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Fiscal developments and financial stress: a threshold VAR analysis

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Abstract We use a threshold VAR analysis to study the linkages between changes in the debt ratio, economic activity and financial stress within different financial regimes. We use quarterly data for the US, the UK, Germany and Italy, for the period 1980:4–2014:1, encompassing macro, fiscal and financial variables, and use nonlinear impulse responses allowing for endogenous regime-switches in response to structural shocks.

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The results show that output reacts mostly positively to an increase in the debt ratio in both financial stress regimes; however, the differences in estimated multipliers across regimes are relatively small. Furthermore, a financial stress shock has a negative effect on output and worsens the fiscal situation. The large time-variation and the estimated nonlinear impulse responses suggest that the size of the fiscal multipliers was higher than average in the 2008–2009 crisis.

1 Introduction

The financial crisis of the late 2000s and the Great Recession that followed revived the interest in estimation of fiscal multipliers and the differences of the effects of fiscal policy on overall economic activity in expansions and recessions. Notably, policy makers were interested in the expected effects of fiscal packages intended to stabilize the demand and the financial meltdown forced them to bailouts of financial institutions mainly in the banking sector. Both, fiscal stimulus and bailouts were at the cost of higher sovereign debt.

The simultaneous occurrence of severe financial instability and recession has been, however, not anything specific to the Great Recession. The historical evidence shows that economic downturns and higher stress on financial markets are related to each other relatively often (Cardarelli et al. 2011). In the periods of high financial stress, the share of non-performing loans increases and negative sentiments in the markets depress the value of other financial assets. Subsequently, the disruptions in financial markets or accumulated non-performing loans in balance sheets of banks may trigger a recession by reducing the credit flow to the other sectors. In such periods, countercyclical fiscal policy can compensate the decline in private sector demand via increased government spending or decreased taxes that could offset the effects of lower credit flows from a fragile financial sector. Also, government spending related to bailouts in the fragile financial sectors can change the economic sentiment and expectations and contribute to a revival in the economy. On the other hand, fiscal expansion can easily reach the limits of the available fiscal space; it can undermine the sovereign debt credibility and increase financial stress due to concerns about sustainability of the government debt.[1]

This paper assesses the effects of fiscal policy on economic activity under financial instability within a threshold VAR framework. More specifically we use quarterly data,

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[1] See for example Arghyrou (2014) for an attempt to provide an assessment of the sovereign debt crisis. The feedback from government debt to financial instability became relevant for numerous countries in the EU that were hit by the financial meltdown seriously like Ireland or Spain, countries with comparably low debt/GDP ratios before 2008. The channel how the perceived un-sustainability can worsen the outlook for the prospective GDP growth can be described as follows: when the debt sustainability is concerned, financial markets may refuse to buy new government debt or roll-over the old one, while transactions in the secondary market may also become less frequent. The inability to sell government bonds in the market reduces the liquidity of the debt and weakens the balance sheet of the banks and of other financial institutions that hold government debt.

for the USA, the U.K., Germany and Italy, for the period 1980:4–2014:1, encompassing macro, fiscal and financial variables. The regimes are determined by a measure representing financial instability, the Financial Stress Index (Cardarelli et al. 2011), that has a broad coverage across different sources of financial stress including excessive volatility on financial markets, indicators of stress in the banking sector or excessive volatility of the exchange rate. Due to the proximity of recessions to times of higher financial stress, the identified regimes are related to slowdowns in economic activity, but the information from the financial markets are readily available in the real time, while the indicators of economic activity are available with a delay. Additionally, the financial stress is included among the set of endogenous variables as well so that the change in financial stress can contribute to a shift from one regime to another.

Rather than utilizing specific instruments of fiscal policy, the overall stance of the fiscal policy is represented by changes in the government debt-to-GDP ratio. The debt ratio, or the overall debt itself, has been central in many policy discussions about bailouts, fiscal stimuli and consolidation efforts. Naturally, a broad variety of instruments has been used to achieve the intended outcomes with different multipliers corresponding to specific instruments but due to the relevance of the dynamics of the debt ratio it is relevant to focus on its effect as a whole.[2]

The fiscal multipliers are computed from estimated nonlinear impulse responses. The nonlinear impulse responses are derived as conditional forecasts at each period of time; hence, it is possible to study time-variance in responses to shocks not only across regimes, but also within regimes. This feature makes a threshold VAR a convenient alternative to time-varying VAR models: changes between regimes are often smooth. Moreover, it is possible to test whether nonlinearities are statistically significant and still having a forcing variable causing the time variation. Interpreting the nonlinear impulse responses in this way is another relevant contribution of our paper, as is the investigation of time variation within regimes.

