Fiscal Regime Shifts in Spain: Non-linear Fiscal Rules and Impulse Response Functions

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Abstract: In this paper we study fiscal regime shifts for the Spanish Economy, using a new quarterly dataset of Spanish public finance variables (De Castro et al., 2012) for the period 1986-2012, within a Markov-Switching framework. First, we estimate fiscal policy rules to characterize the behavior of Spanish fiscal policymakers and, second, we estimate a vector autoregressive model to analyze the effects of a positive shock to the primary deficit to GDP ratio on the Spanish economy. Our main results show the existence of two fiscal regimes in Spain: regime 1, the post-1996 period, and regime 2, the pre-1996 period. From the results of our simulations, for regime 1 we observe that Spanish fiscal policymakers are not worried about debt stabilization and also that during exceptional circumstances and/or bad economic times they increase public expenditure and/or automatic stabilizers run and consequently public deficit grows; in other words, regime 1 is "active" and countercyclical. Moreover, an unexpected increase in the primary deficit to GDP ratio harms economic activity (anti-Keynesian effect) during the first two years and has no effect (non-Keynesian effect) from that point forward. For regime 2 we show that the behavior of Spanish fiscal policymakers is marginally less active but more countercyclical. Likewise, the response of the output gap to a positive shock to the primary deficit to GDP ratio is non-Keynesian, except on impact, which is anti-Keynesian.

Keywords: Fiscal regimes, Fiscal rules, Markov-Switching, VAR, Spain

JEL Classification: E62, E63, F41, H20, H50

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1 Introduction

Traditionally, both politicians and economists have agreed on the important role of fiscal policy as an effective tool in issues such as tax collection, income redistribution and macroeconomic stabilization. Regarding the latter objective, how can fiscal policy be employed as a stabilizing instrument in the short run without compromising the sustainability of public finances in the long run? If so, what is the best mode to achieve both of them: discretionary measures or fiscal rules? If found, do the effects of discretionary or regulated fiscal policy measures depend on the expansionary or recessionary state of the economy?

Contrary to what it might seem, the fiscal performance of the EU has been slightly better than that of some advanced economies as the USA or Japan since the beginning of the current international financial and economic crisis. In Table 1, we present some data on that matter in the European Union of Fifteen (EU15), the USA and Japan between 2007 and 2012, which can corroborate our affirmation. In that period, the year-by-year deficit-to-GDP ratios and the year-by-year debt-to-GDP ratios of the EU15 were lower than those of the USA and Japan. In the same vein, the increase in the debt-to-GDP ratio was around 56 percent in the EU15 for that period, which again contrasts favorably with the rise of about 59 percent in the USA.

In legislative terms, EMU countries have agreed on mechanisms that introduce some kind of fiscal policy coordination since the early days of the founding of the euro area. In order to avoid that a relaxed fiscal policy of a Member State impose constraints on the other ones through the interest rate burden, enforce fiscal discipline within EMU and ensure sound and sustainable public finances, the Stability and Growth Pact (SGP) was approved in 1997 (and later revised and softened). Under the provisions of the SGP, EMU countries must respect two criteria: a deficit-to-GDP ratio of 3 percent and a debt-to-GDP ratio of 60 percent. The fact that there have not been sanctions until now, even though some countries had excessive deficits according to SGP terms, could affect the credibility of the EU.

Given those reasons, why the perceived fiscal vulnerability of the EU is higher than that of other advances economies as the USA or Japan? Following Campa (2012), the EU as a whole and each of its Member States are more vulnerable to a sustainability analysis of their public finances because of three distinctive concerns: (1) notable differences in debt levels across the EU15, (2) funding problems of that debt and its interest payments in the short term, and (3) poor growth prospects for diluting the debt burden.

The EU has trying to provide convincing answers to those concerns by several ways. According to the orientation of economic policy measures, the responses to the crisis can be divided in two groups: a first one, which ranges from 2007 to 2009, defined by Keynesian-inspired measures; and a second one, which extends from 2010 on, characterized by comprehensive measures. In an attempt to classify the measures contained in that second broad group, three areas can be distinguished: mechanisms to provide financial support to individual EU countries, measures to enhance fiscal policy coordination among EU Member States, and country-specific measures to boost sustainable growth.

Among the mechanisms to provide financial support to individual EU countries, we should highlight the following ones: two packages of financial assistance to Greece in 2010 and 2011, which consisted in loans, privatization plans and macroeconomic adjustment plans, the European Financial Stabilization Mechanism (EFSM) and the European Financial Stability Facility (EFSF), which were two temporary financial assistance procedures based on guarantees from the EU budget and the euro area Member States respectively, and the European Stability Mechanism (ESM), which is a permanent financial institution designed to provide emergency lending to euro area Member States.

Regarding the measures to enhance fiscal policy coordination among EU Member States, we identify three groups of reforms. A first group consists of reforms on European Legislation, basically a more automatic application of SGP recommendations and sanctions, a new procedure to address the appearance of macroeconomic imbalances in the euro area, and a yearly cycle of economic and fiscal policy coordination within the EU called the European Semester. Among reforms on national fiscal legislation, the most important is the Fiscal Compact, a part of the Treaty on Stability, Coordination and Governance, which requires EU Member States to enshrine key SGP provisions in national law. The third group of reforms is country-specific commitments to meet the Europe 2020 Agenda objectives on employment, innovation, education, social inclusion and climate/energy.

With respect to the country-specific measures to boost sustainable growth, we should note that fiscal coordination within the EU is very small beyond establishing goals for fiscal deficits, and fiscal sustainability is pursued by pension reforms and the management of fiscal policy discussed above. At the same time, some EU Member States are making efforts to break the vicious circle between the perceived solvency of the banking sector and the growing financing costs of the country.

Those reforms constitute a first step towards improving investors' concerns on the fiscal sustainability of the EU as a whole and its Member States. However, as Castañeda (2009) says, the use of fiscal rules is neither a necessary nor a sufficient condition for the development of a fiscal policy that pursues both the sustainability of public finances and the stability of the economic in the medium to long term simultaneously.

Table 1. Fiscal performance in some advanced economies. Deficits and debt as a ratio of GDP. 2007-2012

	2007	2008	2009	2010	2011	2012
General Government Overall Balance (% GDP)						
Austria	-1.0	-1.0	-4.1	-4.5	-2.5	-2.5
Belgium	-0.1	-1.1	-5.6	-3.9	-3.9	-4.0
Denmark	4.8	3.3	-2.8	-2.7	-2.0	-4.2
Finland	5.3	4.3	-2.7	-2.8	-1.1	-2.3
France	-2.8	-3.3	-7.6	-7.1	-5.3	-4.9
Germany	0.2	-0.1	-3.1	-4.2	-0.8	0.1
Greece	-6.8	-9.9	-15.6	-10.8	-9.6	-6.3
Ireland	0.1	-7.3	-13.8	-30.5	-13.1	-7.6
Italy	-1.6	-2.7	-5.4	-4.3	-3.7	-2.9
Netherlands	0.2	0.5	-5.6	-5.1	-4.4	-4.1
Portugal	-3.2	-3.7	-10.2	-9.9	-4.4	-6.4
Spain	1.9	-4.5	-11.2	-9.7	-9.6	-10.8
Sweden	3.5	2.2	-1.0	0.0	0.0	-0.7
United Kingdom	-2.8	-5.0	-11.3	-10.0	-7.8	-7.9
EU-15 Average	-0.2	-2.0	-7.1	-7.5	-4.9	-4.6
United States	-2.7	-6.5	-12.9	-10.8	-9.7	-8.3
Japan	-2.1	-4.1	-10.4	-9.3	-9.9	-10.1
General Government Gross Debt (% GDP)						
Austria	60.2	63.8	69.2	72.3	72.8	74.1
Belgium	84.0	89.2	95.7	95.6	97.8	99.8
Denmark	27.1	33.4	40.7	42.7	46.4	45.6
Finland	35.2	33.9	43.5	48.7	49.2	53.6
France	64.2	68.2	79.2	82.4	85.8	90.2
Germany	65.4	66.8	74.5	82.4	80.4	81.9
Greece	107.2	112.9	129.7	148.3	170.3	156.9
Ireland	24.9	44.2	64.4	91.2	104.1	117.4
Italy	103.3	106.1	116.4	119.3	120.8	127.0
Netherlands	45.3	58.5	60.8	63.4	65.7	71.3
Portugal	68.4	71.7	83.7	94.0	108.4	123.8
Spain	36.3	40.2	54.0	61.7	70.4	85.9
Sweden	40.2	38.8	42.6	39.4	38.6	38.3
United Kingdom	43.7	51.9	67.1	78.5	84.3	88.8
EU-15 Average	57.5	62.8	73.0	80.0	85.4	89.6
United States	64.4	73.3	86.3	95.2	99.4	102.7
Japan	183.0	191.8	210.2	216.0	230.3	238.0

Note: EU15 averages exclude Luxembourg data.
Sources: IMF Fiscal Monitor, October 2013; Own calculations.

