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Fiscal Policies and Credit Regimes: A TVAR Approach*

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Abstract

In the present work we investigate how the state of credit markets non-linearly affects the impact of fiscal policies. We estimate a Threshold Vector Autoregression (TVAR) model on U.S quarterly data for the period 1984-2010. We employ the spread between BAA-rated corporate bond yield and 10-year treasury constant maturity rate as a proxy for credit conditions. We find that the response of output to fiscal policy shocks are stronger and more persistent when the economy is in the "tight" credit regime. The fiscal multipliers are abundantly and persistently higher than 1 when firms face increasing financing costs, whereas they are feebler and often lower than 1 in the "normal" credit regime. On the normative side, our results suggest policy makers to carefully plan fiscal policy measures according to the state of credit markets.

JEL Codes: J32, E32, E44, E62

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1 Introduction

The Great Recession has revealed the strong interrelations between financial markets and macroeconomic dynamics and it has awoken new interest in assessing the effects of fiscal policies, given the ineffectiveness of monetary policy alone to restore growth. The pervasiveness of financial frictions (see Brunnermeier et al., 2012, for a survey) explains why credit markets propagate shocks in a non-linear way, increasing the magnitude and the persistency of negative shocks via the financial accelerator (Bernanke et al., 1999; Gertler and Kiyotaki, 2010). The debate about the quantitative effects of fiscal policies is at the top of the research agenda in economics (for a survey see Hebous, 2011; Ramey, 2011a) as well as the political one, given the issues of the "fiscal cliff" in the U.S. and of tighter fiscal discipline for the member countries of the European Monetary Union. Recently, Blanchard and Leigh (2013) have argued that the fiscal consolidation plans released by European countries in 2010-11 produced stronger recessionary effects than expected because the estimated fiscal multipliers did not take into account specific macroecononomic conditions such as the zero lower bound constraining monetary policy, the depth of the recession, and the dismal situation of the financial system.

In this work we try to shed some light on the latter point by studying with a Threshold Vector Autoregression model (TVAR; Tsay, 1998) how the effects of fiscal policy can be amplified or dampened according the state of credit markets.[1] More precisely, we conjecture that fiscal policies should be more successful in stimulating output in regimes where the financial accelerator leads to "tight" credit conditions, which increase the difficulties of firms to finance their production and investment activities. Whenever financial frictions dry up the flow of credit to firms, debt-financed expansionary fiscal policies could stimulate output without siphoning resources that would be otherwise channeled to the private sector. Moreover, in presence of firms constrained in their borrowing by the value of their collateral (e.g. Kiyotaki and Moore, 1997), expansionary fiscal policies could relax the constraint itself, thus crowding-in private investment (Röger et al., 2010). Financial frictions could also amplify the effects of fiscal shocks in presence of a debt-deflation spiral à la Fisher (1933) or if debt contracts are specified in nominal terms (Fernández-Villaverde, 2010; Eggertsson and Krugman, 2012). Finally, at the empirical level, Melina and Villa (2012) provide evidence about the negative reaction of credit spreads to fiscal policy shocks.

As a proxy for the non-linearities resulting from credit conditions, we consider as threshold variable the spread between the BAA-rated corporate bond yield and the 10-

[1] An increasing number of papers employ multiple regime models to study the non-linear effects of fiscal policies according to the state of the economy (see e.g. Auerbach and Gorodnichenko, 2012a,b; Bachmann and Sims, 2012; Afonso et al., 2011; Mittnik and Semmler, 2012; Baum and Koester, 2011). To our knowledge, our work is the first attempt to study the interconnections between the state of firms access to credit markets and fiscal policy in a multiple regime framework. More on that in Section 2.

year treasury constant maturity rate (BAA spread; Atanasova, 2003; Ernst et al., 2010). The BAA spread is supposed to capture fluctuations in the external finance premium paid by firms as well as possible flight-to-quality dynamics (Bernanke et al., 1996). We also consider a variable strictly linked to the loan supply to better catch the effects of credit rationing (Stiglitz and Weiss, 1981).

Following the suggestions of Tsay (1998) and sup-LR tests (Galvão, 2003; Hansen, 1999), we estimate a two credit-market regime TVAR model in first differences on U.S. quarterly data for the period 1984-2010. We add fiscal variables to the specification employed by Balke (2000) and in line with the literature assessing the effects of fiscal policy with (linear) SVAR (e.g. Fatás and Mihov, 2001; Galí et al., 2007), we identify the fundamental shocks through a Choleski decomposition of residuals. More precisely, we order first in the TVAR real government expenditures and gross investment, followed by GDP, a public-debt dynamics variable, the price acceleration rate, the federal fund rate, and the BAA spread variable. We estimate the model by minimizing the sum of squares of the residuals (Tsay, 1998; Galvão, 2003) and we compute the generalized impulse response functions (GIRFs; Koop et al., 1996) as to fiscal policy shocks.

We find that the responses of output to fiscal policies significantly change according to the state of credit markets. Whenever the economy is in the "tight" credit regime, the GIRFs display a strong and persistent reaction of output to fiscal policy shocks. On the contrary, the response of GDP to fiscal policies is much milder when the economy experiences "normal" credit conditions.

The different patterns exhibited by the GIRFs in the two credit regimes are reinforced by the computation of fiscal multipliers. When firms face increasing financing costs, the multipliers are much higher than one at different time horizons. Conversely, the multipliers are much weaker — usually lower than one — when the external finance premium is reducing.

We test the robustness of our results to five potential issues concerning i) the specification of the model (first differences vs. levels); ii) the presence of expectations about fiscal policies not already absorbed by the model (i.e. the fiscal foresight); iii) the adoption of a different threshold variable linked to the credit supply; iv) alternative measures of output, fiscal and monetary variables; v) different sample periods going back to the sixties and excluding the observations after the Lehman Brothers bankruptcy. We find that the results of our empirical analysis are robust to the battery of controls we performed.

Coming back to the debate about the quantitative effects of fiscal policies, our empirical results suggest policy makers to carefully plan fiscal interventions according to the state of credit markets. When credit conditions become "tight", expansionary fiscal policies could be desirable in order to restore economic growth and stabilize credit markets. On the contrary, if governments aim to stabilize public debt dynamics with negligible sacrifices, they should put in place fiscal consolidation policies in periods of credit bonanza when firms can easily borrow at moderate interest rates. In that respect, European countries do not seem to have chosen the right timing to implement fiscal consolidation plans.

The rest of the paper is organized as follows: in Section 2 we discuss the literature about the effects of fiscal policies and the possible interactions between credit and real dynamics; in Section 3 and Sections 4 we describe our methodology and the data employed; the mains results of the empirical analysis are presented in Section 5; the battery of robustness checks are performed in Section 6; finally, in Section 7 we provide concluding remarks.

2 Related literature

Our work refers to two main research avenues. The first one assesses the magnitude of government spending multipliers, while the second one studies the macroeconomic consequences of financial market imperfections. In both strands of literature, research questions are still open. Indeed, notwithstanding a blossoming of works in recent years, the debate about the size of fiscal multipliers is far from being settled (see the survey in Ramey, 2011a; Hebous, 2011) and the mechanisms trough which fiscal policies affect macroeconomic dynamics in periods of financial turmoils have not been completely uncovered.

The size of fiscal multipliers has been appraised so far by studies driven by theoretical models and by empirical investigations.[2] Within the former field of research, we find a large number of models rooted either in the Real Business Cycle or in the New Keynesian traditions (for a survey, see Ramey, 2011a). In general, in both frameworks multipliers are lower than unity unless some modifications are introduced in the utility functions of households (e.g. Linnemann, 2006; Ravn et al., 2006; Bouakez and Rebei, 2007) or in the productivity of government spending (e.g. Baxter and King, 1993); non-Ricardian consumers are assumed (e.g. Galí et al., 2007); or the Central Bank operates at the zero lower bound (e.g. Christiano et al., 2011; Erceg and Lindé, 2010; Woodford, 2011).[3]

Moving to empirical studies, results differ according to many features such as the sample period, the specification of the model, the choice of the fiscal variable, the way multipliers are computed, etc. However, the main issues concern the identification of fiscal shocks. Among the different identification strategies, empirical studies usually resort either to the Structural VAR (SVAR) methodology or to the narrative approach.[4]

[2]Spilimbergo et al. (2009) identify four methodologies to study fiscal multipliers: model simulations; case studies; VARs; econometric studies of consumer behavior in response to fiscal shocks. Gechert and Will (2012) propose a meta regression approach in order to deal with the enormous amount of results coming out from both model-based strategies and empirical methods.

[3]See Coen et al. (2012) for a comparison of the predictions resulting from seven structural DSGE models provided by different economic organizations and two medium-scale DSGE models (Christiano et al., 2005; Smets and Wouters, 2007).

[4]Alternative approaches are proposed, among the others, by Acconcia et al. (2011), Mertens and Ravn

SVAR studies rely either on recursive identification (e.g. Fatás and Mihov, 2001; Galí et al., 2007) or on more complex structures (e.g. Blanchard and Perotti, 2002), where the fiscal variable is ordered first, as implementation lags are supposed to postpone the effects of discretionary fiscal policy on output.[5] Blanchard and Perotti (2002) report a peak spending multiplier between 0.9 and 2 depending on assumptions about the trend and fiscal foresight, whereas Galí et al. (2007) find an impact multiplier of 0.68 and a response of 1.78 after 8 quarters for their main model specification.

Turning to the narrative approach, the identification of exogenous fiscal shocks involves the use of external information provided by e.g. government reports or newspapers (Ramey and Shapiro, 1998; Edelberg et al., 1999; Burnside et al., 2004; Romer and Romer, 2010; Ramey, 2011b).[6] As reported in the survey of Ramey (2011a), the multipliers produced by models following the narrative approach range from 0.6 and 1.2 depending on the sample employed and the way multipliers are computed (i.e. cumulative vs. peak responses).

Spurred by the Great Recession, a new strand of literature have recently started to study the non-linear effects of fiscal policies according to the state of the economy. For instance, Almunia et al. (2010) showed that fiscal multipliers where much greater during the Great Depression, when the economy was in a regime characterized by a dysfunctional banking system and a monetary policy constrained by the zero lower bound (see also DeLong and Summers, 2012). Employing annual data for a panel of 17 OECD countries, Corsetti et al. (2012) found that fiscal multipliers are higher than two when the economy experiences financial crisis episodes (captured by dummy variables).

The main modeling tools employed to study the effects of fiscal policies under different regimes are smooth transition vector autoregressions (STVAR) and threshold vector autoregressions (TVAR). The sources of multiple regimes studied so far are GDP growth/output gap (e.g. Auerbach and Gorodnichenko, 2012b,a; Baum et al., 2012b; Batini et al., 2012; Baum and Koester, 2011; Mittnik and Semmler, 2012; Bachmann and Sims, 2012); financial stress indexes (e.g. Afonso et al., 2011); banking crises (e.g. Röger et al., 2010); public debt (e.g. Baum et al., 2012a). The main result shared by these studies is that fiscal policies have a stronger impact during periods of crisis. For instance, Auerbach and Gorodnichenko (2012b) and Bachmann and Sims (2012) find fiscal multipliers higher than 2 during recessions but around 1 in periods of expansion.

The closest antecedent to the present study is the work of Afonso et al. (2011), who employ a TVAR to assess the effects of fiscal policies vis-á-vis a financial stress index

(2012) and Fisher and Peters (2010).

[5]For a a justification for ordering first the government spending variable see Fragetta and Melina (2011). An alternative strategy consists in imposing sign restrictions (see e.g. Mountford and Uhlig, 2009).