Our results show that the use of a nonlinear framework with regime switches, determined by a financial stress indicator, is corroborated by nonlinearity tests. Therefore, we found support for the hypothesis that fiscal multipliers depend on the state of the economy defined by the presence of financial instability, although the differences in the estimated multipliers across financial regimes are relatively small in comparison with the related literature, such as the Auerbach and Gorodnichenko (2012), but the difference between the nonlinear impulse responses is significant mainly at the horizon of four quarters.

Additionally, we show that fiscal policy can attenuate financial stress. With respect to time variation of fiscal multipliers within regimes, we find that the size of the fiscal multipliers has been higher than average in the 2008–2009 crisis in most countries in our sample.

In terms of sensitivity analysis, we also used real debt and real government consumption and gross investment expenditures (GCE) as the relevant fiscal variables in the threshold VAR. Generally, the results for the real debt are pretty much equivalent to the baseline specification with the debt ratio. Higher multipliers, exceeding one in

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[2] The multipliers of specific instruments of fiscal policy are surveyed in Gerchert and Rannenberg (2014).

the high stress regime, are obtained when the real government consumption and gross investment expenditures is used as an alternative but narrower indicator of fiscal policy stance. This latter result points to the importance of selection of proper instruments of fiscal policy to deliver the intended policy outcome.

The paper is organized as follows. Section 2 reviews the literature. Section 3 explains the methodology. Section 4 conducts the empirical analysis, and Sect. 5 concludes.

2 Related literature

2.1 On the effects of fiscal policy

The empirical research on the effects of fiscal policy on macroeconomic aggregates faces a number of challenges. First, the identification of fiscal policy shocks needs to consider the fact that government expenditures and revenues partly automatically respond to fluctuations in economic activity, and these fluctuations need to be distinguished from deliberate policy changes. This problem is relevant especially in VAR-based studies where the different approaches to identification schemes in the VAR analysis lead to somewhat different results.[3]

The second challenge is the possibility that the size of fiscal multipliers may depend on the state of the economy. While in expansions characterized by low unemployment, high capacity utilization and high domestic and foreign demand, the effects of say a fiscal expansion can be rather weak or even negative, the situation can be markedly different in recessions and other times of weak demand. Such nonlinearity has important policy implications both for fiscal stimuli or efforts in fiscal consolidation.[4] For instance when investigating fiscal policy effects in special times, Barro and Redlick (2009) found that the fiscal multiplier can be high when the unemployment rate is over 12% (in the USA), while Christiano et al. (2011) claim that the fiscal multiplier could be up to 10 when the zero bound of interest rates is reached; and C. Romer and Burstein (2009) found that fiscal multiplier could be about three or larger in the 2009 in the USA.

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[3] An overview of the effectiveness of fiscal policy and evaluation of fiscal multipliers in several VAR models is provided in Van Brusselen (2010) and Hebous (2011). The role of the different identification schemes for the estimated multipliers has been investigated by Caldara and Kamps (2008), with alternative identifications: SVAR following Blanchard and Perotti (2002) and Perotti (2005); recursive identification scheme with Choleski decomposition; sign-restriction approach following Uhlig (2005) and Mountford and Uhlig (2009); narrative approach for the USA, along the lines of Ramey and Shapiro (1999). The results by Caldara and Kamps (2008) were supported by a meta-analysis of fiscal multipliers by Gechert and Will (2012).

[4] See, notably for fiscal consolidations, Alesina and Ardagna (1998), Afonso and Jalles (2014), and Afonso and Martins (2016). In particular, policy makers in Europe were strongly influenced by the hypothesis of expansionary fiscal consolidations. In addition, Giavazzi and Pagano (1990) pointed that the costs of the debt were so high that decreasing the debt via fiscal consolidation allowed rise of private consumption through improvements in expectations about taxation in the future. The so-called non-Keynesian effects dominated the discussion about the adequate response to the Great Recession in Europe following a contribution by Alesina (2010). However, the recent evidence shows that fiscal contractions are likely to be recessionary and the non-Keynesian effects are exceptional (see for example Guajardo et al. (2014).

Moreover, significant dependence of fiscal multipliers on the state of the economy was confirmed by Auerbach and Gorodnichenko (2012). Using a nonlinear VAR model, they documented sizeable differences in multipliers depending on economic growth in the USA. In recessions, the expenditure multipliers easily exceed a value of two while they remain below one in expansions. Using a nonlinear vector error correction model, Candelon and Lieb (2013) find multipliers exceeding one in recessions as well; however, the magnitudes are notably lower than in Auerbach and Gorodnichenko (2012). Higher multipliers in recessions were also reported in Baum et al. (2012), Batini et al. (2012), Mittnik and Semmler (2012) and others. On the contrary, Ramey and Zubairy (2014) while focusing on military expenditures did not find significantly different multipliers across states of the economy.

