
BP(1,5-12 yr.)	1.1	-0.36	-0.28	-0.19	-0.08	0.07	0.23	0.39	0.56	0.72	pro-cyc. lag.
Average	1.3	-0.38	-0.36	-0.30	-0.23	-0.12	0.01	0.16	0.31	0.48	pro-cyc. lag.
THN, real											
First diff.	1.6	-0.53	-0.51	-0.44	-0.46	-0.37	-0.27	-0.19	-0.02	0.09	count-cyc. lead
Linear trend	2.0	-0.75	-0.71	-0.66	-0.60	-0.52	-0.42	-0.32	-0.20	-0.08	count-cyc. lead
HP 1600	1.5	-0.69	-0.70	-0.66	-0.57	-0.42	-0.24	-0.03	0.20	0.42	count-cyc. lead
HP 3200	1.4	-0.69	-0.67	-0.61	-0.52	-0.39	-0.21	-0.02	0.18	0.38	count-cyc. lead
BP(1,5-8 yr.)	1.3	-0.67	-0.77	-0.81	-0.78	-0.67	-0.50	-0.26	0.02	0.30	count-cyc. lead
BP(1,5-12 yr.)	1.6	-0.72	-0.68	-0.61	-0.50	-0.36	-0.18	0.01	0.22	0.41	count-cyc. lead
Average	1.5	-0.68	-0.67	-0.63	-0.57	-0.46	-0.30	-0.14	0.07	0.25	count-cyc. lead
UNB, real											
First diff.	7.3	-0.40	-0.39	-0.37	-0.48	-0.41	-0.36	-0.23	-0.11	-0.06	count-cyc. lead
Linear trend	7.3	-0.70	-0.67	-0.62	-0.57	-0.50	-0.41	-0.31	-0.19	-0.06	count-cyc. lead
HP 1600	6.2	-0.61	-0.67	-0.70	-0.70	-0.62	-0.49	-0.30	-0.09	0.13	count-cyc. lead
HP 3200	5.7	-0.63	-0.66	-0.65	-0.62	-0.53	-0.40	-0.23	-0.05	0.16	count-cyc. lead
BP(1,5-8 yr.)	6.3	-0.52	-0.67	-0.78	-0.83	-0.80	-0.69	-0.50	-0.25	0.04	count-cyc. lead
BP(1,5-12 yr.)	6.6	-0.77	-0.79	-0.78	-0.73	-0.63	-0.49	-0.31	-0.10	0.12	count-cyc. lead
Average	6.6	-0.61	-0.64	-0.65	-0.66	-0.58	-0.47	-0.31	-0.13	0.06	count-cyc. lead
GCR											
First diff.	1.8	-0.06	-0.04	0.15	0.19	0.28	0.21	0.16	0.16	0.26	pro-cyc. cont.
Linear trend	1.2	-0.22	-0.11	0.02	0.14	0.25	0.34	0.42	0.50	0.57	pro-cyc. lag.
HP 1600	1.1	-0.18	-0.06	0.11	0.26	0.38	0.42	0.44	0.47	0.51	pro-cyc. lag.
HP 3200	1.0	-0.06	0.08	0.25	0.39	0.52	0.57	0.61	0.63	0.65	pro-cyc. lag.
BP(1,5-8 yr.)	1.0	-0.35	-0.23	-0.07	0.08	0.20	0.26	0.30	0.35	0.42	pro-cyc. lag.
BP(1,5-12 yr.)	0.9	-0.13	0.03	0.20	0.36	0.49	0.57	0.63	0.69	0.73	pro-cyc. lag.
Average	1.2	-0.17	-0.06	0.11	0.24	0.35	0.40	0.43	0.47	0.52	pro-cyc. lag.

Table 4: Cumulative output multipliers

	Quarters					
	1	4	8	12	16	20
Q-ESFIPDB	0.17*	0.77*	0.97*	0.63	0.07	-0.62
Q-ESFIPDB (1980:1-2007:4)	0.45*	1.32*	1.66*	1.40*	1.12*	0.85*
REMS	-0.64*	-0.51*	-0.24	-0.56	-1.27	-2.30
MTBE	0.51*	1.03*	1.39*	1.06*	0.64	0.20