[6]For a description of the relationship between the SVAR and the narrative approach see Perotti (2008), Favero and Giavazzi (2012) and Caldara and Kamps (2012).

encompassing bank, stock-market and exchange-rate dynamics. For the U.S., they find insignificant differences between the cumulative multipliers in the two regimes. Our work is focused instead on the possible interrelations between fiscal policies and the state of corporate-bond markets, which are intimately related to the investment decisions of firms. Moreover, we control for the issue of fiscal foresight as well as for other potential problems (see Section 6 below).[7]

There is a wide micro and macroeconomic literature studying how imperfect information in financial markets can affect real dynamics. At the microeconomic level, financial market imperfections increase the cost of borrowing of firms (Townsend, 1979), reduce the supply of credit (Stiglitz and Weiss, 1981) and justify the adoption of incomplete contracts (Hart and Moore, 1994), which force firms to provide their net worth as collaterals. In this framework, the credit sector can increase macroeconomic instability amplifying and propagating negative shocks through the financial accelerator and possibly leading to flight-to-quality episodes (Bernanke and Gertler, 1989; Bernanke et al., 1996, 1999; Gertler and Kiyotaki, 2010; Brunnermeier et al., 2012). The key mechanisms at the root of the financial-accelerator dynamics are the external finance premium paid by firms and the evolution of their net worth. Recently, a new vintage of macro models has started investigating the impact of financial frictions on macroeconomic performance (see e.g. Cúrdia and Woodford, 2011; Gertler and Karadi, 2010; Hall, 2011; Christiano et al., 2013; Carrillo and Poilly, 2013). In particular, Eggertsson and Krugman (2012) show that during recessions, when the financial system is working poorly, expansionary fiscal policies are highly effective (see also Fernández-Villaverde, 2010).[8] Given the foregoing literature, we expect the effects of government spending shocks to be stronger during periods in which firms face higher difficulties in obtaining external funds to finance their production and investment choices.

3 Methodology

As mentioned above, we investigate the effects of government spending shocks within the flexible framework provided by Threshold VAR (TVAR) models (Tong, 1983; Tsay, 1998; Galvão, 2003), in order to account for the possible presence of different credit-market regimes.

TVAR models have a number of interesting features that make them a useful tool to capture non-linearities such as regime switching, multiple equilibria, asymmetric reaction

[7]See also Balke (2000) and Atanasova (2003) for TVAR studies on the the effects of monetary policy in different credit-market regimes.

[8]See Aghion et al. (2010) and Aghion et al. (1999) for a study on the relationship between investment, credit constraints and growth volatility with some interesting implications for fiscal policy. See also Dosi et al. (2013) for an investigation on the interactions between Minskian credit dynamics and fiscal policies in an evolutionary, agent-based model.

to shocks, etc. (Atanasova, 2003; Afonso et al., 2011). First, the threshold variable is considered as endogenous. This allows one to study regime switches, which result from shocks hitting another variable within the system. Second, TVARs are very simple to estimate: within each regime, the parameters can be recovered by ordinary least squares (OLS). However, once estimated, the state dependent dynamics of TVARs allows for non-linear and asymmetric impulse response functions.

Let us consider a TVAR model with two regimes. Given y the vector of endogenous variables and w the threshold variable (belonging to y), the model can be represented as follows:

$$y_t = c_j + \sum_{i=1}^{p} A_{j,i} y_{t-i} + \varepsilon_{t,j}, \tag{1}$$

where $r_{j-1} < w_{t-d} \leq r_j$, $j = \{1, 2\}$ identifies the two regimes and the r_js specify the bounds of each regime; d is the lag of the threshold variable relevant for regime changes; c_j is a constant vector; p is the autoregressive order; $A_{j,i}$ is the matrix of coefficients of regime j and lag i. Each regime can be characterized by a variance-covariance matrix Σ_j.[9] Note that the TVAR model is linear within each regime, but the changes in the parameters across regimes account for non-linearities.

TVARs can be estimated through OLS conditional on the threshold variable, w_{t-d}, the number of regimes and the order p. Identification can be performed employing standard procedures used in the linear framework. In particular, we rely on a Choleski decomposition of the variance-covariance matrix of residuals (in each regime), ordering first the fiscal policy variable. This is the standard procedure to disentangle discretionary fiscal policies from automatic stabilizers commonly followed in both linear (e.g. Fatás and Mihov, 2001; Galí et al., 2007) and non-linear models (Afonso et al., 2011).

There are many tests in order to assess the linearity of VAR models. Here we use the method proposed by Tsay (1998) which requires the stationarity of the threshold variable and the continuity of its distribution, restricted to a bounded set $S = [\underline{z}, \overline{z}]$, which is an interval on the full sample.

Once the hypothesis of linearity is rejected by the data, we can estimate the Threshold VAR.[10] Given the linearity of the model within each regime, we apply conditional least squares (for all the possible threshold values) and — under the assumption of a given number of regimes — we select the model minimizing the sum of squares of the residuals (Tsay, 1998).[11] Since the number of parameters to estimate is proportional to the number of regimes and our main dataset contains only 108 usable observations (see Section 4), we assume the existence of *two* regimes.

[9]As economic theory suggests that financial frictions can increase the effects and the persistency of shocks, we estimate regime-dependent variance-covariance matrices.

[10]On the plausibility of approximating a non-linear model with a threshold model see e.g. Tong (1983).

[11]See Galvão (2003) for an alternative method consisting in minimizing the determinant of the variance-covariance matrix of the residuals.

In order to check the robustness of the results provided by the Tsay tests as to possible small-sample biases, we also perform a sup-LR test (Hansen, 1999; Lo and Zivot, 2001; Galvão, 2003; Clements and Galvão, 2004).[12]

We estimate a TVAR model in first differences.[13] Given the limited amount of observations, we estimate the model selected by the *Bayesian Information Criterion* (BIC from now on).

Note that if cointegration relationships are present in the data, our analysis is not exploiting all the possible information provided by our sample. In order to control for the robustness of our results as to cointegration, in Section 6 we estimate also TVAR models in levels without explicitly specifying the cointegrating relationships linking the endogenous variables.

Once the estimation of the TVAR is accomplished, the next step consists in analyzing the impulse response functions. In a non-linear setup, the reaction of an endogenous variable to a shock depends on the past history, the state of the economy and the size of the shock under study at time 0, and the size and the sign of all the shocks hitting the economy within the period of interest. In order to average out the influences of history and of all other shocks, simulation methods are necessary to recover the generalized impulse response functions (GIRF; Koop et al., 1996). In particular, if we define ε_t as the shock to the variable we are interested in, a horizon m, and a history Ω_{t-1}, we can define the GIRF as:

$$\begin{aligned} GIRF = {} & E\left[X_{t+m}|\varepsilon_t, \varepsilon_{t+1}=0, \ldots, \varepsilon_{t+m}=0, \Omega_{t-1}\right] - \\ & E\left[X_{t+m}|\varepsilon_t=0, \varepsilon_{t+1}=0, \ldots, \varepsilon_{t+m}=0, \Omega_{t-1}\right] \end{aligned} \tag{2}$$

The algorithm employed to derive the generalized impulse response function is described in appendix B. The general idea is to simulate the model for any possible starting point over the time horizon of interest by feeding the system with boostrapped shocks and to repeat the exercise by adding a new shock of a specific size (1 or 2 times the standard deviation of the fundamental shock in the linear model). The procedure is done hundreds times with newly generated series of bootstrapped residuals. Finally, the responses to shocks specific to a particular regime is recovered by averaging out the simulation results. Following Afonso et al. (2011), given that small-sample biases are likely to arise in each given regime, we build confidence bands using the empirical distributions obtained from Monte Carlo simulations. We now turn to the description of the data.

[12]For alternative linearity tests, see e.g. Hansen (1996) and Hansen and Seo (2002).

[13]An exception is the output gap. For the threshold variable, we employ a MA(2) filter, cf. Section 4.

4 Data

We employ U.S. quarterly data drawn from the FRED database released by the Federal Reserve of St. Louis. Our main sample ranges from the first quarter of 1984 to the last quarter of 2010. The choice of the data sample is motivated by the willingness to study a relatively coherent time period as far as both fiscal and monetary policies are concerned. That is why we exclude, for instance, the period of the Great Inflation and the ensuing Volcker's disinflation. However, to refine the robustness of our analysis, we also extend the sample back to 1961 and we shrink it up to 2007, thus excluding the period following the Lehman Brothers collapse that was characterized by strong policy shocks (e.g., the Economic Stimulus and the American Recovery and Reinvestment acts) and by the interest rate close to the zero lower bound (see Section 6.4 below). A detailed description of the data is provided in Appendix A.

The threshold variable. We specify a TVAR model that studies the effects of government consumption and gross investment on output dynamics under different credit regimes. More precisely, in our TVAR models we consider as endogenous variable the spread between the BAA-rated corporate bond interest rates and the 10-year treasury constant-maturity rate (from now simply the BAA spread) as a proxy for credit conditions. In presence of financial market imperfections, the spread is supposed to capture the premium for external finance possibly linked to restrictions in the supply of credit to firms (Ernst et al., 2010). In this framework, as fluctuations in spreads should reflect changes in the supply of credit, their dynamics becomes relevant when there are financial frictions (Gilchrist and Zakrajsek, 2012), which could give rise e.g. to flight-to-quality phenomena (Bernanke et al., 1996). According to Atanasova (2003), the presence of financial frictions should imply rising spreads after a monetary tightening. At the empirical level, Gertler and Lown (2000) find that spreads increase during downturns.

We prefer the BAA corporate-bond spread to commercial-paper one because as the former is more intertwined to long-term investment projects, it allows to better capture long-term changes in lenders' perceived risk (see Atanasova, 2003; Ernst et al., 2010). Moreover, as the low default rates on commercial paper makes it a close substitute for treasury bills, we believe that the BAA spread is better suited to catch flight-to-quality episodes. However, in order to further improve the robustness of our study, we also use a variable capturing the quantity of loans supplied within the economy (see Section 6.3). More precisely, we employ the MIX, i.e. the ratio between the total amount of loans in the liabilities of non-financial firms (corporate and non-corporate) and the sum of that amount plus the amount of commercial paper issued by non-financial corporate firms (Kashyap et al., 1993; Bernanke et al., 1996; Balke, 2000). The MIX should allow to better catch the impact of credit rationing (Stiglitz and Weiss, 1981) on firms' financing choices.

The Tsay (1998) test for linearity requires the stationarity of the threshold variable. Therefore, we consider the first difference of the BAA spread. Moreover, following Balke (2000), we apply a MA(2) to the series in first-differences to avoid the presence of an implausible number of regime switches over time. The obtained series is showed in Figure 1 for the whole sample period (1984:1-2010:4) together with the MA(2) of the first difference of the AAA corporate bond spread. The MIX variable is displayed in Figure 2. In order to avoid too many changes of regime, we work with a flexible moving average (for details, see Section 6.3).

A possible problem could arise if the variations of the spread variables closely track business cycles. In this case, our threshold variable would not be able to capture different credit-market regimes as it would be only a proxy of output fluctuations. A straightforward way to test this hypothesis is to compute the correlation between our spread variable and GDP growth rates. We find that the correlations between the first difference of GDP and the BAA spread is only -0.34. Moreover, we compare the sample of observations in the "tight" credit regime with the ones classified as "contractions" according to the NBER business cycle chronology. We find that only 9 observations out of 31 in the "tight" credit regime correspond to NBER recessions. Finally, we estimate a TVAR model using the GDP rate of growth as threshold variable (in line with Auerbach and Gorodnichenko, 2012a) and we compare the ensuing regimes with the ones resulting from our original model finding that only 8 observations overlap.[14]

Other variables. All the variables are made stationary when necessary before entering in the TVAR. All the series, both in first differences and in levels, are shown in Figures 3, 4 and 5.

As a measure of output, we employ the rate of growth of GDP. We also perform the analysis using the output gap estimated through an HP-filter. This is the first of a series of robustness checks (cf. Section 6.4) where we replace one variable of the TVAR model with its closest substitutes.