The empirical literature on state-dependent multipliers is substantially reviewed in a meta-analysis study by Gerchert and Rannenberg (2014). The authors concluded that the spending multiplier increases by 0.6–0.8 in downturns, while tax multipliers are not significantly different across regimes. Additionally, a broad overview of estimates for the European countries is done by Kilponen et al. (2015). Based on fifteen structural models used by the central banks in the EU, they evaluate the effects of fiscal consolidation under various scenarios and confirmed the qualitative findings of previous works: tightening government consumption has more pronounced negative effects in times of economic slack than in normal times, while the differences of consolidations focused on taxes are substantially smaller. Nevertheless, the results differ across countries and fiscal policy instruments.

Other empirical studies also provide a mixed view. For instance Baldacci et al. (2009) found that fiscal policy responses are significant for the duration of the crisis (OLS and truncated LOGIT). Furthermore, the composition of the adopted fiscal packages matters.

2.2 Fiscal policy and financial instability

Financial instability, in particular credit frictions but also other components of financial instability are sometimes considered as propagators of shocks that amplify output fluctuations and the effects of monetary policy on output (Kiyotaki and Moore 1997; Bernanke et al. 1996). For example, the Kiyotaki-Moore model of credit cycles assumes that business cycles fluctuations are amplified when credit markets are imperfect and borrowers cannot be forced to repay their debts. Hence, the lenders require capital as collateral, but in recessions the value of collateral decreases causing lower willingness to lend and borrow money that could be spent on investments. Therefore, output falls deeper in comparison with the baseline model without credit frictions.

These considerations were confirmed in empirical studies that have addressed the relevance of financial instability on propagation of monetary policy shocks, such as Balke (2000), Atanasova (2003), Li and St-Amant (2010) and Berkelmans (2005). For instance, Balke (2000) uses a threshold vector autoregression (TVAR), with credit conditions as a threshold variable for the USA, and reports that output responds more to monetary policy in a credit-rationed regime. Similarly, Atanasova (2003) analysed the impact of credit frictions on business cycles dynamics in the UK and her results broadly confirm the conclusions by Balke (2000).

Interestingly, several structural NK-DSGE models imply that the effects of fiscal policy are driven by financial stability as well. Several papers worthwhile mentioning include Fernandez-Villaverde (2010), Carrillo and Poilly (2013) or Kara and Sin (2012). All these studies found that fiscal multipliers are high under financial instability and constrained credit markets and the economic growth fostered by a fiscal stimulus is amplified by a fall in real interest rates and easier access to credits.

Nevertheless, the differences in the effects of fiscal policy in times of financial instability have not been widely studied so far. Baldacci et al. (2009) have found for 99 countries that fiscal policy expansion can shorten the duration of a financial crisis significantly and that the composition of the fiscal package is a key to success. On the contrary, Afonso et al. (2010) using a panel of OECD and non-OECD countries, for the period 1980–2007, did not reject the hypothesis that the effects of fiscal policy are essentially the same in the absence and during a financial crisis. Similarly, Bouthevillain and Dufrenot (2010), who used a Markov switching model with time-varying probabilities within a single-equation framework, have not found differences in the efficiency of fiscal policy in France.

Furthermore, Ferraresi et al. (2014) investigated state-dependent multipliers driven by financial conditions using a TVAR model on US quarterly data and found that the response of output to fiscal policy shocks is stronger and more persistent when the economy is in the 'tight' credit regime. According to Ferraresi et al. (2014), fiscal multipliers are significantly different in the two regimes: they are abundantly and persistently higher than one when firms face increasing financing costs, whereas they are feebler and often lower than one in the 'normal' credit regime.

3 Methodology

3.1 Threshold vector autoregression

The threshold VAR model approach used in this paper closely follows the approach used by Balke (2000) and Atanasova (2003) in their analysis of the state-dependent effects of monetary policy. We include a threshold variable in the fiscal VAR, for which we have chosen the financial stress index (FSI), introduced by the IMF (see Cardarelli et al. 2011) and modified by Balakrishnan et al. (2009).

The threshold VAR model has a number of interesting features that make it attractive for our purposes. First, it is a relatively simple way to capture possible nonlinearities such as asymmetric reactions to shocks or the existence of multiple equilibriums. Because the effects of the shocks are allowed to depend on the size and the sign of the shock, and also on the initial conditions, the impulse response functions are no longer linear, and it is possible to distinguish, for instance, between the effects of fiscal developments under different financial stress regimes.