The objective of this paper is twofold. On the one hand, we analyze the fiscal behavior of the Spanish economy by estimating fiscal policy rules in which the government reacts to the public debt and the business cycle. Following Afonso and Toffano (2013), we apply Markov-Switching techniques to allow for a shift in the parameters of the fiscal policy rules in order to account for the non-linearity of fiscal policy and its relation to different political preferences. On the other hand, we study the response the Spanish economy to fiscal shocks by estimating a Markov-Switching VAR model that includes macroeconomic, fiscal and financial variables.

The rest of the paper is structured as follows. In Section 2, we briefly review the recent literature on fiscal rules that focus on European countries. In Section 3, we explain the methodology used in this paper, both the analytical and empirical

framework and the database. In section 4, we present the results for the different fiscal regimes. Finally, in Section 5, we summarize our findings and conclude.

2 Literature review

Since the publication of the famous article "Discretionary versus Policy Rules in Practice" by John Taylor in 1993, where he proposed a simple monetary policy rule which gives interest rates as a function of inflation and output deviations, much has been said about the use of rules in policymaking, especially on the monetary side. Among the advantages of policy rules are their simple specification, their potential to differentiate between discretionary and rule-based policy behavior and their use as a benchmark for policy evaluation (Thams, 2007). Nevertheless, their main disadvantage follows from one of their benefits: their simplicity cannot be adequate to manage with complex situations like the current international economic crisis. All in all, policy rules are a tool that can guide the action of economic policymakers, as they explicitly link the instruments to the objectives, but the instruments, the objectives and the links can change over time.

On the fiscal side, many advanced countries introduced fiscal rules over the last 25 years, in the form of golden rules, balanced budget rules or deficit and debts targets; the EU's Maastricht criteria and the SGP are usually put as examples. Following Badinger (2009), two basic reasons support the introduction of fiscal rules: on the one hand, to ensure sustainability of fiscal policy through avoiding excessive deficits and unsound policies and, on the other hand, to improve macroeconomic stability by limiting the room for discretionary fiscal policy. Both academics and policymakers acknowledges that the Maastricht criteria together with the SGP lead to fiscal consolidations in many EU countries in the nineties and thus they serve as a discipline device for fiscal authorities.

This move towards "rules rather than authorities" (in the terminology of Friedman, 1948) reflects a fundamental shift in the paradigm of fiscal policy. In this sense, according to the behavior of fiscal authorities, we can distinguish two types of fiscal policies: an "active" (non-Ricardian) fiscal policy and a "passive" (Ricardian) fiscal policy (Leeper, 1991). Fiscal policy is said to be "active" when is does not stabilize public debt, and "passive" when it does stabilize government debt. In this latter case, primary budget balances react to changes in public debt to safeguard fiscal solvency, because fiscal authorities expect that future fiscal receipts cover the cost of current outstanding government liabilities.

The applied study of fiscal rules has been methodologically developed from two different perspectives: panel analysis and Markov-Switching regressions. Those papers present and test some kind of fiscal policy reaction functions where the primary budget balance reacts not only to the public debt, in order to account for fiscal sustainability

motives, but also to the output gap, in order to consider business cycle effects. In this section, we briefly review those recent studies that focus on European countries.

In the first group of studies, Ballabriga and Martinez-Mongay (2005) empirically assess sustainability of public finances in the EU-15 Member States through testing the response of the primary surplus to accumulated debt for the sample period 1977-2002. They find that sustainability was prevalent in many EU countries before Maastricht, but also that the Maastricht criteria induced the shift towards sustainability in some of them.

Afonso (2008) evaluate the empirical evidence concerning the existence of "passive" (Ricardian) fiscal regimes in EU-15 countries using an annual panel data set for the period 1970-2003. The results highlight that the EU-15 governments have a tendency to use the primary budget surplus to reduce the debt-to-GDP ratio, synonym of a "passive" (Ricardian) fiscal regime throughout the sample period.

Marneffe et al. (2011) analyze the effects of fiscal rules on the fiscal stance by estimating panel-regressions for the 16 euro-area countries for the period 1995-2008. They conclude that an increase in debt contributes to a lower total balance, but also to a higher primary balance, which reflects a stabilizing mechanism as a high debt level increases the (perceived) need to improve the primary fiscal balance.

Golinelli and Momigliano (2008) provide an interesting survey on 21 recent empirical papers that analyze the fiscal behavior of EMU countries and try to explain the roots of the differences in their results. They find that differences are driven partly by the choices made in modelling fiscal behavior and in the related notions of fiscal policy cyclicality, but are also affected by data source and vintage.

The second group of studies allows for the endogenous estimation of changes in fiscal policy regimes, which can occur over time, by the use of Markov-Switching regressions. Several types of fiscal rules has been estimated: first, a fiscal rule where the primary budget deficit to GDP ratio adjusts to stabilize the debt to GDP ratio, second, a fiscal rule where one fiscal instrument (public expenditure to GDP ratio or public receipts to GDP ratio) reacts to the other fiscal instrument, the government debt to GDP ratio and the output gap, and third, a fiscal rule which mixes the two last approaches, i.e. where the primary deficit to GDP ratio responds to changes in the public debt to GDP ratio, the output gap and other variables.

For several EU countries, in the aim of the first branch, Claeys (2006) test the fiscal sustainability of Germany, France, Italy, Great Britain, Spain, the Netherlands and Austria, as well as the United States and Japan, with annual data from the 60s or 70s to 2003. He finds that there is a significant stabilizing reaction to debt, but the model is not able to reject insolvency for Germany, France and Japan, and that there are regime shifts in fiscal policy that are mainly related to debt.

In the second branch of Markov-Switching regression papers, Thams (2007) investigate the relationship between fiscal instruments and public debt for Germany

(1970:Q1-2003:Q4) and Spain (1986-2003). He finds that both Germany and Spain generally exhibit a positive relationship between government revenues and debt, and that both countries changed their policy behavior at the end of the nineties because of rising debt to GDP ratios. However, this change in policy behavior differs in its characteristics across the two countries and seems to be non-permanent in the case of Germany.

In terms of the third branch, Afonso and Toffano (2013) assess the existence of fiscal regime shifts in the UK, Germany and Italy, using a new fiscal quarterly data set for the periods 1970:Q4-2010:Q4, 1979:Q4-2010:Q3 and 1983:Q3-2010:Q4 respectively. Their results prove that in the UK fiscal policy tended to be more active for the periods 1992-1996 and after 2007, in Germany fiscal regimes have been overall more passive, supporting more fiscal sustainability throughout the sample period, and in Italy a more passive fiscal behavior is uncovered in the run-up to EMU

For individual European countries, in the first branch of Markov-Switching regression papers, Claeys (2008) test the fiscal sustainability of Sweden using quarterly data from the first quarter of 1970 to the fourth quarter of 2006. He concludes that after the introduction of procedural and numerical rules in response to the severe 1991 fiscal crisis and after the fiscal consolidation of the nineties, those rules did not eradicated destabilizing policies over the period 2000-2002.