The variable identifying fiscal policy is the real government consumption and gross investment. In order to study public debt dynamics, we consider the difference between government gross investment and savings divided by the GDP (as in Galí et al., 2007). We also check for a primary deficit measure even though the expenditures on interest rates do not seem to play a large role in the United States.

As far as monetary policy is concerned we use the federal fund rate. For robustness, following Atanasova (2003), we repeat the analysis with both nominal and real M2. For inflation, we employ the first difference of the logarithm of GDP implicit deflator.

Finally, although we mainly rely on aggregate data, we also employ a model specifi-

[14]For instance, according to our TVAR model, the economy was in a "tight" credit regime in the first quarter of 2006, whereas it was not in a downturn according to the TVAR model driven by the rate of growth of GDP which captures the closest recession in 2008:4.

cation with normalized GDP, government spending and money supply. More precisely, following Galí et al. (2007), we normalize real GDP, government consumption expenditure and gross investment and M2 by the size of the civilian population over 16 years old.

5 Main results

We can now study the effects of fiscal policy shocks under different credit regimes. In this Section we provide the results for the main sample period (1984:1-2010:4), postponing to Section 6 the results of the battery of robustness checks we performed.

The specification of the TVAR model follows the one proposed by Balke (2000) to study the role of financial-market regimes as non-linear propagators of shocks to which we add a fiscal policy variable and a variable capturing the dynamics of public debt. The Choleski order of the variables of our model is in line with the one followed by Fatás and Mihov (2001) and Galí et al. (2007). More specifically, the first difference of the logarithm of real government expenditures and gross investment is ordered first, followed by the first difference of GDP, the first difference of the public debt dynamics variable, the price acceleration rate, the federal fund rate, and the BAA spread variable. Note also that our choice of ordering the fiscal policy variable first just before GDP is supported by the evidence provided by Fragetta and Melina (2011).

We start performing augmented Dickey-Fuller tests to check the stationarity of the filtered spread between the BAA-rated corporate bond interest rates and the 10-year treasury constant-maturity rate. The results, together with the details about the specification of the tests (e.g. inclusion of the constant, number of lags, etc.) are reported in Table 1. All the performed tests reject the null hypothesis concerning the presence of a unit root in the threshold series.

Given the stationarity of the threshold variables, we can perform linearity tests. Both the results of the Tsay and sup-LR tests reject the hypothesis of linearity, suggesting the presence of two regimes in corporate-bond markets (see Table 2).[15]

The estimated lag of the threshold variable is two.[16] In particular, the value according to which the sum of the squares of the residuals is minimized is 0.12. This implies that the model spends almost one third of the time (31 observations out of 108) in the regime characterized by the presence of tensions in corporate-bond markets. According to the cut-off value of the threshold variable, whenever in the last two quarters the variation of the BAA spread accelerates on average by more than 12 basis points, the economy is going to enter in the "tight" credit regime in the next period.

[15]We perform the tests and we estimate the model leaving at least 15% of the observations in each regime.

[16]The results of our study do not substantially change when we consider only one lag of the threshold variable.

As the BIC selects a model with one lag, we estimate a TVAR(1) and we assess the effect of fiscal policy shocks by way of generalized impulse response functions (GIRF, see Section 3 and Appendix B). More specifically, we study the average response of GDP growth rates as to a 1% standard deviation shock to the rate of growth of government consumption expenditure and gross investment in both regimes for the period 1984:1-2010:4 normalized in order to obtain a 1% actual increase in the policy variable in both regimes. The GIRFs well capture the non-linear response of output to fiscal policy shocks (see Figure 6). When corporate-bond markets are under stress, government spending shocks appear to spur GDP growth strongly and persistently. On the contrary, fiscal policy does not seem to succeed in stimulating output when the BAA spread is not accelerating. The outcomes do not change if a negative shock is considered: fiscal consolidation policies appear to be extremely harmful in periods when the economy is in the "tight" credit regime.

To provide a more precise quantitative assessment of the patterns just showed by the GIRFs, we report in Table 3 the multipliers associated to a (positive) fiscal shock under different corporate-bond market regimes. The multipliers (k) are computed dividing the cumulative responses at each horizon by the average ratio (over the whole sample) between government spending and GDP. More specifically, denoting by Y output and by G government consumption expenditures and gross investment, the multiplier at time $t+n$ (k_n) as well as the peak multiplier (k_n^*) are computed as follows:

$$k_n = \frac{\Delta Y_{t+n}}{\Delta G_t} \qquad\qquad k_n^* = \frac{max_n \Delta Y_{t+n}}{\Delta G_t} \tag{3}$$

The multipliers associated to the TVAR(1) model for the period 1984-2010 reveal strong differences in the effects of fiscal policies under the two credit regimes. In periods when the BAA spread is accelerating, the multipliers are at least more than two times bigger than the ones associated to the "peaceful" corporate-bond market regime. More precisely, in the "tight" credit regime, fiscal policies appear to have strong effects on output dynamics: the impact multiplier is 2.26, rising to 4.16 after 5 quarters. On the contrary, in the "normal" credit regime, only the impact multipliers is not lower than one.

According to our analysis, as the effects of fiscal policies are amplified when corporate-bond markets are under pressure, policy-makers should carefully design the timing of fiscal interventions. More specifically, when spreads are accelerating and firms are paying increasing financing costs, expansionary fiscal policies should be implemented in order to boost aggregate demand and foster output growth, postponing fiscal consolidation measures to periods in which confidence in corporate-bond markets is restored. In the next Section, we control whether the results supporting these policies implications are robust to a series of issues which could potentially undermine our analysis.

6 Robustness analysis

We control the sensitivity of our results as to five potential problems, namely i) the presence of cointegrating relationships between variables of our data sample; ii) fiscal foresight; iii) alternative threshold variables and different methods according to which the threshold variable enters the VAR; iv) different measures of output; v) different sample periods. Before entering in the details of the robustness tests we performed, we can anticipate here as a kind of sneak preview that the main findings of our empirical study are robust to all the potential issues we single out and test below.

6.1 Cointegration relationships

In presence of cointegrating relationships between the variables of the sample, specifying a TVAR in growth rates, as we did above, does not allow to exploit all the possible information present in the data. Since macroeconomic theory does not provide any clear insight about possible cointegrating relationships within our model, we pragmatically estimate the TVAR in levels without trying to identify any possible cointegrating relationships.[17]

In line with the results of the previous section, the GIRFs generated by a positive fiscal policy shock show a different patterns in the two corporate-bond regimes (see Figure 7). When firms face increasing financing costs, expansionary fiscal policies have stronger and more persistent impact on GDP dynamics than in the other regime.[18]

The computed fiscal multipliers[19] confirm the above results (cf. Table 3). In the "normal" credit regime, the fiscal multipliers are feeble and become negative after eight quarters, whereas when the BAA spread is accelerating they are persistently higher than one. Note that the multipliers resulting from the TVAR in first difference are higher than the ones stemming from the TVAR in levels. Nonetheless, we can conclude that both the GIRFs and the multipliers confirm the patterns and the results obtained with our baseline TVAR model.

6.2 Fiscal foresight

The estimates of the effects of fiscal policies performed in Section 5 could not be reliable if the information set exploited by the econometric model does not coincide with the one used by policy makers and consumers (e.g. Leeper et al., 2008; Mertens and Ravn, 2010; Ramey, 2011b). In order to take into account the potential issue of *fiscal foresight*,

[17] In this case, the presence of non-stationary time series may violate some of the regularity conditions required by both Tsay (1998) and Hansen (1996) procedures thus uncovering spurious non-linearities. For this reason, we do not perform linearity tests and we directly estimate the model in levels.

[18] In both regimes, the GIRFs turn negative at the end of the horizon. The same dynamics is found when a linear SVAR is estimated.

[19] In this case the fiscal multipliers are computed dividing the value of the impulse response at each horizon by the ratio (average value over the sample period) between government spending and GDP.

following Auerbach and Gorodnichenko (2012b) we add to the baseline specification of our TVAR the forecasted changes in federal, state and local government consumption and gross investment drawn from *Survey of Professional Forecasters*.[20] We order first in the system the variable controlling for expectations and we consider fiscal shocks orthogonal to the forecasted values. We estimate TVAR models of order one both in growth rates and levels employing the thresholds estimated above.

In line with our previous results, the GIRFs[21] resulting from the TVAR controlling for fiscal foresight show that the effects of fiscal policies are much higher in the "tight" credit regime vis-à-vis the one characterized by normal conditions in corporate-bond markets (cf. Figure 8).

The related fiscal multipliers are reported in Table 3. In both the growth-rate and level specifications, the impact of fiscal policies on GDP dynamics is stronger when firms face accelerating borrowing costs with peak multipliers abundantly higher that one. The multipliers associated to the first-differenced TVAR are generally bigger than those computed from the model in levels. The comparison between the fiscal-foresight multipliers and the ones obtained from the benchmark TVAR shows that the effects of fiscal policies are reinforced in the "tight" credit regime when expectations are taken into account. The latter result is reversed when the TVAR model is estimated in levels. The general conclusion of this analysis is that even controlling for fiscal foresight, the effects of fiscal policies are stronger with multipliers higher than one when corporate-bond markets are under stress.

6.3 Alternative threshold variables

The threshold variable employed so far —the spread between BAA-rated corporate bond yield and 10-year treasury constant maturity rate— is supposed to capture how financial frictions make the borrowing decisions of firms more difficult by rising their financing costs as to safe assets (Balke, 2000; Atanasova, 2003). We now assess the robustness of our results with respect to an alternative threshold variable which is better suited to capture the presence of restrictions in the supply of credit.[22] More specifically, in line with Balke (2000), we employ as threshold variable the MIX, computed as the ratio between the total amount of loans to non-financial firms (corporate and non-corporate) and the sum of this amount plus the commercial paper issued by non-financial corporate firms

[20]In particular, we directly use the series used by Auerbach and Gorodnichenko (2012b) which already consists of the aggregate of federal and state and local government spending.

[21]For reason of space, from now on we only report the GIRFs for the first-differenced TVAR. The GIRFs associated to the models in levels are available from the authors upon request.

[22]We also estimate a TVAR with the median value of the BAA spread instead of the average one in order to have the same number of observations in each regime. Moreover, as in Balke (2000) and Atanasova (2003), we estimate a model in which the threshold variable enters in first differences in the VAR and as a moving average only when the threshold is considered. In both cases we find that the results do not substantially change.

(Kashyap et al., 1993; Bernanke et al., 1996). As non-corporate firms cannot typically rely upon commercial paper, the MIX should capture restrictions in the supply of credit.

Contrary to the BAA spread, we apply a moving average to the MIX growth rate series only when we consider it as a threshold variable. Furthermore, we consider the threshold not in absolute terms but as a flexible value changing over time. More precisely, the model experiences a change in regime whenever the lagged rate of growth of the MIX is higher/lower with respect to the moving average (whose order has to be estimated) of its past rates of growth. We think that this approach is better suited to catch regime shifts for a variable like the MIX dealing with firm liabilities which are characterized by higher degree of inertia over time.[23] The dynamics of the MIX is reported in Figure 2.

The GIRFs show (cf. Figure 9) that expansionary fiscal policies appear to be more successful in spurring output growth when financial frictions restrict the supply of credit to firms, also when we employ a threshold variable related to the supply of loans.

We now turn to the fiscal multipliers (cf. Table 3). Let us begin with the model in first differences. Even when the MIX is employed as threshold variable, there is a great difference between the fiscal multipliers in the two regimes: when the proportion of loans to firms is squeezing, the multipliers are higher than one and reach 2 after 8 quarters, whereas they are lower than one when credit is more abundant. Interestingly, controlling for fiscal foresight increase the multipliers only within the "tight" credit regime. Even if the multipliers associated to the MIX are lower than the ones computed when the BAA spread is employed, they still support the case for implementing expansionary fiscal policies in the "tight" credit regime.