Second, another advantage of the TVAR methodology is that the variable by which different regimes are defined can itself be an endogenous variable included in the VAR. Therefore, this makes it possible that regime switches may occur after the shock to each variable. In particular, the fiscal policy shock might either boost the output or increase the financial stress conditions that harm the prospects of economic growth, and the overall effect GDP of a fiscal expansion might became negative.

The threshold VAR can be specified as follows:

$$Y_t = A^1 Y_t + B^1(L)Y_{t-1} + (A^2 Y_t + B^2(L)Y_{t-1})I[s_{t-d} > \gamma] + U_t, \quad (1)$$

where Y_t is a vector of endogenous (stationary) variables, I is an indicator function that takes the value of 1 if, in our case, the financial stress is higher than the threshold value γ, and 0 otherwise. The time lag d was set to 1. $B^1(L)$ and $B^2(L)$ are lag polynomial matrices, $A^1 Y_t$ and $A^2 Y_t$ represent the contemporaneous terms, because contemporaneous effects might also differ across the regimes. U_t are structural disturbances. We assume that the matrices A^1 and A^2 have a recursive structure.

We have used a recursive identification scheme for the VAR and included the following variables: GDP growth (y), inflation (π), the fiscal variable (f), the short-term interest rate (i), and the indicator for financial market conditions (s), for which we will use the Financial Stress Indicator (FSI) presented in Sect. 4. The VAR model in standard form is

$$Y_t = c + \sum_{i=1}^{p} V_i Y_{t-i} + \varepsilon_t, \quad (2)$$

where Y_t denotes the (5×1) vector of the m endogenous variables given by $Y_t = [y_t \ \pi_t \ f_t \ i_t \ s_t]$, c is a (5×1) vector of intercept terms, V is the matrix of autoregressive coefficients of order (5×5), and ε_t is the vector of random disturbances.

This particular ordering reflects some assumptions about the links in the economy. We order the FSI last which implies that the FSI reacts contemporaneously to all variables in the system. We assume that all new changes in both macroeconomic aggregates and economic policy that occur during one quarter are transmitted to financial markets within this quarter. The ordering of the fiscal variable after output is motivated by the need to identify the effects of automatic stabilizers in the economy. Hence, following Blanchard and Perotti (2002), we assume that all reactions of fiscal policy within each quarter (e.g. changes in government debt) are purely automatic because of implementation lags of fiscal policy measures. The interest rate shows up after the fiscal variable since the short-term interest rate can react contemporaneously to fiscal policy, but not vice versa.[5]

3.2 Nonlinear impulse responses

In a linear model, the impulse responses can be derived directly from the estimated coefficients and the estimated responses are symmetric both in terms of the sign and of the size of the structural shocks. Furthermore, these impulse responses are constant over time as the covariance structure does not change. However, these convenient properties do not hold within the class of nonlinear models as shown by Potter (2000) and Koop et al. (1996). The moving average representation of the TVAR is nonlinear in the structural disturbances U_t, because some shocks may lead to switches between

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[5] The lag length of the endogenous variables, p, is determined by the Schwarz information criteria, which attaches a larger penalty to the number of coefficients estimated in the model; hence, we use only one or two lags given the low number of observations in the high stress regime.

regimes, and thus their Wold decomposition does not exist. Consequently, in contrast to linear models, we cannot construct the impulse responses as the paths the variables follow after an initial shock, assuming that no other shock hits the system. To cope with these issues, Koop et al. (1996) proposed nonlinear impulse response functions defined as the difference between the forecasted paths of variables with and without a shock to a variable of interest.

Formally, the nonlinear impulse responses functions (NIRF) are defined as

$$\text{NIRF}_y(k, \varepsilon_t, \Omega_{t-1}) = E(Y_{t+k}|\varepsilon_t, \Omega_{t-1}) - E(Y_{t+k}|\Omega_{t-1}), \tag{3}$$

where Y_{t+k} is a vector of variables at horizon k, Ω_{t-1} is the information set available before the time of shock t. This implies that there is no restriction regarding the symmetry of the shocks in terms of their sizes, because the effects of a ε_t shock depend on the magnitude of the current and subsequent shocks. Moreover, in the high stress regime, the size of the fiscal shock matters, since a small shock is less likely to induce a change in the regime. Likewise, the impulse responses depend also on the entire history of the variables that affect the persistence of the different regimes.

Therefore, in order to get the complete information about the dynamics of the model, the impulse responses have to be simulated for various sizes and for the signs of the shocks. The algorithm proceeds as follows. First, the shocks for the periods from 0 to q are drawn from the residuals of the estimated VAR model. Then, for each initial value that is, for each point of our sample, this sequence of shocks is fed through the model to produce forecasts conditional on initial conditions. These steps are repeated for the same initial condition and the same set of residuals except for the shock to the variable of interest, which is set to ± 1 standard error and ± 2 standard errors at time 0.