In the first and second branch of Markov-Switching regression articles, Afonso, Claeys and Sousa (2011) estimate both primary budget deficit and public expenditure and public receipts rules for the case of Portugal utilizing a new dataset of quarterly fiscal series that ranges from the first quarter of 1978 to the fourth quarter of 2007. They find some evidence for the existence of two fiscal regimes: a pre-1988 period, when fiscal policy was active and a-cyclical, and a post-1988 period, when fiscal policy becomes only slightly more passive and pro-cyclical. Nevertheless, this change is not very significant and fiscal policy continued to be unsustainable.

3 Methodology

3.1 The theoretical framework

Following Kirsanova et al. (2006) and Reade (2011), the theoretical model that underlie the specifications of our fiscal rules and our vector autoregressive (VAR) model can be seen as an augmented New Keynesian structural model (see Clarida, Galí and Gertler, 1999) that incorporates not only the usual IS curve, the Phillips curve and the Taylor-type monetary policy rule, but also the government budget constraint and the fiscal policy rule. In detail, the theoretical model can be described as follows:

The first equation is an IS curve that takes the form:

$$\bar{y}_t = \beta_0 + \beta_1 \bar{y}_{t-1} + (1-\beta_1) E_t \bar{y}_{t+1} - \beta_2 [i_t - E_t \pi_{t+1}] + \beta_3 b_t + \beta_4 pd_t + \varepsilon_t^{\bar{y}} \quad (1)$$

where $\bar{y}_t$ is the output gap, π_t the inflation rate, i_t the nominal interest rate, $[i_t - E_t\pi_{t+1}]$ the real interest rate, b_t the stock of public debt, and pd_t the primary (i.e. net of interest payments) deficit defined as public spending minus receipts. The latter two fiscal variables are defined as a ratio of GDP. $\varepsilon_t^{\bar{y}}$ is an i.i.d. distributed demand shock. E_t is the expectation operator. According to that specification, the output gap is explained by a weighted average of its past and futures values, the contemporary real interest rate, the public debt to GDP ratio and the primary deficit to GDP ratio.

The second equation is a Phillips curve such as:

$$\pi_t = \alpha_0 + \alpha_1\pi_{t-1} + (1-\alpha_1)E_t\pi_{t+1} + \alpha_2\bar{y}_t + \varepsilon_t^{\pi} \tag{2}$$

where the variables are defined as above and ε_t^{π} is an i.i.d. distributed inflation shock. Conforming to that equation, the inflation depends on its lagged and expected values and the output gap. Note that neither monetary nor fiscal policy affects inflation, contrary to what happens in the IS curve, where monetary and fiscal policies influence the evolution of the output gap.

The third equation refers to debt accumulation:

$$b_t = (1+\rho_t)b_{t-1} + pd_t \tag{3}$$

where the variables are defined as above and ρ_t is the rate of return on public debt.

The fourth equation is the Taylor-type monetary policy rule, whose form is:

$$i_t = \phi_0 + \phi_1\pi_{t-1} + \phi_2\pi_t + \phi_3E_t\pi_{t+1} + \phi_4\bar{y}_{t-1} + \phi_5\bar{y}_t + \phi_6E_t\bar{y}_{t+1} \tag{4}$$

where the nominal interest rate depends on past, present and expectations on the future values of inflation and the output gap. In the words of Leeper (1991), monetary policy is said to be "active" when real interest rates rise in response to a growth in inflation, that is, when nominal interest rates are increased on more than one-for-one basis following a rise in inflation ($\phi_1 + \phi_2 + \phi_3 > 1$); on the contrary, it is "passive" when $\phi_1 + \phi_2 + \phi_3 < 1$. According to Svensson (1999), since output is usually considered a predictor of future inflation, interest rates usually rise in response to a positive output gap ($\phi_4 + \phi_5 + \phi_6 > 1$).

The fifth equation is a simple fiscal policy rule, which can be expressed as:

$$pd_t = \delta_0 + \delta_1 b_{t-1} + \delta_2\bar{y}_t + \delta_3\pi_t \tag{5}$$

where the primary deficit to GDP ratio is a function of the past debt to GDP ratio and the current output gap and inflation. Again, in the words of Leeper (1991), fiscal policy is said to be "active" (non-Ricardian) when it does not stabilize the public debt, that is, when the reaction of fiscal policy to debt dynamics (δ_1) is negative or smaller than the real interest rate, monetary policy will have to reduce interest rates in response to an

inflation shock in order to stabilize the public debt; on the contrary, it is "passive" (Ricardian) when the reaction of fiscal policy to debt dynamics (δ_1) is positive and greater than the real interest rate.

3.2 The empirical framework

3.2.1 Fiscal rule specification

Once we have explained the theoretical framework of our policy reaction functions, we continue with the estimation of a fiscal rule for the Spanish economy. Basically, a fiscal rule is an equation that links an instrument of fiscal policymakers to some exogenous variables in order to evaluate and recommend some sort of policy behavior. In this sense, we follow Afonso and Toffano (2013) who were inspired by Bohn (1998, 2005) to estimate a fiscal policy reaction function which is very similar to the one explained above.

The form of the fiscal policy rule can be expressed as:

$$pd_t = \gamma_0 + \gamma_1 b_{t-1} + \gamma_2 \bar{g}_t + \gamma_3 \bar{y}_t + \gamma_4 \pi_t + \varepsilon_t \quad (6)$$

where pd_t is the nominal primary deficit to GDP ratio, b_t the nominal debt to GDP ratio, $\bar{g}_t$ the primary (i.e. net of interest payments) expenditure gap defined as the current expenditure minus the trend expenditure, $\bar{y}_t$ the output gap calculated as the current output minus the trend output, π_t the year-on-year inflation, and ε_t a normal mean zero-constant variance error term. For computing the gaps, the trend components are obtained applying the Hodrick-Prescott filter (smoothing parameter equals to 1600) to the log of real expenditure and the log of real GDP respectively, whereas inflation is calculated by using the GDP deflator.

The selection of the variables that are contained in our fiscal rule is not trivial. According to Thams (2007), the inclusion of the lagged debt to GDP ratio is compulsory for econometric and economic reasons: on the one hand, there would be an endogeneity problem if the current debt to GDP ratio were considered and, on the other hand, it would be very strange a prompt reaction of fiscal policy to changes in public debt because of implementation lags. Referring to the optimal taxation theory of Barro (1986), the incorporation of the expenditure gap is based on that temporary rises of government expenditure do not compromise debt stabilization and the inclusion of the output gap is justified on the grounds that fiscal policy usually follows a countercyclical motive. In this sense, γ_2 would be positive because during exceptional circumstances (e.g. in war times) public expenditure increases and therefore deficit grows, and γ_3 would be negative because in bad economic times (i.e. when output is below trend) automatic stabilizers run and so deficit goes up. Finally, as explained in Claeys (2006), the addition of the inflation rate is founded on that fiscal policy can play an inflation-stabilizing role allowing for interaction with monetary policy.

Since fiscal policy is highly influenced by the current phase of the economic cycle and the political sign of the government, we will not only estimate the fixed fiscal policy rule explained in equation (6), but also state-varying ones whose parameters change endogenously. In detail, the Markov-Switching fiscal policy rule takes the following form:

$$pd_t = \gamma_0(S_t^F) + \gamma_1(S_t^F)b_{t-1} + \gamma_2(S_t^F)\bar{g}_t + \gamma_3(S_t^F)\bar{y}_t + \gamma_4(S_t^F)\pi_t + \sigma(S_t^F)\varepsilon_t \qquad (7)$$

where $S_t^F \in \{1,...,M\}$ denotes the state of fiscal policy at time *t*, which follows a first order Markov chain with transition matrix $P^F = (p_{ij})$ with elements $p_{ij} = \Pr[s_t = i, s_{t-1} = j]$, for all $i, j \in \{1,...,M\}$, and the other parameters, defined as above, can take different values depending on the fiscal regime of the moment. We should also highlight that the variance of the error term is state dependent. As we have mentioned earlier, fiscal policy is "active" in the sense on Leeper (1991) when the behavior of the fiscal authority is directed towards several objectives ignoring debt stabilization ($\gamma_1 > 0$), and it is "passive" when the behavior of the fiscal authority is concentrated on the stabilization of public debt and therefore decreases the primary deficit level in response to a growth in the debt level ($\gamma_1 < 0$).