6.4 Different measures of variables and sample periods

We estimate a series of TVAR models employing alternative measures of output variations, monetary and fiscal policies. First, we replace the output growth rates with the output gap estimated through an HP-filter (the two series are compared in Figure 3). The ensuing GIRFs (cf. Figure 10) confirm our main empirical results: notwithstanding the measure of output dynamics employed, fiscal shocks are extremely successful in stimulating output when corporate-bond markets are under pressure, whereas their effects are softened in the "normal" credit regime.[24] We then substitute the federal funds rate with M2 as a proxy variable for monetary policy and we employ also a primary deficit variable to purge public debt dynamics from the expenditures on interest rates. The results of our

[23]To further test the sensitivity of our results as to the filter employed to smooth the threshold variable series, we apply the same strategy used for the MIX to the BAA spread. We find that the results are robust to different smoothing techniques.

[24]As the estimation of the output gap through the HP-filter suffers from end-of-sample problems, which make the calculation of fiscal multipliers less reliable, we decided not to compute them.

empirical analysis appear to be robust to both changes.[25] Finally, we normalize the variables entering in the TVAR by the size of the civilian population over 16 years old (see Galí et al., 2007) finding no substantial differences in the results generated by the model.

So far we estimate our TVARs on a sample period ranging from 1984 to 2010 which is supposed to be relatively coherent in terms of fiscal and monetary policies. However, the results of our empirical exercises could be intimately linked to the specific sample period employed. As a final robustness control, we repeat our analysis on different sample periods.

We begin enlarging the covered time period up to the first quarter of 1961. The Tsay test rejects the null hypothesis of linearity also in the enlarged sample (cf. Table 2). We then estimate the TVARs replacing the federal funds rate with M2, both in nominal and real terms, because the latter variable shows a smoother path making the number of observations in both regimes more balanced.[26] The GIRFs confirm the results obtained for the smaller sample: there is a much higher effect of government spending in the regime characterized by increasing spreads (see Figure 11). Moreover, when firms face increasing financing costs, the multipliers are still abundantly higher than one and quite far from the ones of the "normal" credit regime (cf. Table 3).[27]

Finally, we consider the sub-sample 1984-2007 in order to exclude the financial crisis originated with the bankruptcy of Lehman Brothers and, more generally the period in which monetary policy was constrained by the zero lower bound, thus minimizing the crowding-out effects of fiscal policies. In both regimes, the resulting multipliers associated to the model are smaller than the ones related to the full sample period (see Table 3).[28] Nevertheless, the differences between the two regimes persist and the fiscal multipliers are still largely higher than ones in the "tight" credit regime even without a fully accommodating monetary policy. These results are even stronger when we control for fiscal foresight.

[25]Due to space reasons, we decided not to report in the paper the results related to different monetary policy and public debt variables as well as to the "normalized" model. Nonetheless, the results are available from the authors upon request.

[26]As the enlarged sample period contains some turbulent economic phases (e.g. the oil shocks, the Volcker's disinflation) and it allows us to almost double the number of observations, we estimate a TVAR of order four. This choice is supported by AIC and Ljung-Box tests. Moreover, in order to increase the precision of our estimates we leave at least 20% of observations in each regime.

[27]In this case we cannot control for fiscal foresight as the government spending series of the *Survey of Professional Forecasters* starts only in 1981.

[28]The patterns of the GIRF (not shown) are in line with our previous empirical exercises. Given the short time span covered by the sample, we leave at least 20% of observations within each regime.

7 Conclusions

In this work we contribute to the literature about the non-linear effects of fiscal policies (e.g. Auerbach and Gorodnichenko, 2012b) by studying how the effects of fiscal shocks on output dynamics depend on the state of credit markets. Given the pervasive presence of financial frictions in credit markets (Brunnermeier et al., 2012), we conjecture that the effects of fiscal policies should be much stronger in periods when the financial accelerator (Bernanke et al., 1999; Gertler and Kiyotaki, 2010) worsens the credit conditions faced by firms.

We perform our analysis employing a Threshold Vector Autoregression Model (TVAR; Tsay, 1998), whose threshold variable is deemed to single out two regimes according to how financial frictions affect the dynamics of credit markets. More specifically, we used as threshold variable the spread between the BAA-rated corporate bond yields and the long-term treasury interest rate (BAA spread, see Atanasova, 2003; Ernst et al., 2010), which should capture the dynamics of the external finance premium as well as flight-to-quality episodes (Bernanke et al., 1996).

As the linearity tests support the presence of two different regimes in corporate-bond markets, we estimate a TVAR on U.S. quarterly data for the period 1984-2010 and we compute generalized impulse-response functions (GIRF; Koop et al., 1996) for government spending shocks. We find that the response of output to fiscal shocks is much stronger whenever firms are subject to increasing financing costs in bond markets. The different patterns showed by the GIRFs in the two regimes are confirmed by the fiscal multipliers. In the "tight" credit regime, the multipliers are abundantly and persistently higher than one, whereas they are feebler and often lower than one when the BAA spread is slowing down. Our results proved to be robust to a series of checks, namely different model specifications (first differences vs. levels); fiscal foresight; an alternative threshold variable capturing the supply of credit; different measures of output, fiscal and monetary policy variables; different sample periods.

On the normative side, our empirical results support the case for regime-dependent fiscal policies. In periods when firms face increasing difficulties in borrowing funds to finance their production and investment activities, policy makers should consider to carry out expansionary fiscal policies, which would be highly effective in boosting aggregate demand, output and thus relaxing firms' financial constraints. Conversely, fiscal consolidation measures designed to control public debt dynamics should be implemented in periods when financial funds flow copiously from credit markets to firms at low interest rates. On the base of our results, the painful effects produced by the fiscal consolidation policies carried out by European countries in the last years should be partially due to the "tight" credit conditions faced by firms.

Our work could be extended in several directions. First, state-dependent impulse-response functions could be derived for diverse spending aggregates in order to control for the possible effects due to the different composition of the fiscal shocks in the two regimes. A second line of research involves searching for the long-run equilibrium relations between the variables of the model by directly specifying the cointegration relationships. Third, different identification schemes could be adopted to sort out fundamental shocks, paying special attention to those imposing over-identifying restrictions on the variance-covariance matrices of residuals (see e.g. Moneta, 2008; Moneta et al., 2012). Finally, statistical tools should be developed in order to assess the statistical significance of the differences between the impulse response functions within alternative regimes when few observations fall in at least one of them.

References

Acconcia, A., G. Corsetti and S. Simonelli (2011), "Mafia and Public Spending: Evidence on the Fiscal Multiplier from a Quasi-experiment", CEPR Discussion Papers 8305, C.E.P.R. Discussion Papers, April.

Afonso, A., J. Baxa and M. Slavik (2011), "Fiscal Developments and Financial Stress: A Threshold VAR Analysis", ECB Working Paper Series 1319, European Central Bank.

Aghion, P., G.-M. Angeletos, A. Banerjee and K. Manova (2010), "Volatility and Growth: Credit Constraints and the Composition of Investment", *Journal of Monetary Economics*, 57: 246–265.

Aghion, P., A. Banerjee and T. Piketty (1999), "Dualism And Macroeconomic Volatility", *The Quarterly Journal of Economics*, 114: 1359–1397.

Almunia, M., A. Bénétrix, B. Eichengreen, K. H. O'Rourke and G. Rua (2010), "From Great Depression to Great Credit Crisis: Similarities, Differences and Lessons", *Economic Policy*, 25: 219–265.

Atanasova, C. (2003), "Credit Market Imperfections and Business Cycle Dynamics: A Nonlinear Approach", *Studies in Nonlinear Dynamics and Econometrics*, 7.

Auerbach, A. J. and Y. Gorodnichenko (2012a), "Fiscal Multipliers in Recession and Expansion", in *Fiscal Policy after the Financial Crisis*, National Bureau of Economic Research, Inc.

Auerbach, A. J. and Y. Gorodnichenko (2012b), "Measuring the Output Responses to Fiscal Policy", *American Economic Journal: Economic Policy*, 4: 1–27.

Bachmann, R. and E. R. Sims (2012), "Confidence and the Transmission of Government Spending Shocks", *Journal of Monetary Economics*, 59: 235–249.

Balke, N. S. (2000), "Credit and Economic Activity: Credit Regimes and Nonlinear Propagation of Shocks", *The Review of Economics and Statistics*, 82: 344–349.

Batini, N., G. Callegari and G. Melina (2012), "Successful Austerity in the United States, Europe and Japan", IMF Working Paper 12/190, IMF.

Baum, A., C. Checherita-Westphal and P. Rother (2012a), "Debt and Growth: New Evidence for the Euro Area", ECB Working Paper Series 1450, European Central Bank.

Baum, A. and G. B. Koester (2011), "The Impact of Fsical Policy on Economic Activity over the Business Cycle - Evidence from a Threshold VAR Analysis", Discussion Paper Series 1: Economic Studies No. 03/2011, Deutsche Bundesbank.

Baum, A., M. Poplawski-Ribeiro and A. Weber (2012b), "Fiscal Multipliers and the State of the Economy", IMF Working Paper 12/286, IMF.

Baxter, M. and R. G. King (1993), “Fiscal Policy in General Equilibrium”, *The American Economic Review*, 83: 315–334.

Bernanke, B. S. and M. Gertler (1989), “Agency Costs, Net Worth, and Business Fluctuations”, *American Economic Review*, 79: 14–31.

Bernanke, B. S., M. Gertler and S. Gilchrist (1996), “The Financial Accelerator and the Flight to Quality”, *The Review of Economics and Statistics*, 78: 1–15.

Bernanke, B. S., M. Gertler and S. Gilchrist (1999), “The Financial Accelerator in a Quantitative Business Cycle Framework”, in J. B. Taylor and M. Woodford, (eds.), *Handbook of Macroeconomics*, Elsevier, 1341–1393.

Blanchard, O. and D. Leigh (2013), “Growth Forecast Errors and Fiscal Multipliers”, IMF Working paper 13/1, IMF.

Blanchard, O. and R. Perotti (2002), “An Empirical Characterization Of The Dynamic Effects Of Changes In Government Spending And Taxes On Output”, *The Quarterly Journal of Economics*, 117: 1329–1368.

Bouakez, H. and N. Rebei (2007), “Why Does Private Consumption Rise after a Government Spending Shock?”, *Canadian Journal of Economics*, 40: 954–979.

Brunnermeier, M. K., T. M. Eisenbach and Y. Sannikov (2012), “Macroeconomics with Financial Frictions: A Survey”, NBER Working Papers 18102, National Bureau of Economic Research, Inc.

Burnside, C., M. Eichenbaum and J. D. M. Fisher (2004), “Fiscal Shocks and their Consequences”, *Journal of Economic Theory*, 115: 89–117.

Caldara, D. and C. Kamps (2012), “The Analytics of SVARs: A Unified Framework to Measure Fiscal Multipliers”, Finance and Economics Discussion Series 2012-20, Board of Governors of the Federal Reserve System (U.S.).

Carrillo, J. A. and C. Poilly (2013), “How Do Financial Frictions Affect the Spending Multiplier During a Liquidity Trap?”, *Review of Economic Dynamics*, forthcoming.

Christiano, L., M. Eichenbaum and S. Rebelo (2011), “When Is the Government Spending Multiplier Large?”, *Journal of Political Economy*, 119: 78–121.

Christiano, L., R. Motto and M. Rostagno (2013), “Risks Shocks”, NBER Working Papers 18682, National Bureau of Economic Research, Inc.

Christiano, L. J., M. Eichenbaum and C. L. Evans (2005), “Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy”, *Journal of Political Economy*, 113: 1–45.