Second, we calculate the forecasts conditional on the shocks and on the initial conditions with and without an additional shock at $t = 0$, and the difference between these two is the impulse response function. This procedure is replicated 500-times for each initial condition and the median, average and quantiles are saved. Then we compute averages over the initial conditions from each regime to get the impulse responses for both regimes.[6]

Therefore, the threshold VAR combined with nonlinear impulse response functions has a number of appealing features for our analysis. Importantly, the threshold VAR allows to investigate both time-variance and state-dependence simultaneously, because the impulse responses do not depend only on each regime, but also on the length of the periods identified as tight-credit regimes and on the extend, how tight are conditions on the credit market in each regime. Hence, the threshold VAR with nonlinear impulse responses can be considered as an alternative to a time-varying parameter (TVP)-VAR that imposes a priori structure. Moreover, its potential benefit is that the results can be interpreted easily: the changes in impulse responses can be directly associated with a variable determining the threshold.

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[6] We used the WinRATS code provided by Nathan Balke, which we modified for our purposes.

4 Empirical analysis

4.1 Financial stress index as a switching variable

We use the financial stress index (FSI) developed by the IMF as an approximation to potential instability of financial markets and as a variable defining the two different states of the economy (Cardarelli et al. 2011, substantially revised by Balakrishnan et al. 2009). The FSI contains three main components: (i) Bank-related stress: beta of banking sector showing the perception of risk of the banking sector compared to other sectors in the economy, the TED spread (difference between the short-term interbank interest rate and treasury bills rate) and the inverted term structure, both indicating limited availability of credit and a flight to liquidity by lenders and investors. Then, (ii) the securities-related stress: corporate bond spread, negative stock market returns and stock-market volatility, pointing to a risk that uncertainty and deteriorating value of assets can have real effects due to possibility of deleveraging and deteriorating confidence in economic growth. The final component of the index is (iii) the Exchange rate stress represented by the exchange rate volatility that can increase uncertainty in the economy as well. The FSI index is then constructed as a sum of normalized values of all these sub-components. The larger value of the FSI, the higher is the stress during each period.[7] Plots of the FSI for each country are provided in "Appendix 2".

Cardarelli et al. (2011) describe the effects of the FSI and its sub-components on output. Based on their findings, the most important effects on output occur in the periods of financial stress connected with the banking sector. Additionally, the authors document relatively tight link between occurrence of high financial stress and recessions in advanced countries. Since 1980, more than 3/4 of recessions were preceded by a period of financial stress. Baxa et al. (2013) studied the reaction of central bank inflation targeting to financial stress using the augmented Taylor rule with time-varying coefficients. They found that these central banks normally do not react to financial stress; however, their behaviour changes in times of large and longer stress such as the Bank of England during the ERM crisis and the Great Recession, for example.

The size of the FSI that makes the effects of fiscal policy different is, however, unknown, and it is also a priori unclear, whether there is a significant difference between the two regimes at all.[8] Therefore the threshold value γ in (1) needs to be estimated. Since the parameter γ is not identified under the null hypothesis of no

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[7] Cardarelli et al. (2011) have shown that the components of the FSI are relatively uncorrelated and, importantly, adding different variable does not change the resulting path of the FSI significantly. Regarding the exchange rate component, we do not observe, for Germany and Italy, significant changes around the adoption of the euro in 1999. For Italy, some volatility can be seen after the exiting of the Italian Lira and of the British Pound from the European Exchange Rate Mechanism on September 1992. The version of the FSI in Cardarelli et al. (2011) is constructed by taking the average of the components after adjusting for the sample mean and standardizing by the sample standard deviation. Then, the index is rebased so that it ranges from 0 to 100. Episodes of high stress are identified as those periods when the FSI is more than one standard deviation above its trend determined by the Hodrick–Prescott filter.

[8] Balakrishnan et al. (2009) suggest the value of one for the FSI to distinguish the periods of high and low stress. Their judgment is based on the experience that such identification of stress periods mimics well the historical episodes of financial instability.

threshold, the testing procedure involves non-standard inference. Following Hansen (1986), we estimated the TVAR model for all possible values of γ (to avoid over-fitting, the possible values were set so that at least 20% of the observations plus the number of coefficients is included in each regime), and we stored the values of the Wald statistics testing the hypothesis of no difference between regimes. Second, we constructed three test statistics: sup-Wald, which is the maximum value of the Wald statistics over all possible γ. In order to conduct inference, we simulated the empirical distribution of sup-Wald statistics with p values obtained from 500 replications of the simulation procedure. The estimated thresholds were those that maximized the log determinant of the structural residuals U_t.