3.2.2 Markov-Switching VAR specification

The VAR model that we consider as a basic empirical specification can be seen as the reduced form of a standard structural macroeconomic model or, more generally, as an approximation to the conditional solution (without the restrictions imposed by the theory) of a dynamic stochastic general equilibrium (DSGE) model like the augmented New Keynesian structural model described above. Since the behavior of agents is not constant over time and is affected by the economic environment, the usual VAR representation is replaced by a Markov-Switching VAR model (MS-VAR) whose more general form is as follows:

$$\begin{aligned}\mathbf{X}_t = {} & a_0(S_t^F) + A_1(S_t^F)\mathbf{X}_{t-1} + A_2(S_t^F)\mathbf{X}_{t-2} + ... + A_p(S_t^F)\mathbf{X}_{t-p} \\ & + B_0^*(S_t^F)\mathbf{X}_t^* + B_1^*(S_t^F)\mathbf{X}_{t-1}^* + ... + B_q^*(S_t^F)\mathbf{X}_{t-q}^* + \Sigma(S_t^F)^{1/2}\boldsymbol{\varepsilon}_t\end{aligned} \qquad (8)$$

where $\mathbf{X}_t = (\bar{y}_t, \pi_t, pd_t, i_t)$ is a vector of endogenous variables, $\mathbf{X}_t^* = (trend, b_{t-1})$ is a vector of exogenous and predetermined variables, a_0 is a vector of fixed intercepts, *A* is a matrix of coefficients associated to lagged endogenous variables, *B* is a matrix of coefficients related to contemporaneous and lagged exogenous variables, *p* is the lag number of endogenous variables, *q* is the lag number of exogenous variables, and $\boldsymbol{\varepsilon}_t \approx N(\mathbf{0}, \boldsymbol{I}_4)$ is the vector of normally distributed errors.

Matrices of coefficients and the variance-covariance matrix may switch between the *M* regimes and, as we said before, S_t^F denotes the state of fiscal policy at time *t*, $S_t^F \in \{1,...,M\}$, which follows a first order Markov chain with transition matrix P^F with

elements $p_{ij} = \Pr[s_t = i, s_{t-1} = j]$. Then, the proposed specification is based on the very general assumption that all the parameters of the VAR model vary according to the state of the economy controlled by the unobserved variable S_t^F.

3.3 The database

In this sub-section we briefly explain the database employed in the estimation of the fiscal rules and the fiscal MS-VAR for Spain. Contrary to previous studies, we use a new quarterly dataset of Spanish public finance variables fit for economic analysis (see De Castro et al., 2012). The sample period ranges from the first quarter of 1986 to the fourth quarter of 2012 and so includes some facts that are very important for the analysis of the behavior of fiscal policy in Spain: (a) the accession of that country into the European Economic Community in 1986, (b) the construction of its welfare state in the second half of the eighties, (c) the entry into force of the Treaty on European Union (the "Maastricht Treaty") in November 1993, which created the Economic and Monetary Union (EMU) and forced Member States to respect financial and budgetary discipline, (d) the Spanish economic crisis of 1993-1994, (e) the adoption of the Stability and Growth Pact (SGP) in 1997, which encourages Member States to apply sound budgetary policies (basically, a deficit to GDP ratio below 3 per cent and a debt to GDP ratio below 60 per cent) from the time they enter the third stage of EMU (1 January 1999 for Spain), (f) the international financial and economic crisis, whose beginning dated back to the bankruptcy of one of the largest global financial services firms Lehman Brothers in September 2008, and the bursting of the housing bubble in Spain, whose climax was marked by the collapse of the country's leading real estate company Martinsa-Fadesa in July 2008, and (g) the intensification of the sovereign debt crisis in the euro area since late 2009.

As Afonso and Toffano (2013) stated, "the choice of using quarterly data is given by the fact that, even if the budget is set annually, infra-annual discretionary adjustments are common in the implementation of fiscal policy".

Figure 1 shows the Spanish output gap and the year-on-year inflation rate for the analyzed period. Note that the estimation of the output gap offers information about the evolution of the economic activity that can be different to the analysis of the economic cycles; in this sense, we try to identify those years when the Spanish economy has been growing above and below trend. Roughly speaking, the country grew above trend from the third quarter of 1987 to the fourth quarter of 1992, from the second quarter of 1999 to the fourth quarter of 2001 and from the first quarter of 2006 to the fourth quarter of 2008; and it grew below trend on the rest of the years. Regarding inflation, this indicator has essentially decreased thorough the sample period, from two-digit values in the middle eighties to around zero at the end of the noughties.

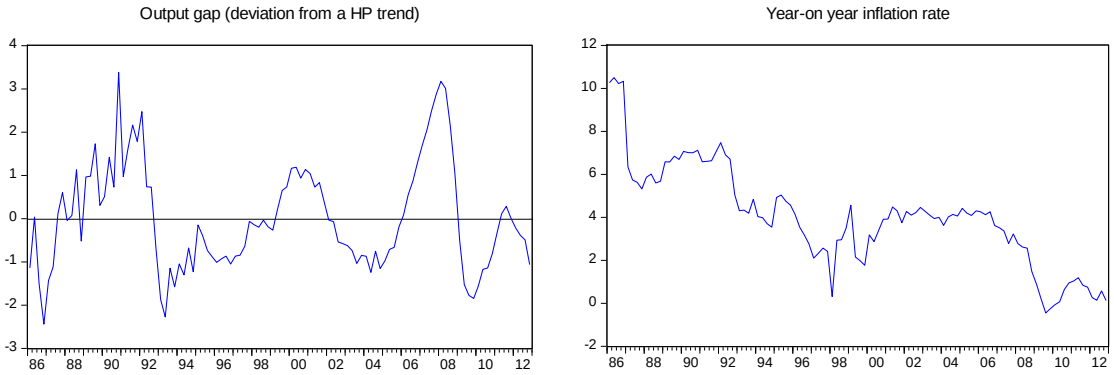


Figure 1. Output gap and inflation rate. Spain. 1986:Q1-2012:Q4
Note: All variables are expressed in percentage terms.
Source: Own calculations.