Clements, M. P. and A. B. C. Galvão (2004), “A Comparison of Tests of Nonlinear Cointegration with Application to the Predictability of US Interest Rates Using the Term Structure”, *International Journal of Forecasting*, 20: 219–236.

Coen, G., C. J. Erceg, C. Freedman, D. Furceri, M. Kumhof, R. Lalonde, D. Laxton, J. Lindé, A. Mourougane, D. Muir, S. Mursula, C. de Resende, J. Roberts, W. Roeger, M. Snudden, S. Trabandt and J. in't Veld (2012), “Effects of Fiscal Stimulus in Structural Models”, *American Economic Journal: Macroeconomics*, 4: 22–68.

Corsetti, G., A. Meier and G. Müller (2012), “What Determines Government Spending Multipliers?”, *Economic Policy*, 27: 521–565.

Cúrdia, V. and M. Woodford (2011), “The Central-Bank Balance Sheet as an Instrument of Monetary Policy”, *Journal of Monetary Economics*, 58: 54–79.

DeLong, J. B. and L. H. Summers (2012), “Fiscal Policy in a Depressed Economy”, Working paper, Brookings Institution.

Dosi, G., G. Fagiolo, M. Napoletano and A. Roventini (2013), "Income Distribution, Credit and Fiscal Policies in an Agent-Based Keynesian Model", *Journal of Economic Dynamics and Control*, 37: 1598–1625.

Edelberg, W., M. Eichenbaum and J. D. Fisher (1999), "Understanding the Effects of a Shock to Government Purchases", *Review of Economic Dynamics*, 2: 166–206.

Eggertsson, G. B. and P. Krugman (2012), "Debt, Deleveraging, and the Liquidity Trap: A Fisher-Minsky-Koo Approach", *The Quarterly Journal of Economics*, 127: 1469–1513.

Erceg, C. J. and J. Lindé (2010), "Is There a Fiscal Free Lunch in a Liquidity Trap?", CEPR Discussion Papers 7624, C.E.P.R. Discussion Papers.

Ernst, E., S. Mittnik and W. Semmler (2010), "Interaction of Labor and Credit Market Frictions: A Theoretical and Empirical Analysis", unpublished manuscript.

Fatás, A. and I. Mihov (2001), "The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence", CEPR Discussion Papers 2760, C.E.P.R. Discussion Papers.

Favero, C. and F. Giavazzi (2012), "Measuring Tax Multipliers: The Narrative Method in Fiscal VARs", *American Economic Journal: Economic Policy*, 4: 69–94.

Fernández-Villaverde, J. (2010), "Fiscal Policy in a Model with Financial Frictions", *American Economic Review*, 100: 35–40.

Fisher, I. (1933), "The Debt-Deáation Theory of Great Depressions", *Econometrica*, 1: 337–357.

Fisher, J. D. M. and R. Peters (2010), "Using Stock Returns to Identify Government Spending Shocks", *Economic Journal*, 120: 414–436.

Fragetta, M. and G. Melina (2011), "The Effects of Fiscal Policy Shocks in SVAR Models: A Graphical Modelling Approach", *Scottish Journal of Political Economy*, 58: 537–566.

Galí, J., 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.

Galvão, A. B. C. (2003), "Multivariate Threshold Models: TVARs and TVECMs", *Brazilian Review of Econometrics*, 23: 143–171.

Gechert, S. and H. Will (2012), "Fiscal Multipliers: A Meta Regression Analysis", IMK Working Paper 97-2012, IMK at the Hans Boeckler Foundation, Macroeconomic Policy Institute.

Gertler, M. and P. Karadi (2010), "A Model of Unconventional Monetary Policy", *Journal of Monetary Economics*, 58: 17–34.

Gertler, M. and N. Kiyotaki (2010), "Financial Intermediation and Credit Policy in Business Cycle Analysis", in B. M. Friedman and M. Woodford, (eds.), *Handbook of Monetary Economics*, North Holland Elsevier.

Gertler, M. and C. S. Lown (2000), "The Information in the High Yield Bond Spread for the Business Cycle: Evidence and Some Implications", NBER Working Papers 7549, National Bureau of Economic Research, Inc.

Gilchrist, S. and E. Zakrajsek (2012), "Credit Spreads and Business Cycle Fluctuations", *American Economic Review*, 102: 1692–1720.

Hall, R. E. (2011), "The High Sensitivity of Economic Activity to Financial Frictions", *The Economic Journal*, 121: 351–378.

Hansen, B. E. (1996), "Inference When a Nuisance Parameter Is Not Identified under the Null Hypothesis", *Econometrica*, 64: 413–430.

Hansen, B. E. (1999), "Testing for Linearity", *Journal of Economic Surveys*, 13: 551–576.

Hansen, B. E. and B. Seo (2002), "Testing for Two-Regime Threshold Cointegration in Vector Error-Correction Models", *Journal of Econometrics*, 110: 293–318.

Hart, O. and J. Moore (1994), "A Theory of Debt Based on the Inalienability of Human Capital", *The Quarterly Journal of Economics*, 109: 841–879.

Hebous, S. (2011), "The Effects of Discretionary Fiscal Policy on Macroeconomic Aggregates: A Reappraisal", *Journal of Economic Surveys*, 25: 674–707.

Kashyap, A. K., J. C. Stein and D. W. Wilcox (1993), "Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance", *American Economic Review*, 83: 78–98.

Kiyotaki, N. and J. Moore (1997), "Credit Cycles", *Journal of Political Economy*, 105: 211–248.

Koop, G., M. H. Pesaran and S. M. Potter (1996), "Impulse Response Analysis in Nonlinear Multivariate Models", *Journal of Econometrics*, 74: 119–147.

Leeper, E. M., T. B. Walker and S.-C. S. Yang (May 2008), "Fiscal Foresight: Analytics and Econometrics", NBER Working Papers 14028, National Bureau of Economic Research, Inc.

Linnemann, L. (2006), "The Effect of Government Spending on Private Consumption: A Puzzle?", *Journal of Money, Credit and Banking*, 38: 1715–1735.

Lo, M. C. and E. Zivot (2001), "Threshold Cointegration and Nonlinear Adjustment to the Law of One Price", *Macroeconomic Dynamics*, 5: 533–576.

Melina, G. and S. Villa (2012), "Fiscal policy and Lending Relationships", Center for Economic Studies - Discussion papers ces12.06, Katholieke Universiteit Leuven, Centrum voor Economische Studiën.

Mertens, K. and M. O. Ravn (2010), "Measuring the Impact of Fiscal Policy in the Face of Anticipation: A Structural VAR Approach", *Economic Journal*, 120: 393–413.

Mertens, K. and M. O. Ravn (2012), "A Reconciliation of SVAR and Narrative Estimates of Tax Multipliers", CEPR Discussion Papers 8973, C.E.P.R. Discussion Papers.

Mittnik, S. and W. Semmler (2012), "Regime Dependence of the Fiscal Multiplier", *Journal of Economic Behavior and Organization*, 83: 502—522.

Moneta, A. (2008), "Graphical Causal Models and VARs: An Empirical Assessment of the Real Business Cycle Hypothesis", *Empirical Economics*, 35: 275–300.

Moneta, A., D. Entner, P. O. Hoyer and A. Coad (2012), "Causal Inference by Independent Component Analysis: Theory and Applications", *Oxford Bulletin of Economics and Statistics*, .

Mountford, A. and H. Uhlig (2009), "What Are the Effects of Fiscal Policy Shocks?", *Journal of Applied Econometrics*, 24: 960–992.

Perotti, R. (2008), "In Search of the Transmission Mechanism of Fiscal Policy", in *NBER Macroeconomics Annual 2007, Volume 22*NBER Chapters, National Bureau of Economic Research, Inc, 169–226.

Ramey, V. A. (2011a), "Can Government Purchases Stimulate the Economy?", *Journal of Economic Literature*, 49: 673–685.

Ramey, V. A. (2011b), "Identifyiing Government Spending Shocks: It's all in the Timing", *The Quarterly Journal of Economics*, 126: 1–50.

Ramey, V. A. and M. D. Shapiro (1998), "Costly Capital Reallocation and the Effects of Government Spending", *Carnegie-Rochester Conference Series on Public Policy*, 48: 145–194.

Ravn, M., S. Schmitt-Grohe and M. Uribe (2006), "Deep Habits", *Review of Economic Studies*, 73: 195–218.

Röger, W., I. Székely and A. A. Turrini (2010), "Banking crises, Output Loss and Fiscal Policy", CEPR Discussion Papers 7815, C.E.P.R. Discussion Papers.

Romer, C. H. and D. H. Romer (2010), "The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks", *American Economic Review*, 100 (3): 763–801.

Smets, F. and R. Wouters (2007), "Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach", *American Economic Review*, 97: 586–606.

Spilimbergo, A., S. Symansky and M. Schindler (2009), "Fiscal Multipliers", Imf staff position note spn/09/11, IMF.

Stiglitz, J. E. and A. Weiss (1981), "Credit Rationing in Markets with Imperfect Information", *American Economic Review*, 71: 393–410.

Tong, H. (1983), *Threshold models in non-linear time series analysis. Lecture notes in statistics, No.21*, Springer-Verlag.

Townsend, R. M. (1979), "Optimal Contracts and Competitive Markets with Costly State Verification", *Journal of Economic Theory*, 21: 265–293.

Tsay, R. S. (1998), "Testing and Modeling Multivariate Threshold Models", *Journal of American Statistical Association*, 93: 1188–1202.

Woodford, M. (2011), "Simple Analytics of the Government Expenditure Multiplier", *American Economic Journal: Macroeconomics*, 3: 1–35.

Appendices

A Data

The data have been recovered from the FRED database[29] provided by the Federal Reserve Bank of St. Louis and transformed in order to get real values through the GDP implicit deflator. The series employed in the empirical analysis are listed below

- Gross Domestic Product (GDP);
- GDP Implicit Deflator (GDPDEF);
- Government Consumption Expenditures and Gross Investment (GCE);
- Government Gross Investment: Federal National Defense Gross Investment (DGI) + Federal Non-defense Gross Investment (NDGI) + State and Local Government Gross Investment (SLINV);
- Gross Government Saving (GGSAVE);
- Moody's Seasoned BAA Corporate Bond Yield (BAA);
- 10-Year Treasury Constant Maturity Rate (GS10);
- Effective Federal Fund Rate (FEDFUNDS);
- Commercial Paper - Assets - Balance Sheet of Non-farm Nonfinancial Corporate Business (CPLB-SNNCB);
- Bank Loans N.E.C. - Liabilities - Balance Sheet of Non-farm Nonfinancial Corporate Business (BLNECLBSNNCB);
- Bank Loans N.E.C. - Liabilities - Balance Sheet of Non-farm Nonfinancial non-corporate Business (BLNECLBSNNB);
- Civilian Noninstitutional Population (CNP16OV).