Because the observed persistence of the financial stress index is very low, when comparing to fluctuations of other macroeconomic variables, reasonable values of the threshold would have led to a segmentation of periods with high financial stress. Therefore, we have determined the threshold from the FSI smoothed 3-period moving average.[9] To increase the robustness of our analysis, the nonlinearity test proposed by Tsay (1998) was performed along with the sup Wald statistics. The nonlinearity tests confirm our hypothesis of significant differences across regimes that are determined by values of the FSI.[10] The estimated threshold values range from 0.996 for the UK to 1.222 for Italy, and the thresholds are always significant with a p value less than 0.0001 for the Sup-Wald statistics. The estimated thresholds for each country are reported in Table 1.

The threshold splits the sample into a high stress regime with about one-third of observations (from 34 to 45) and a low stress regime with the remaining part of the sample. Such division seems to be well in line with the fact that periods of financial tranquillity have longer duration than times of financial instability. It should be also noted that the identified periods of high stress are closely related to recessions. Table 2 lists both the stress periods and recessions for countries in our sample. The results of nonlinearity tests imply that almost all recessions in all countries have their counterpart among the high financial stress periods with the exception of the recessions of 2011 in the UK and Italy.[11] Also, the average output growth rates are lower in high stress periods than in low stress periods. Hence, the results of the nonlinearity tests point to the existence of a close link between financial instability, recessions and slowdowns in economic activity in line with the financial instability hypothesis that considers the financial instability as the main source of business cycle fluctuations (Minsky 1974). The recurrence of financial crises with significant costs and sharp recessions is also a central idea of Reinhart and Rogoff (2009).

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[9] The threshold variable shall be stationary to assure alternation of the regimes. Stationarity of both, the FSI and its moving average has been confirmed by the ADF test.

[10] Additionally, we performed tests also for other specifications of the models, in particular, for alternative fiscal variables (real debt, budget balance, government consumption) and different transformations of variables (first differences, annual differences). Overall, the significant nonlinearity has been confirmed in most of these tests, even for the UK with the Tsay test. Hence, we consider the nonlinearity as rather significant also for the UK where the p value of the Tsay test is the highest.

[11] One can conjecture that these results for Italy and the UK might reflect the fact that the slowdown in economic activity was driven by fiscal consolidation and not primarily by financial instability.

Table 1 Thresholds per country

| | Estimated threshold | Sup-Wald test | Tsay test | VAR order | Sample | No. of observations | |
						Low stress	High stress
United States	1.0866	96.67 (0.000)	53.04 (0.006)	1	1980Q4–2014Q1	89	42
United Kingdom	0.9961	120.00 (0.000)	40.23 (0.100)	1	1981Q1–2014Q1	98	34
Germany	1.1424	87.85 (0.000)	44.11 (0.046)	1	1980Q4–2014Q1	86	45
Italy	1.2221	88.04 (0.000)	66.40 (0.000)	1	1980Q4–2014Q1	97	35

Table 2 High financial stress and recessions *Source*: NBER, US business cycle expansions and contractions, http://www.nber.org/cycles/cyclesmain.html. CEPR, Euro Area Business Cycle Dating Committee, http://www.cepr.org/data/dating/. Economic Cycle Research Institute (ECRI) www.businesscycle.com. 1/ identified using the estimated thresholds

High stress 1/		NBER recessions			Annual output growth rates	
		Peak	Trough		High stress	Low stress
US						
1981Q3	1983Q2	1981Q3	1982Q4	Average	1.28	3.15
1986Q3	1986Q4			Min	−4.15	−0.07
1987Q2	1988Q3			Max	4.68	8.20
1989Q4	1991Q3	1990Q3	1991Q1	SD	2.61	1.53
1999Q1	1999Q4					
2000Q3	2001Q3	2001Q1	2001Q4			
2008Q2	2010Q1	2007Q4	2009Q2			
2012Q2						

High stress 1/		ECRI recessions			Annual output growth rates	
		Peak	Trough		High stress	Low stress
UK						
1982Q2	1982Q3			Average	1.00	2.79
1985Q4	1986Q1			Min	−6.11	−0.19
1988Q1	1988Q4			Max	6.96	6.76
1989Q4	1991Q4	1990Q2	1992Q1	SD	3.13	1.17
1993Q1	1993Q3					
1999Q1	1999Q3					
2000Q4	2001Q1					
2008Q2	2010Q1	2008Q2	2010Q1			
		2010 Q3	2012Q1			
Germany						
1981Q4	1982Q3	1980Q1	1982Q4	Average	0.40	2.45
1991Q2	1993Q3	1991Q1	1994Q2	Min	−7.05	−0.98
1999Q1	1999Q3			Max	6.35	7.27
2001Q2	2002Q2	2001Q1	2003Q3	SD	2.60	1.58
2003Q1	2003Q4					
2008Q2	2010Q1	2008Q2	2009Q1			
2011Q1	2014Q1					