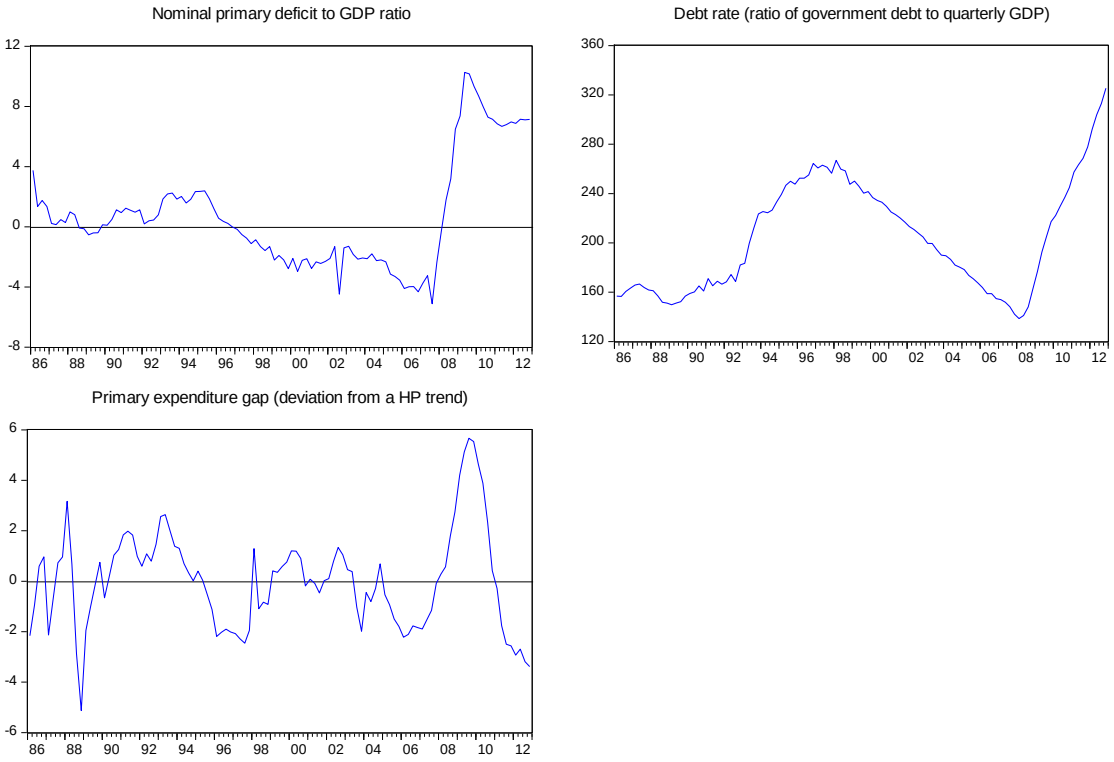


Figure 2. Primary deficit to GDP ratio, debt to GDP ratio and primary expenditure gap. Spain. 1986:Q1-2012:Q4
Note: All variables are expressed in percentage terms.
Source: Own calculations.

In Figure 2 we present the Spanish primary deficit to GDP ratio, the debt to GDP ratio and the primary expenditure gap for the studied period. Spain had a primary surplus to GDP ratio in two periods only: on the one hand, from the third quarter of 1988 to the third quarter of 1989 and, on the other hand, from the fourth quarter of 1996 to the first quarter of 2008. That second phase of primary surplus to GDP ratio was accompanied by a reduction of the debt to GDP ratio, as we can see from the graph. Both facts are related to the commitment of the Spanish government to meet the convergence criteria set out in the Maastricht Treaty to regulate access to the Third

Stage of EMU. However, the Spanish economy did not suffered for fiscal consolidation for the whole period 1996-2007, but it was a combination of a reduction in public expenditure especially in the second half of the nineties and an increase in government receipts particularly during the housing bubble of the mid noughties.

4 Results

4.1 Fiscal rule results

We report the Ordinary Least Squares estimation results for the fiscal rule denoted in equation (6) for the Spanish primary deficit to GDP ratio in Table 2. All coefficients are statistically significant, except the constant and the parameter associated to the lagged debt to GDP ratio. We observe that past increases in the debt to GDP ratio lead to a growth in the primary deficit to GDP ratio, so fiscal policy seems to be "active". According to our results, countercyclical motives guide the actions of fiscal policymakers: the effects of a rise in the expenditure gap on the primary deficit to GDP ratio are positive, whereas the effects of an increase in the output gap on the primary deficit to GDP ratio are negative. Additionally, Spanish inflation puts downward pressure on the primary deficit to GDP ratio, revealing that fiscal developments improve with price rise.

Table 2. Fixed fiscal policy rule for Spain

γ_0	γ_1	γ_2	γ_3	γ_4
1.7907 (2.3565)	0.0047 (0.0094)	0.6241*** (0.1622)	-0.5987** (0.2565)	-0.5330*** (0.1607)
LL	AIC	SC	HQC	
-264.5431	5.1631	5.0888	0.1316	

Notes: Standard errors in brackets. LL – Log likelihood. AIC – Akaike information criterion. SC – Schwarz criterion. HQC – Hannan-Quinn criterion. *, **, ***, indicates significance at a 10%, 5%, and 1% level.
Source: Own calculations.

We show in Table 3 the Maximum Likelihood estimation results of the Markov-Switching model with two regimes (and constant transition probabilities) for the fiscal reaction function specified in equation (7) for the Spanish primary deficit to GDP ratio.[1] We observe that all parameters are statistically significant, except the parameter associated to inflation rate in regime 1 and the constant in regime 2. Fiscal policy seems to be "active" in both regimes, because the primary deficit to GDP ratio increases in response to a growth in the lagged debt to GDP ratio. In addition, fiscal policy can be also labelled as "countercyclical" in both regimes, but it is less countercyclical in regime 2 than in regime 1. Thus, in times of increasing output gaps, automatic stabilizers make possible higher revenues and lower social transfers, and as a consequence the budget deficit is reduced.

[1] Preliminary analysis indicates that a fiscal rule with three regimes was difficult to estimate with a number of local roots exhibiting coefficient singularity.

However, the responses of the primary deficit to GDP ratio to primary expenditure gap developments are different; in particular, the expenditure gap pushes up the primary deficit to GDP ratio in regime 2, while it reduces that ratio in regime 1. In both regimes fiscal developments improve with price rise, because the primary deficit to GDP ratio decreases in response to a growth in inflation, although the effect is not significant in regime 1.

Table 3. Markov-Switching (with two regimes) fiscal policy rule for Spain

	γ_0	γ_1	γ_2	γ_3	γ_4	Log(σ)
Regime 1	-7.2523*** (1.1581)	0.0235*** (0.0037)	-0.1501* (0.0901)	-0.5596*** (0.1191)	-0.0176 (0.1362)	-0.4642*** (0.1145)
Regime 2	2.2338 (1.9013)	0.0173** (0.0078)	0.3635*** (0.1203)	-0.3146* (0.1788)	-0.6844*** (0.1044)	0.4100*** (0.0987)
LL	AIC	SC	HQC			
-164.4081	3.3347	3.6844	3.4765			

Notes: Standard errors in brackets. LL – Log likelihood. AIC – Akaike information criterion. SC – Schwarz criterion. HQC – Hannan-Quinn criterion. *, **, ***, indicates significance at a 10%, 5%, and 1% level.
Source: Own calculations.

In Figure 3 we plot the filtered probabilities of each regime. We observe that regime 2 predominates throughout the sample, except in the period that ranges from 1996 to 2007, when fiscal policy was dominated the commitment of the Spanish government to meet the EU fiscal criteria set out in the Maastricht Treaty and the Stability and Growth Pact. In Figure 2 we also show the residual, actual and fitted primary deficit to GDP ratio for the Spanish economy. Our fiscal rule denoted in equation (7) seems to adjust the data fairly well.

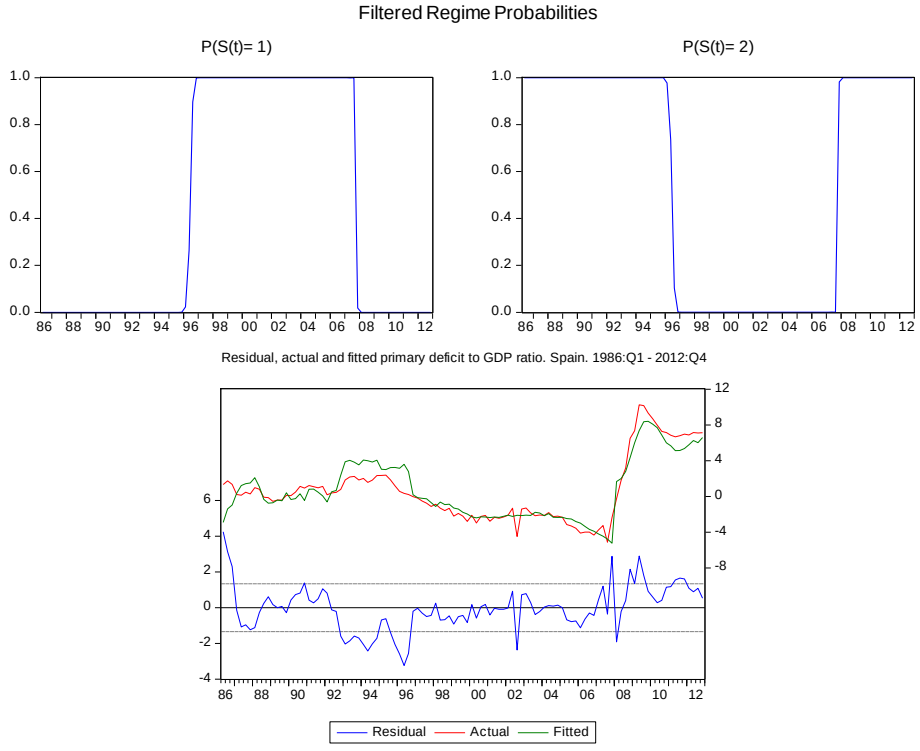


Figure 3. Fiscal regimes (constant transition probabilities) for Spain, 1986Q1-2012Q4
Source: Own calculations.