B Generalized Impulse Response Functions

An algorithm to get the generalized impulse response function (GIRF) specific to each regime with R observations works as follows (see Baum and Koester, 2011):

1. pick a history Ω^r_{t-1};
2. pick a sequence of shocks by bootstrapping the residuals of the TVAR taking into account the different variance-covariance matrix characterizing each regime;
3. given the history Ω^r_{t-1}, the estimated TVAR coefficients and bootstrapped residuals, simulate the evolution of the model over the period of interest;
4. repeat the previous exercise by adding a new shock at time 0;
5. repeat B times the steps from 2 to 4;
6. compute the average difference between the shocked path on the non-shocked one;
7. repeat steps from 1 to 6 over all the possible starting points;
8. compute the average GIRF associated with a particular regime with R observations as:

$$y_{t+m}(\varepsilon_0) = \frac{1}{R}\sum_{r=1}^{R} \frac{y_{t+m}(\Omega^r_{t-1}|\varepsilon_0, \varepsilon^*_{t+m}) - y_{t+m}(\Omega^r_{t-1}|\varepsilon^*_{t+m})}{B}$$

[29] `http://research.stlouisfed.org/fred2/`

Table 1: Augmented Dickey-Fuller Tests applied to the Threshold Variables ($p - values$ in parentheses)

Threshold variable	**Period**	**Specification**	**Results**
BAA spread	1984-2010	7 lags; with constant	-4.85 (0.000)
BAA spread	1961-2010	13 lags; with constant	-5.50 (0.000)
BAA spread	1984-2007	7 lags; with constant	-4.05 (0.001)
MIX	1984-2010	7 lags; with constant	-3.19 (0.020)

Table 2: Linearity Tests ($p - values$ in parentheses)

Threshold variable	**Model**	**Lags**	**Period**	**Tsay test**	**Sup-LR test**
BAA spread	growth rates	1	1984-2010	73.88 (0.002)	116.28 (0.014)
BAA spread	growth rates	4	1961-2010	198.81 (0.005)	342.79 (0.028)
BAA spread	growth rates	1	1984-2007	64.57 (0.014)	92.73 (0.052)
BAA spread	output gap	1	1984-2010	67.29 (0.008)	154.03 (0.013)
BAA spread	output gap	1	1984-2007	65.06 (0.013)	115.98 (0.004)
MIX	growth rates	1	1984-2010	n. p.	146.24 (0.013)

Table 3: Computed multipliers as to a 1% standard deviation shock to government consumption expenditures and gross investment growth rates normalized in order to obtain a 1% increase in actual spending - Tight/normal credit regimes. Asterisks (*): controlling for fiscal foresight.

Threshold variable	**TVAR Model**	**Lags**	**Period**	**Fiscal multipliers**			
				impact	4 quarter	8 quarter	peak(quarter)
BAA spread	growth rates	1	1984-2010	2.26/1.00	4.11/0.42	4.16/0.37	4.16(5)/1.00(0)
BAA spread	growth rates*	1	1984-2010	2.42/0.95	4.47/0.37	4.53/0.32	4.53(5)/0.95(0)
BAA spread	growth rates	1	1984-2007	1.21/1.05	1.53/0.79	1.53/0.74	1.63(1)/1.05(0)
BAA spread	growth rates*	1	1984-2007	1.32/0.95	1.95/0.84	1.84/0.79	2.00(2)/1.05(1)
BAA spread	growth rates	4	1961-2010	2.00/1.20	3.45/0.80	2.90/0.45	3.60(2)/1.35(1)
BAA spread	levels	1	1984-2010	1.63/0.95	1.95/0.32	1.05/-0.16	2.21(2)/0.95(0)
BAA spread	levels*	1	1984-2010	2.32/0.84	1.58/0.42	0.79/0.16	2.32(0)/0.84(0)
MIX	growth rates	1	1984-2010	1.54/0.66	1.97/0.73	2.00/0.72	2.00(8)/0.79(1)
MIX	growth rates*	1	1984-2010	1.68/0.42	2.37/0.47	2.37/0.42	2.37(4)/0.53(1)

Figure 1: The Threshold Variable: the MA(2) of the first difference of the spread between BAA-rated corporate bond yields and 10-year treasury constant maturity rate (red line) and the MA(2) of the first difference of the spread between AAA-rated corporate bond yields and 10-year treasury constant maturity rate (blue line). Shaded areas: recession periods according to the NBER business-cycle chronology.

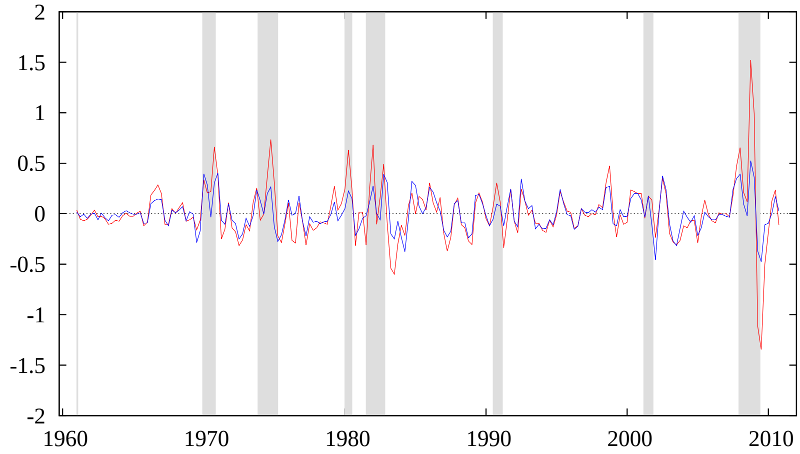


Figure 2: The Threshold Variable: the first difference of the ratio between the total amount of loans in the liability side of non-farm non-financial firms (L) and L plus the commercial paper in the liability side of non-farm non-financial corporate firms (MIX). Shaded areas: recession periods according to the NBER busines-cycle chronology.

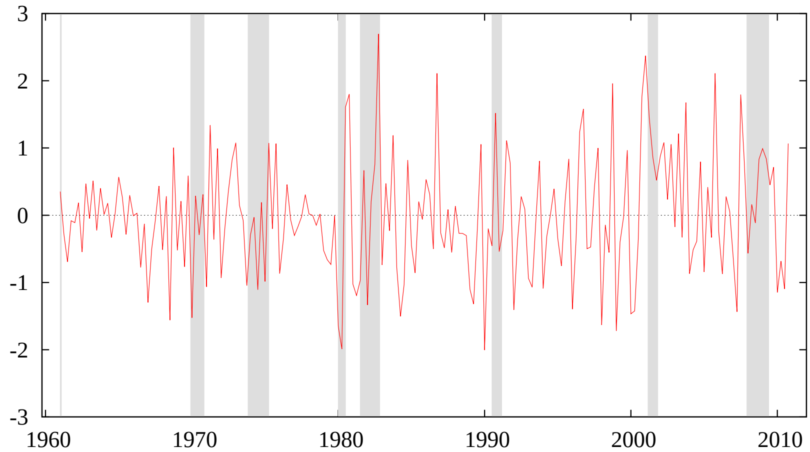
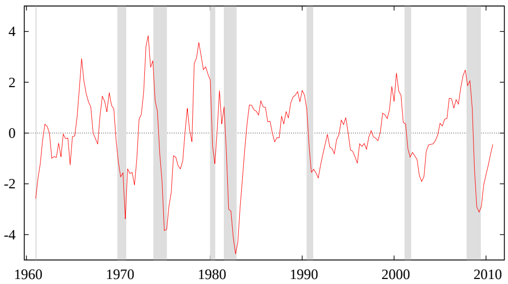
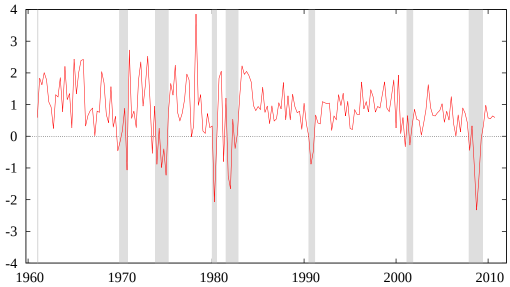


Figure 3: Rate of Growth of GDP vs. Output Gap



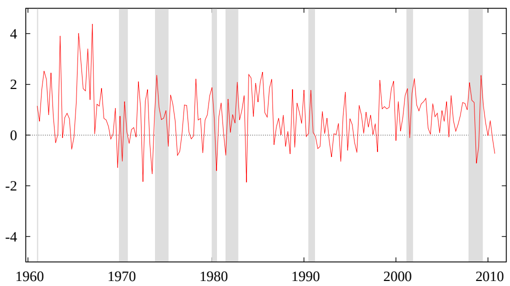
(a) Output gap (HP-filter (λ=1600) applied to the logarithm of the real GDP for the sample 1955:1-2012:4 to avoid beginning/end of sample problems)



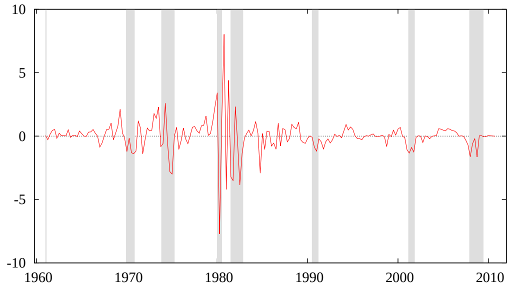
(b) Quarterly rate of growth of GDP

Figure 4: Series (rates of growth)

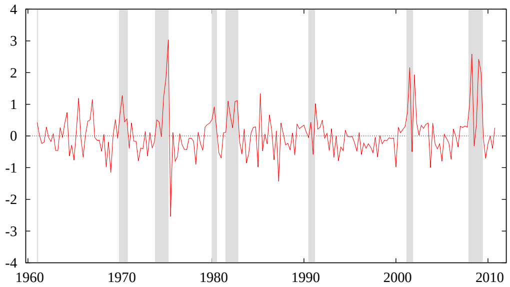
(a) Government consumption expenditures and gross investment



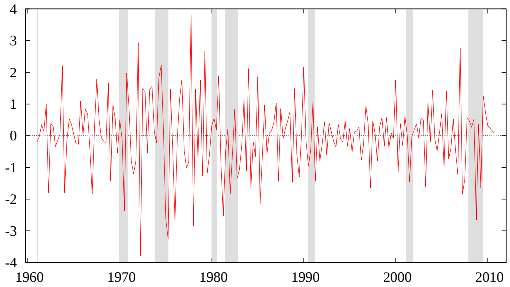
(b) Federal fund rate



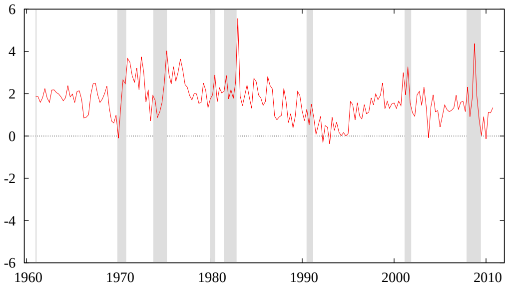
(c) Government gross investment minus government gross saving



(d) Inflation



(e) M2 (nominal)



(f) M2 (real)

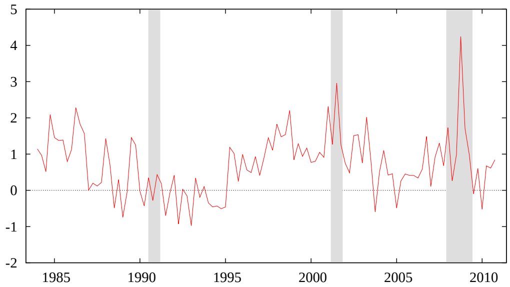
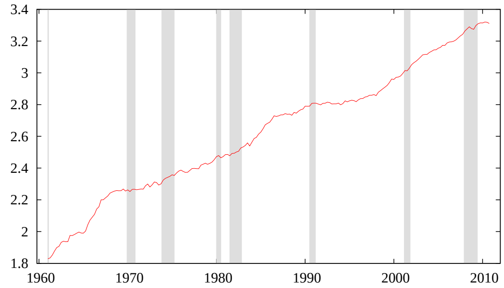
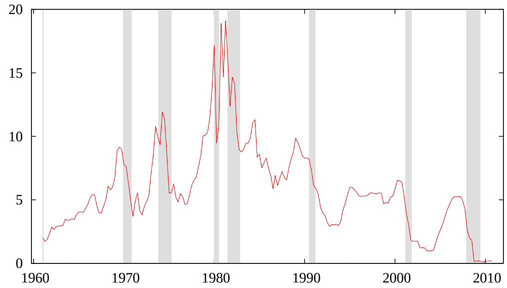