Table 2 continued

High stress 1/		ECRI recessions			Annual output growth rates	
		Peak	Trough		High stress	Low stress
Italy						
1981Q4	1983Q4	1980Q2	1983Q2	Average	0.38	1.47
1986Q3	1988Q4			Min	−7.36	−3.18
1992Q4	1994Q1	1992Q1	1993Q4	Max	4.61	4.20
1998Q3	1999Q1			SD	2.97	1.67
2008Q2	2009Q4	2007Q3	2009Q1			
		2011Q2				
Per memory						

	CEPR recessions	
	Peak	Trough
Euro area		
	1974Q3	1975Q1
	1980Q1	1982Q3
	1992Q1	1993Q3
	2008Q1	2009Q2
	2011Q3	2013Q1

4.2 Variables and data

We use quarterly data for estimation of the threshold VAR model for the period 1980:4–2014:1. The length of the sample has been determined by the data availability of the financial stress index that is available since start of the 1980s. Other variables that enter the model are the annual differences of the log of GDP and price level, the fiscal variable, short-term interest rate and the financial stress index.[12]

A relevant issue with fiscal VARs is the choice of the variables that describe fiscal developments. For example, a discretionary increase in government revenues may have a different macroeconomic impact depending on which taxes are increased (labour versus consumption taxes), depending on whether a tax rate or the tax bases are modified, etc. At the same time, if one is data restricted, it is not possible to build VAR models with an excessive number of endogenous variables to describe fiscal policy. This dilemma is particularly relevant for the threshold VAR model where the sample in the high stress regime barely exceeds 30 observations.

These considerations led us to choose the debt ratio (annual changes) as the baseline variable that represents fiscal policy behaviour. Sovereign debt reflects the developments both in government revenue and expenditure and, importantly, the level of the debt/GDP ratio was central to many policy discussions during the recent crisis. Both,

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[12] For details see "Appendix 1".

fiscal stimuli and bailouts of the banking sector were implemented to avoid even deeper depression but in exchange of increased sovereign debt to previously unprecedented levels. Consequently, many countries resorted to fiscal consolidation, e.g., the USA in 2011 after adoption of the Budget Control Act and the UK initiated fiscal consolidation in 2010. In the EU, many countries attempted to decrease their debt ratio systematically since the 1990s to meet the criteria of the Stability and Growth Pact. Limited success in reduction of the public debt and the sovereign debt crisis of 2009–2012 led many EU countries to even stronger fiscal consolidations. Hence, it is relevant to investigate the effects of changes in the debt-to-GDP ratio both on the economic activity and on financial stress.[13]

Moreover, the government debt ratio captures also government actions that may not be fully reflected in the budget balance (e.g. purchase of financial assets, recapitalization of banking sector, the calling of previously issued government guarantees or any stock-flow adjustments) and has thus, in principle, a wider coverage of government actions than the fiscal balance. Furthermore, the changes in the government debt ratio have an impact on the corporate sector expectations, consumption sentiment of households and on financial market conditions, since it provides information about not only the current fiscal policy but about past fiscal developments. In addition, the government debt ratio has a closer link to financial markets than the fiscal balance because it partly captures also the risk related to the refinancing of the outstanding stock of government debt while influencing interest rates.[14]

The choice of the debt-to-GDP ratio has two important benefits. First, the data for the public debt are available across countries on quarterly frequency for sufficiently long samples. Second, changes in the debt ratios are in the same units as changes in GDP, and following Barro and Redlick (2009) and Ramey and Zubairy (2014) we avoid the bias of converting the impulse responses to fiscal multipliers using sample averages. There are some concerns about potential endogeneity of the debt ratio since it can change not only due to a change of public debt but by a change in the GDP in denominator as well. We addressed this issue in our sensitivity analysis, where we re-estimated the model with changes in the real debt itself and for the USA with the government consumption and gross investment, also to explore the effects of individual components of fiscal policy as well.[15]

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[13] Other authors include just one variable representing fiscal policy in threshold VAR to save the degrees of freedom as well. For example, Ferraresi et al. (2014) consider the real government consumption and gross investment (GCE) and Ramey and Zubairy (2014) focuses on the effects of military expenditures.

[14] The change in the debt ratio and the budget balance ratio are rather correlated for the countries in our analysis.