The probability that regime 1 will be followed by regime 1 is 0.9723, and the probability that regime 2 will be followed by regime 2 is 0.9881; therefore both regimes are very persistent as we can see in Table 4. Additionally, the expected duration of regime 2 is higher than that of regime 1; in detail, regime 1 would last around 36 quarters, whereas regime 2 would go on about 85 quarters.

Table 4. Constant Markov transition probabilities and expected durations for the Markov-Switching fiscal policy rule with two regimes for Spain

Constant transition probabilities P(i, k) = P(s(t) = k | s(t-1) = i) (row = i / column = j)		
	1	2
1	0.9723	0.0277
2	0.0119	0.9881
Constant expected durations (quarters)		
	1	2
	36.1007	84.3504

Source: Own calculations.

To sum up, we can distinguish the existence of two fiscal regimes in Spain: regime 1, which ranges from 1996 to 2007, characterized by an active and countercyclical fiscal policy, and regime 2, which spans between 1986 and 1995 and from 2008 onwards, defined by a marginally less active fiscal policy but a more countercyclical one.[2]

For the sake of comparison, in Table 5 we present the combined estimation results of the Markov-Switching fiscal policy rules, with two regimes (constant transition probabilities), specified in equation (7) for the German, British, Italian and Spanish primary deficit to GDP ratios respectively, taken from Afonso and Toffano (2013) and our paper.[3] From that table, we can conclude that the fiscal policymakers more worried about debt stabilization are the German ones because both regimes are "passive", although the regime 2 is marginally less passive than the regime 1, and that the fiscal policymakers that always focus on multiple objectives ignoring debt stabilization are the Spanish ones because both regimes are "active", although the regime 2 is marginally less active that the regime 1. The behavior of British and Italian fiscal policymakers is somehow between that of Germany and Spain. In detail, the fiscal behavior of the Britishers can be "passive" or "active" depending on the fiscal regime that prevails at every moment, and the fiscal behavior of the Italians can be "passive" or neither passive nor active depending on the fiscal regime that prevails at every moment. The passive behavior of the euro area countries is related to European issues such as the observance on the Maastricht criteria and the SGP rules, whereas British fiscal

[2] Following the suggestion of Diebold, Lee, and Weinbach (1994), and Filardo (1994), who argue that the probability of switching from one regime to the other cannot depend on the behavior of underlying economic fundamentals, but the transition probabilities can and should vary with fundamentals, we estimate the Markov-Switching two-regime fiscal policy rules denoted in equation (7), using variable-dependent transition probabilities for the case of Spain. The results (reported in the Annex) are very close to those reported in the main text for constant transition probabilities, i.e. Spanish fiscal policy is more active and less countercyclical in regime 1 than in regime 2.

[3] See Afonso and Toffano (2013) for details on the estimation of Markov-Switching fiscal policy rules, data sources and sample periods for Germany, the UK and Italy.

policymakers usually adapt their behavior according to the Bank of England decisions. Except for Germany at certain degree, the rest of analyzed countries returned to old patters of fiscal profligacy once that the European impulse was softened by the crisis.

Table 5. Markov-Switching fiscal policy rules -with two regimes- for Germany, the UK, Italy and Spain

Germany					
	γ_0	γ_1	γ_2	γ_3	γ_4
Regime 1	0.0000 (0.0018)	-0.0338*** (0.0033)	0.4528*** (0.0233)	-0.4006*** (0.0388)	0.4052*** (0.0238)
Regime 2	0.0000 (0.0018)	-0.0222*** (0.0040)	0.1714*** (0.0826)	-0.8191*** (0.1282)	0.4052*** (0.0238)
The UK					
	γ_0	γ_1	γ_2	γ_3	γ_4
Regime 1	0.0000 (0.0050)	-0.0258* (0.0124)	0.7410*** (0.1339)	-0.0616 (0.1196)	0.0136 (0.0395)
Regime 2	0.0000 (0.0050)	0.0859*** (0.0098)	-0.2779 (0.1446)	-1.1396* (0.1065)	0.0136 (0.0395)
Italy					
	γ_0	γ_1	γ_2	γ_3	γ_4
Regime 1	0.0000 (0.2060)	-0.0683*** (0.0199)	0.1198*** (0.0357)	-0.2440 (0.1949)	1.1452*** (0.1321)
Regime 2	0.0000 (0.2060)	-0.0348 (0.0220)	0.0838*** (0.0393)	-1.1132* (0.1349)	1.1452*** (0.1321)
Spain					
	γ_0	γ_1	γ_2	γ_3	γ_4
Regime 1	-7.2523*** (1.1581)	0.0235*** (0.0037)	-0.1501* (0.0901)	-0.5596*** (0.1191)	-0.0176 (0.1362)
Regime 2	2.2338 (1.9013)	0.0173** (0.0078)	0.3635*** (0.1203)	-0.3146* (0.1788)	-0.6844*** (0.1044)

Notes: Standard errors in brackets. *, **, ***, indicates significance at a 10%, 5%, and 1% level.
Source: Afonso and Toffano (2013); Own calculations.

Another traditional use of fiscal policy has its foundations on countercyclical motives. If that is true, the coefficient of the expenditure gap would be positive because during exceptional circumstances (e.g. in times of deep recession) public expenditure increases and so deficit goes up, and the coefficient of the output gap would be negative because in bad economic times (i.e. when output is below trend) automatic stabilizers run and therefore deficit grows. In this sense, German and to a lesser extent Spanish fiscal policymakers are always guided by countercyclical reasons, since the primary deficit to GDP ratio responds negatively to an increase in the output gap regardless of the regime that prevails at every moment. Moreover, a rise in the primary expenditure gap has a positive effect on the primary deficit to GDP ratio for both regimes in Germany and for the regime 2 only in Spain. To put in other words, in Germany and Spain, fiscal policy is countercyclical in both regimes, but more countercyclical in the regime 2 than in the regime 1. On the other side of the issue, in the UK and Italy, fiscal policy is a-cyclical as proxied by the output gap in the regime 1, whereas it is countercyclical in the regime 2.

4.2 Markov-Switching VAR results

In Table 6 and Figure 4 the transition probabilities and the plot of the filtered probabilities of each regime are presented, respectively.[4] The probability that regime 1 will be followed by regime 1 is 0.9893, the probability that regime 2 will be followed by regime 2 is 0.9677, and the probability that regime 3 will be followed by regime 3 is 0.9356. Additionally, the regime 1 would last around 67 quarters, the regime 2 would go on about 34 quarters, and the regime 3 would go only 4 four quarters (at the beginning of the sample). This is the reason because, from now on, we will only consider regimes 1 and 2 for the next calculations.

Table 6. Constant Markov transition probabilities and expected durations for the Markov-Switching VAR model with three regimes for Spain

Constant transition probabilities P(i, k) = P(s(t) = k | s(t-1) = i) (row = i / column = j)			
	1	2	3
1	0.9893	0.0000	0.0107
2	0.0314	0.9677	0.0009
3	0.0052	0.0592	0.9356
Constant expected durations (quarters)			
	1	2	3
	67.1459	34.8540	4.0000

Source: Own calculations.