Figure 5: Series (Levels)

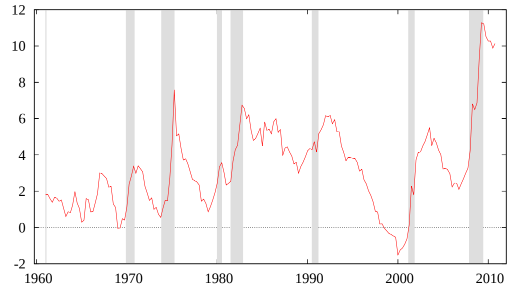
(a) Government consumption expenditures and gross Investment



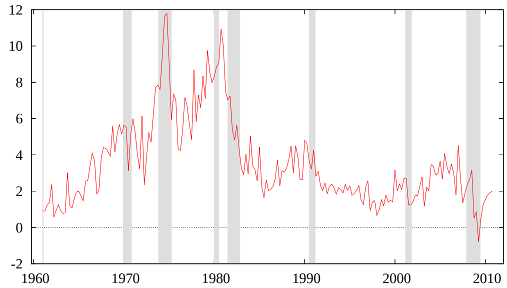
(b) Federal fund rate



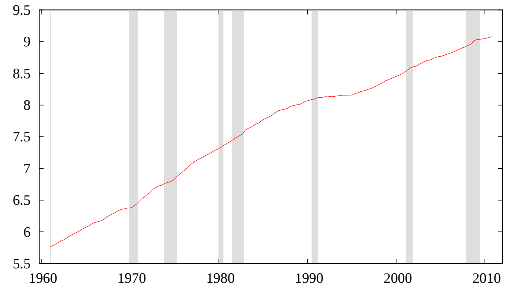
(c) Government gross investment - government gross saving



(d) Inflation



(e) M2 (nominal)



(f) M2 (real)

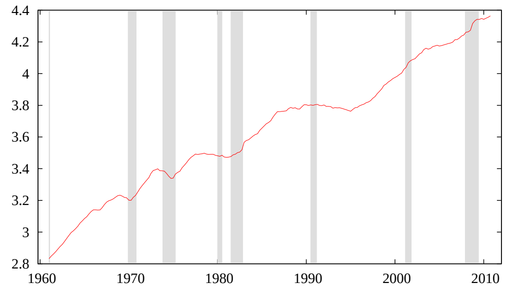
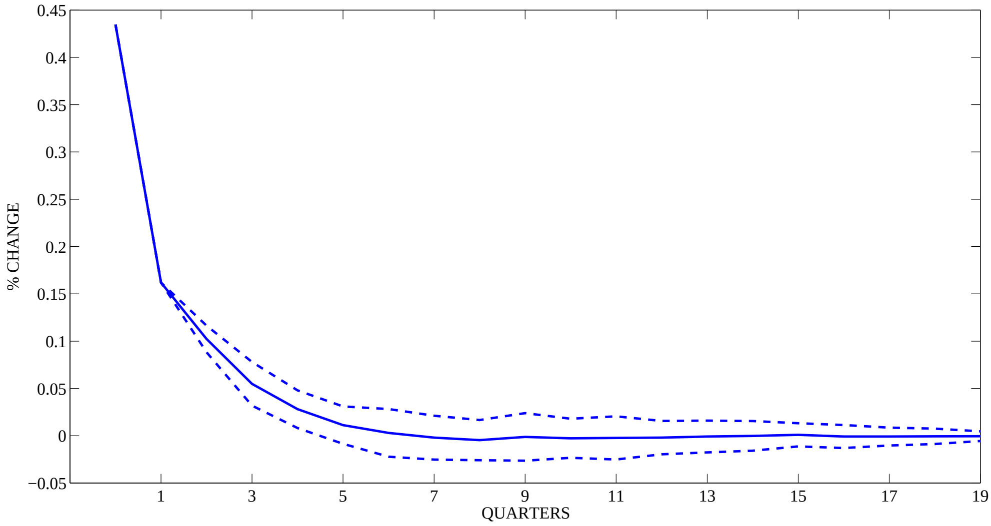


Figure 6: Generalized impulse response functions. Response of GDP growth rate to a 1% standard deviation shock to government consumption expenditures and gross investment growth rates normalized in order to obtain a 1% increase in actual spending (1984:1-2010:4). BAA spread threshold variable. Monte Carlo 95% confidence bands obtained from the empirical distribution of simulated impulse responses assuming normality.

(a) "Tight" credit regime



(b) "Normal" credit regime

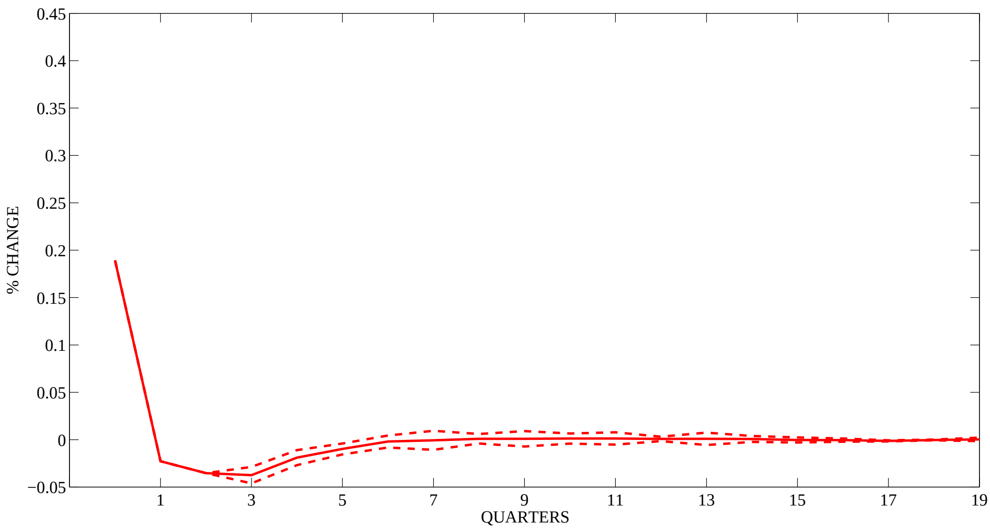
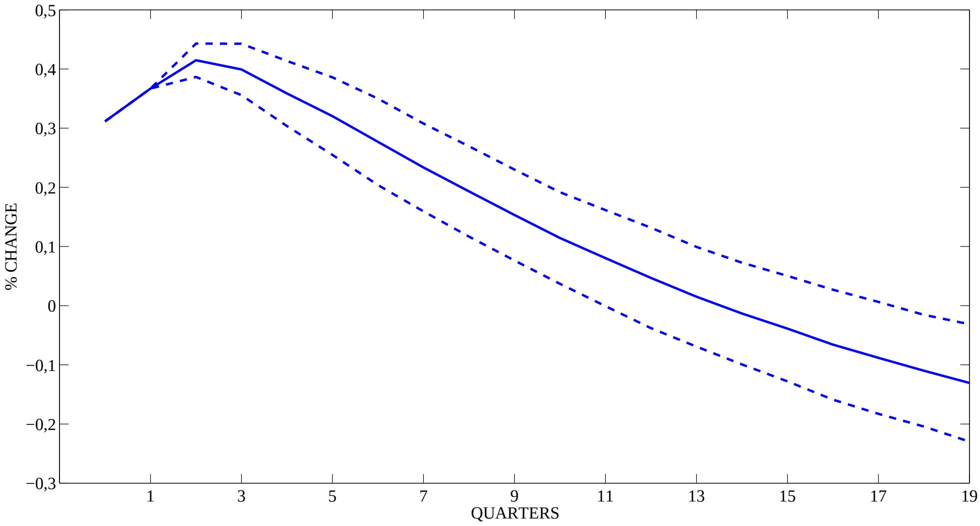


Figure 7: Generalized impulse response functions. Response of GDP to a 1% standard deviation shock to government consumption expenditures and gross investmentnormalized in order to obtain a 1% increase in actual spending (1984:1-2010:4). BAA spread threshold variable. Monte Carlo 95% confidence bands obtained from the empirical distribution of simulated impulse responses assuming normality.

(a) "Tight" credit regime



(b) "Normal" credit regime

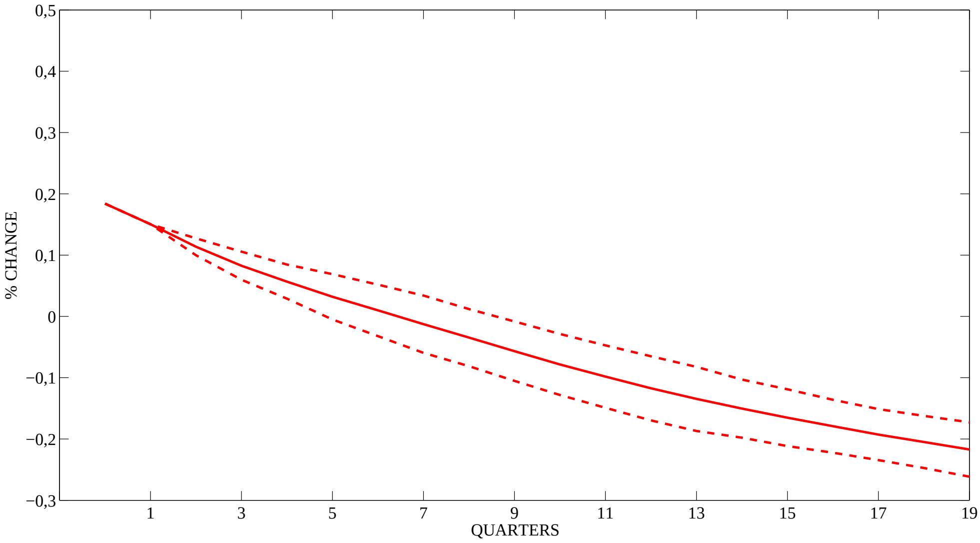
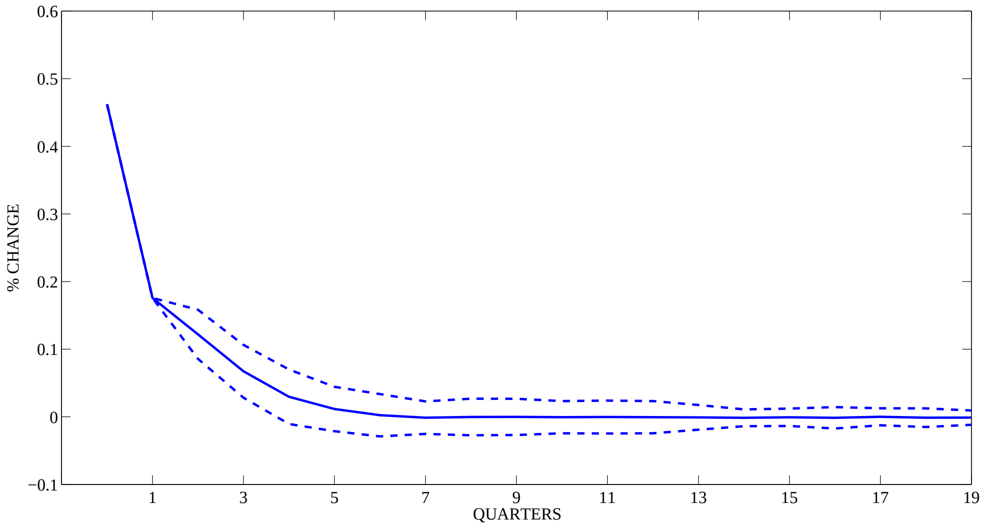


Figure 8: Generalized impulse response functions. Response of GDP growth rate to a 1% standard deviation shock to government consumption expenditures and gross investment growth rates controlling for fiscal foresight normalized in order to obtain a 1% increase in actual spending (1984:1-2010:4). BAA spread threshold variable. Monte Carlo 95% confidence bands obtained from the empirical distribution of simulated impulse responses assuming normality.