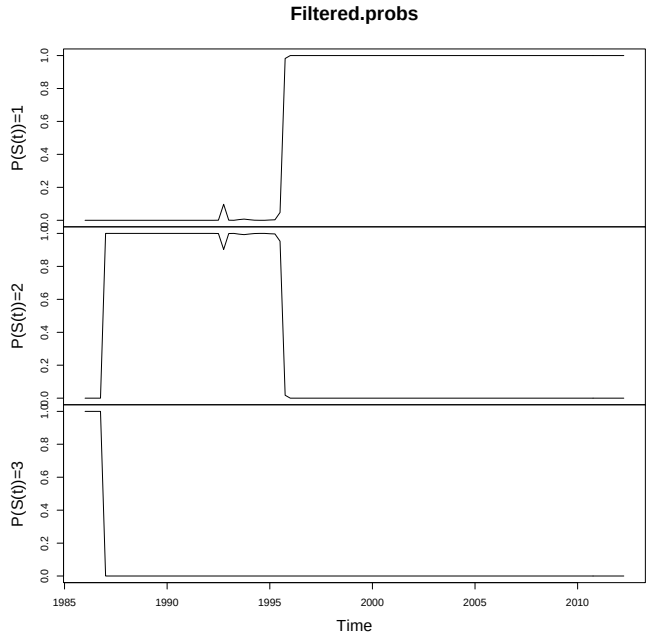


Figure 4. Fiscal regimes (constant transition probabilities) for Spain, 1986Q1-2012Q4
Source: Own calculations.

[4] The estimates of the Markov-Switching VAR model with 3 regimes (states) were obtained by maximum likelihood (ML) The Hamilton filtering algorithm was used to estimate the regimes. The numerical optimization to compute the ML estimates was based on the block-wise algorithm of Sims, Waggoner and Zha (2008).

Generally, one of the most important purposes of estimating a macroeconometric model is performing counterfactual experiments (simulations) that may explain past events and assist in the formulation of economic policy. These simulations typically take the form of a (one standard deviation) shock to some of the observable variables of the model. Once triggered the shock on the variable of interest, we study the time path of the other endogenous variables that make up the model. Therefore, we analyze the dynamic properties of the model by means of the Generalized Impulse Response Functions (GIRFs), which were proposed in Koop, Pesaran and Potter (1996) for nonlinear models. Specifically, we study the effects of a shock to the primary deficit to GDP ratio on the output gap for the Spanish economy.

Unlike other types of impulse response functions, the GIRFs have a balance of advantages and disadvantages which make them suitable for our analysis. On the one hand, the GIRFs are invariant to the order of the variables in the VAR model for the Spanish economy. In particular, the GIRFs do not require the orthogonalization of the residuals of the system and, therefore, any economic-based restrictions, since they take the historical correlations among the variables included in the estimated variance-covariance matrix. On the other hand, the GIRFs do not provide information about the causal relationships among the variables. In this regard, the GIRFs do not require the identification of shocks, so that they cannot be used for economic policy simulations. Thus, it is impossible to interpret those economic shocks in a structural sense, with labels such as "supply shock", "demand shock" or "policy shock". In any case, the analysis of the effects of an unanticipated change in one of the observable variables on the other endogenous variables of the model is an essential step to be considered.

Below we present the effects of a positive shock to the primary deficit to GDP ratio on the output gap for the two main states (regimes 1 and 2 in Table 6 and Figure 4) that can be distinguished in the VAR macroeconometric model build for Spain. Bearing in mind that the output gap normally grows in good economic times and decreases in bad times, the effect of the shock on the output gap can be characterized as follows. First, a positive reaction implies a Keynesian effect: deficit reduction harms growth. Conversely, a negative reaction reflects an anti-Keynesian effect where deficit reduction allows stimulation of economic activity. If the fiscal shock has no significant effect on the output gap, then this implies a non-Keynesian effect.

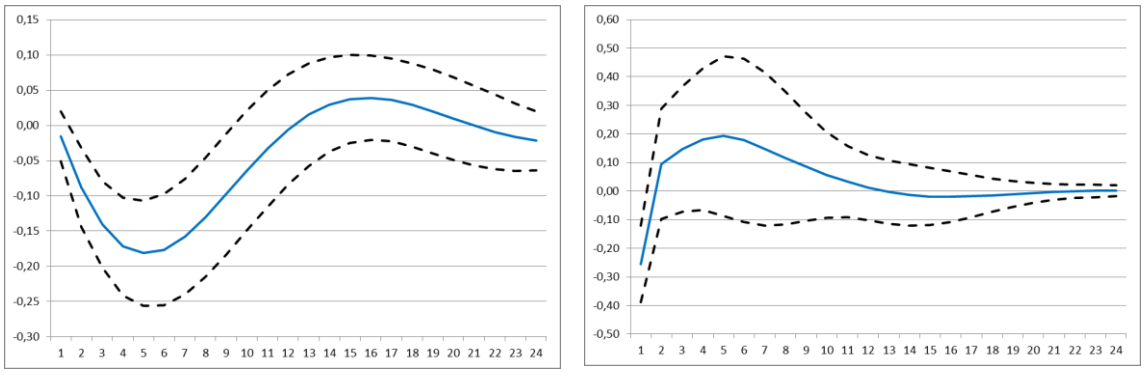
Table 7. Generalized impulse responses of output gap to a 1 standard deviation primary deficit to GDP ratio shock. Spain

Quarters	1	4	8	12
Regime 1	-0.0155 (0.0354)	-0.1718 (0.0697)	-0.1302 (0.0845)	-0.0058 (0.0782)
Regime 2	-0.2548 (0.1347)	0.1812 (0.2481)	0.1155 (0.2314)	0.0117 (0.1145)

Notes: Standard errors in brackets.
Source: Own calculations.

The generalized impulse responses of output gap to a (one standard deviation) positive shock to Spanish primary deficit to GDP ratio are displayed in Table 7 and Figure 5. For regime 1, which spans from the second quarter of 1996 to the fourth

quarter of 2012, the shock causes an instantaneous increase of about 0.02 percent in the output gap of the country. Throughout the first year, the negative impact of the disturbance on the output gap is strengthened, reaching a minimum of 0.18 percent in the fifth quarter. From the third year on, the effect of the shock on the output gap is diluted. In summary, from the results of our simulations, in regime 1 we observe an anti-Keynesian effect during the first two years and a non-Keynesian effect from that point forward.



Regime 1 Regime 2

Figure 5. Generalized impulse responses of output gap to a 1 standard deviation primary deficit to GDP ratio shock. Spain
Notes: Solid lines: baseline estimates, dashed lines: ± 1 standard deviation confidence bands.
Source: Own calculations.

For regime 2, which spans from the third quarter of 1987 to the first quarter of 1996, an unanticipated increase in the primary deficit to GDP ratio causes an instantaneous decrease of about 0.25 percent in the output of the country. However, the negative effect on the variable is reversed from the second quarter after the shock, reaching a maximum of about 0.19 in the fifth quarter. Subsequently, the effects of the disturbance on the output gap gradually fade out. Apart from impact, we should note that the responses are not statistically significant throughout the analyzed period. In short, except on impact, when the effect of the shock seems to be anti-Keynesian, regime 2 can be described as non-Keynesian.

5 Conclusions

In this paper we study fiscal regime shifts for the Spanish Economy, using a new quarterly dataset of Spanish public finance variables fit for economic analysis (see De Castro et al., 2012). In a first step, we estimate fiscal policy rules in which the government reacts to the public debt and the business cycle and so we characterize the behavior of Spanish fiscal policymakers. Those fiscal reaction functions are not ad-hoc, but are derived as optimal rules from an augmented New Keynesian structural model. In a second step, we estimate a vector autoregressive model that includes macroeconomic, fiscal and financial variables and then we present the effects of a positive shock to the primary deficit to GDP ratio on the Spanish economy. The VAR model specification can be seen as an approximation to the conditional solution of an augmented New

Keynesian structural model. In both steps, we apply Markov-Switching techniques to allow for a shift in the parameters of the fiscal policy rules in order to account for the non-linearity of fiscal policy and its relation to different political preferences.