(a) "Tight" credit regime



(b) "Normal" credit regime

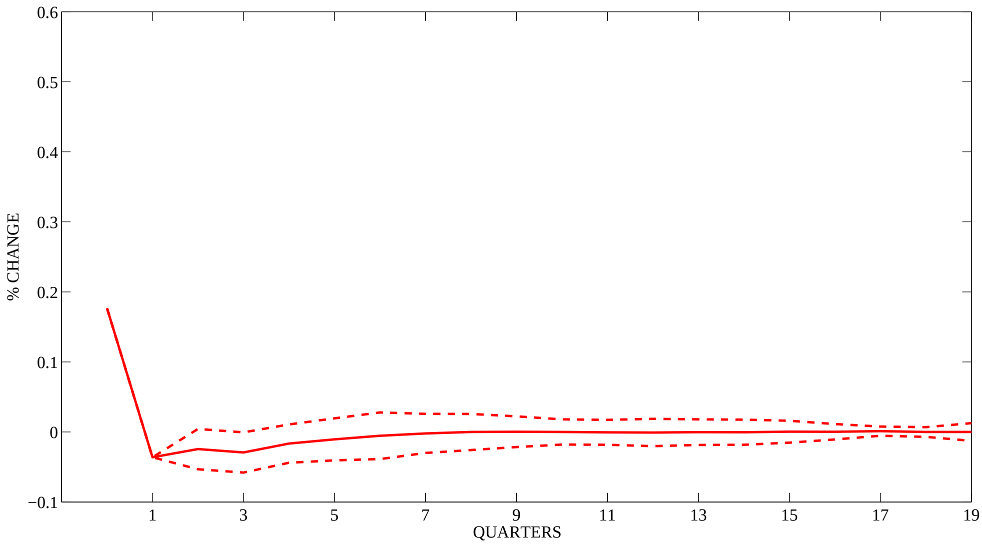
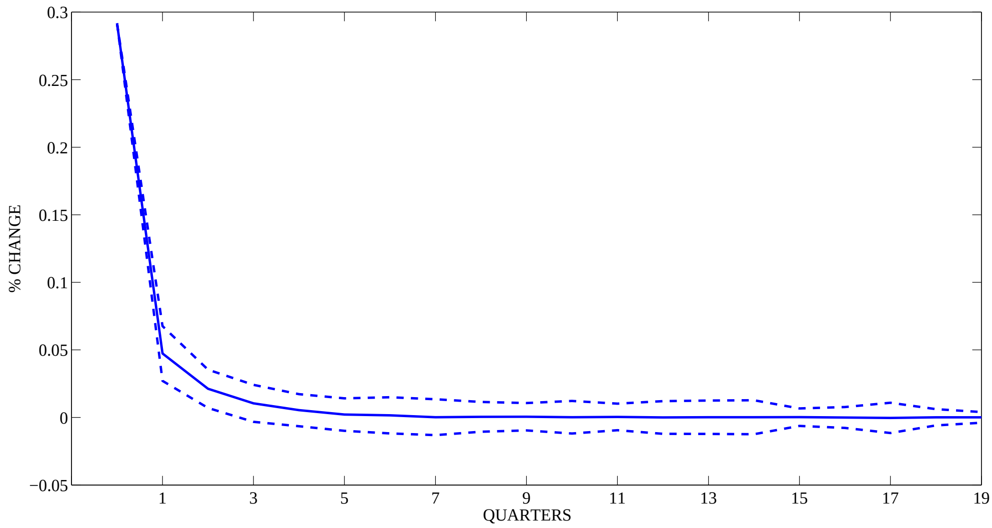


Figure 9: Generalized impulse response functions. Response of GDP growth rate to a 1% standard deviation shock to government consumption expenditures and gross investment growth rates normalized in order to obtain a 1% increase in actual spending (1984:1-2010:4). MIX threshold variable. Monte Carlo 95% confidence bands obtained from the empirical distribution of simulated impulse responses assuming normality.

(a) "Tight" credit regime



(b) "Normal" credit regime

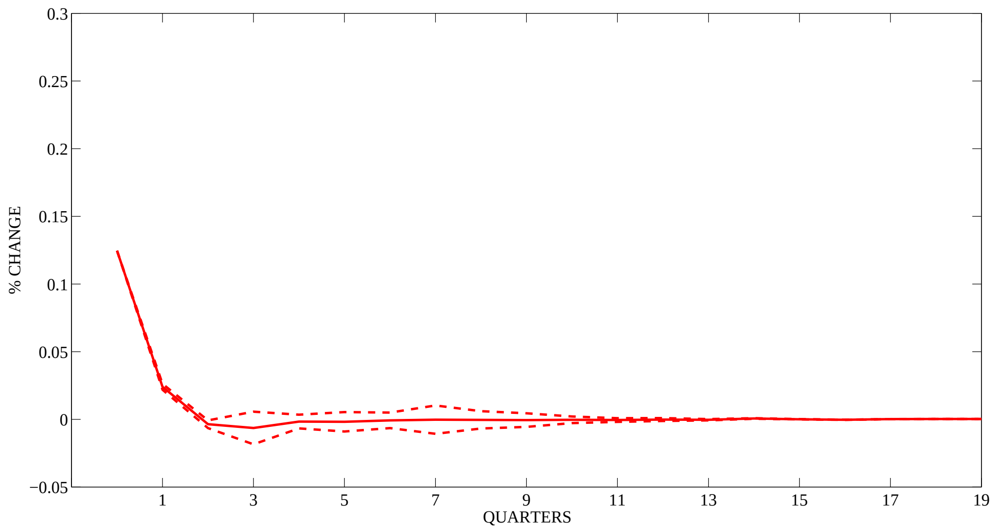
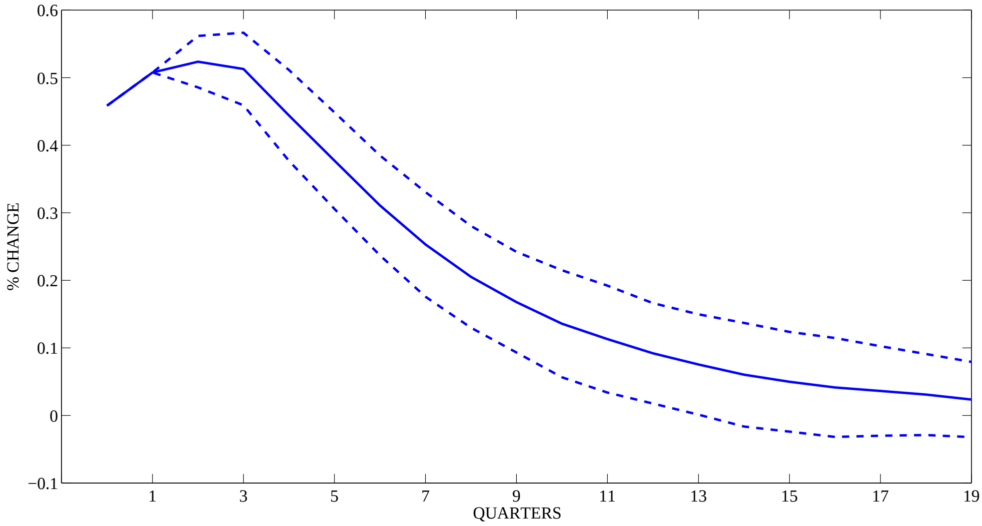


Figure 10: Generalized impulse response functions. Response of Output gap to a 1% standard deviation shock to government consumption expenditures and gross investment growth rates normalized in order to obtain a 1% increase in actual spending (1984:1-2010:4). BAA spread threshold variable. Monte Carlo 95% confidence bands obtained from the empirical distribution of simulated impulse responses assuming normality.

(a) "Tight" credit regime



(b) "Normal" credit regime

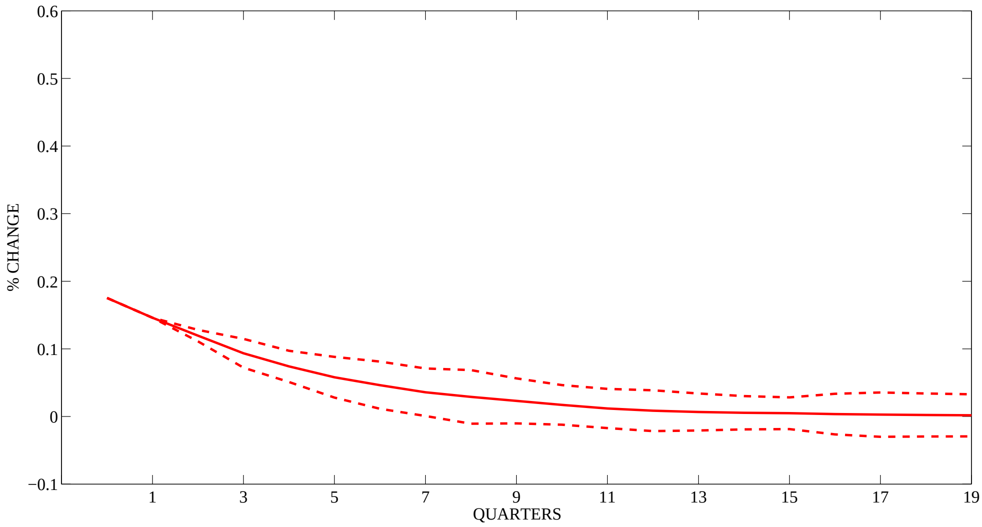
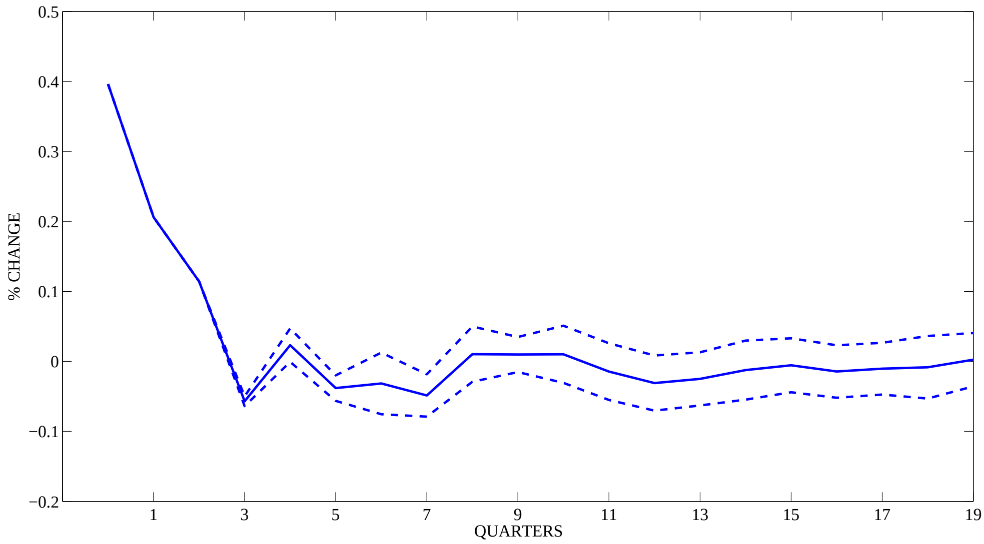


Figure 11: Generalized impulse response functions. Response of GDP growth rate to a 1% standard deviation shock to government consumption expenditures and gross investment growth rates normalized in order to obtain a 1% increase in actual spending (1961:1-2010:4). BAA spread threshold variable. Monte Carlo 95% confidence bands obtained from the empirical distribution of simulated impulse responses assuming normality.

(a) "Tight" credit regime



(b) "Normal" credit regime