Our main results show the existence of two fiscal regimes in Spain: regime 1, which ranges from 1996 to 2007 for the fiscal rule experiment or from 1996 to 2012 for the MS-VAR estimation, and regime 2, which spans between 1986 and 1995 and from 2008 onwards for the fiscal rule experiment or between 1987 and 1996 for the MS-VAR estimation. Differences in time periods that cover the regimes can arise because of the inaccuracy of the HP filter which we use to calculate the output gap at the beginning and the end of the sample. From the results of our simulations, for regime 1 we observe that Spanish fiscal policymakers are not worried about debt stabilization and also that during exceptional circumstances and/or bad economic times they increase public expenditure and/or automatic stabilizers run and consequently public deficit grows; in other words, regime 1 can be defined as "active" and countercyclical. Moreover, an unexpected increase in the primary deficit to GDP ratio harms economic activity (anti-Keynesian effect) during the first two years and has no effect (non-Keynesian effect) from that point forward. For regime 2 we show that the behavior of Spanish fiscal policymakers is marginally less active but more countercyclical. Likewise, the response of the output gap to a positive shock to the primary deficit to GDP ratio is non-Keynesian, except on impact, which is anti-Keynesian.

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ANNEX: Additional Results

In Table A.1, we present the Markov-Switching estimation results with two regimes (variable-dependent transition probabilities) for the primary deficit to GDP ratio fiscal rule defined in equation (7) for the Spanish economy. From that, we can see that most of the relevant coefficients are statistically significant, with the exception of the parameters related to the primary expenditure gap and the inflation rate in regime 1 and the constant in regime 2. As foregoing results, in both regimes previous increases in the debt to GDP ratio are followed by a rise in the primary deficit to GDP ratio. Hence fiscal policy can be once again labelled as "active" in the sense that fiscal authorities are worried about several objectives ignoring debt stabilization (as pointed out in Leeper, 1991). In the same vein, fiscal policy is "countercyclical" in both regimes, but it is less countercyclical in regime 2 than in regime 1, because the primary deficit to GDP ratio responds negatively to an increase in the output gap (i.e. when output is above trend, automatic stabilizers operate and deficit goes down).

On the contrary, the other countercyclical motive that can guide the action of fiscal policymakers and has effects on the primary deficit to GDP ratio, that is, an increase in government expenditure in bad times, only applies in regime 2. In other words, the expenditure gap pushes up the primary deficit to GDP ratio in regime 2, whereas it reduces that ratio in regime 1. In both regimes, a rise in the inflation rate is followed by a reduction in the primary deficit to GDP ratio, even though the response is not statistically significant in regime 1. As a consequence, the Spanish fiscal state ameliorates with price rise.

Table A.1. Markov-Switching fiscal policy rules, with two regimes (variable-dependent transition probabilities). Spain

	γ_0	γ_1	γ_2	γ_3	γ_4	Log(σ)
Regime 1	-7.2474*** (1.1799)	0.0235*** (0.0037)	-0.1498 (0.0911)	-0.5596*** (0.1205)	-0.0181 (0.1393)	-0.4646*** (0.1157)
Regime 2	2.2354 (1.9236)	0.0173** (0.0079	0.3636*** (0.1217)	-0.3145* (0.1809)	-0.6845*** (0.1056)	0.4102*** (0.0998)
LL	AIC	SC	HQC			
-162.9669	3.3452	3.7449	3.5072			

Notes: Standard errors in brackets. LL – Log likelihood. AIC – Akaike information criterion. SC – Schwarz criterion. HQC – Hannan-Quinn criterion. *, **, ***, indicates significance at a 10%, 5%, and 1% level.
Source: Own calculations.

From Figure A.1, where we plot the filtered regime probabilities, we can distinguish the existence of two regimes: regime 1, which ranges from 1996 to 2007, characterized by an active and countercyclical fiscal regime, and regime 2, which spans between 1986 and 1995 and from 2008 onwards, defined by a marginally less active fiscal regime but a more countercyclical one. We also depict the residual, actual and fitted primary deficit to GDP ratio for Spain in Figure 4. From the inspection of that graph, we can conclude that our fiscal rule specified in equation (7) seems to fit the data rather well.

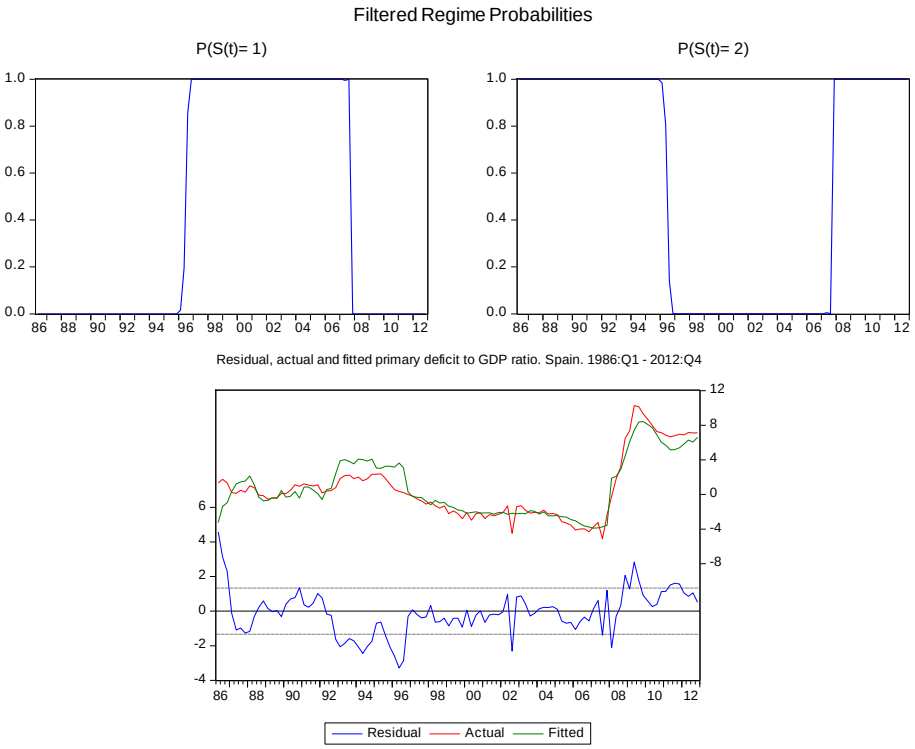

Figure A.1. Fiscal regimes (variable-dependent transition probabilities). Spain. 1986:Q1-2012:Q4
Source: Own calculations.

Both regimes are very persistent as indicated by the transition probabilities presented in Table A.2. In detail, the probability that regime 1 will be followed by regime 1 is 0.9500, and the probability that regime 2 will be followed by regime 2 is 0.9937, so regime 1 is less persistent than regime 2. In addition, the expected duration of regime 1 is lower than that of regime 2; in particular, the regime 1 would last around 108 quarters, while the regime 2 would go on about 191 quarters.

Table A.2. Time-varying Markov transition probabilities and expected durations. Markov-Switching fiscal policy rules, with two regimes (variable-dependent transition probabilities). Spain

Time-varying Markov transition probabilities P(i, k) = P(s(t) = k | s(t-1) = i) (row = i / column = j)		
	1	2
1	0.9500 (0.0905)	0.0500 (0.0905)
2	0.0063 (0.0024)	0.9937 (0.0024)
Time-varying expected durations		
	1	2
	107.8292 (135.2053)	190.8387 (96.0471)

Notes: Standard deviations in brackets.
Source: Own calculations.