[15] It can be also noted that extensive sensitivity tests have been performed also by Ramey and Zubairy (2014). They re-estimate their model with potential GDP in the denominator of the government spending variable finding that this change has little effects for the results.
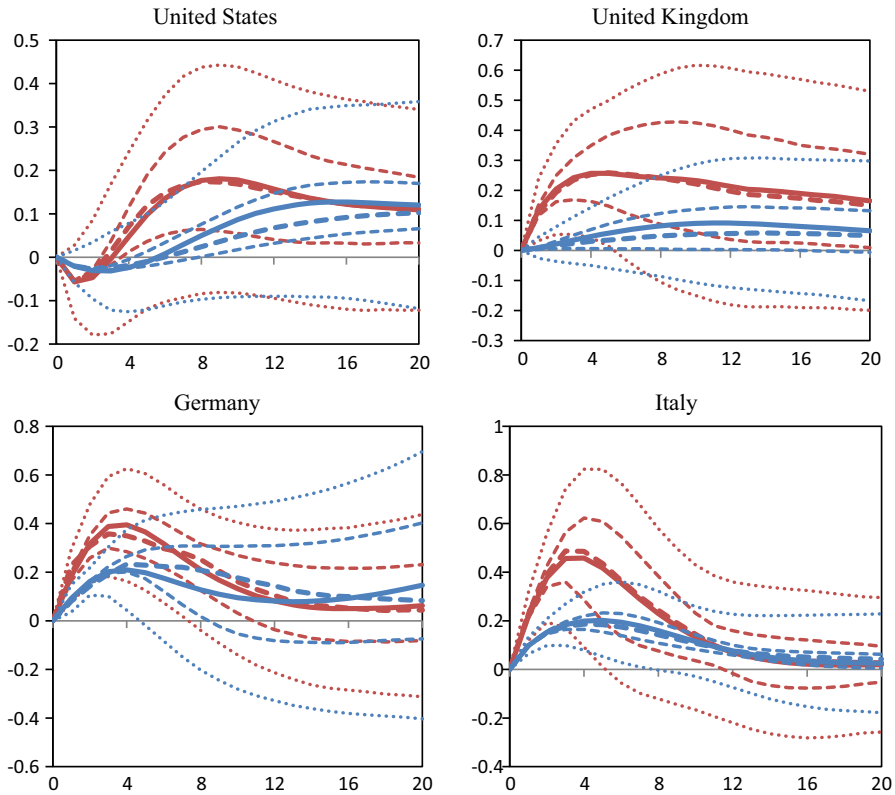
Fig. 1 Impact of fiscal shock on output growth. *Note*: High stress regime (*red*), Low stress regime (*blue*). *Solid line* mean, *thick dashed line* median. Confidence bands 16, 25, 75 and 84%. The impulse responses are rescaled to a fiscal shock of 1% of GDP. (Color figure online)

4.3 Results

4.3.1 The effects of fiscal policy

Overall, in response to a fiscal shock, output growth increases (Fig. 1). However, growth is larger in the regime characterized by higher financial stress than in periods of stability, although the magnitude of the impulse responses and of the difference across regimes is not unique across countries.[16] The rise in output growth is higher notably on the horizons up to 2 years after the shock when also the 50% confidence bands do not overlap. Also, the differences between the mean responses in the high and low regime are significantly different at the short-term horizons up to 1 or 2 years despite (Table 3).

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[16] Note that the impulse responses of output were divided by the initial size of the fiscal shock to normalize sizes of the shocks to 1% of GDP. The values of the impulse responses equal to $\Delta Y_{t+k}/\Delta D_t$ where t is time of shock and k horizon of the impulse response, thus correspond to multipliers at horizon k.

Table 3 Test of differences of impulse responses at selected horizons, p values

	4Q	8Q	12Q	16Q
United States	0.0361	0.0066	0.2323	0.3945
United Kingdom—High	0.0000	0.0172	0.0923	0.1132
Germany—High	0.0000	0.1090	0.3978	0.3296
Italy—Low	0.0003	0.2070	0.3931	0.3848

p values of the test of the H0: the differences between impulse response in the high and low stress regime is zero; t test used

Table 4 Multipliers at selected horizons

	4Q	8Q	12Q	16Q
United States—High	0.027	0.105	0.167	0.217
United States—Low	−0.013	0.011	0.052	0.097
United Kingdom—High	0.162	0.316	0.555	0.968
United Kingdom—Low	0.021	0.048	0.083	0.123
Germany—High	0.304	0.459	0.526	0.551
Germany—Low	0.140	0.193	0.215	0.235
Italy—High	0.601	1.187	1.356	1.317
Italy—Low	0.122	0.191	0.233	0.268

The peaks of impulse responses are highest in Germany and Italy, countries with least flexible exchange rate regime in our sample, while the effects of fiscal policy are weakest for the USA. Furthermore, we calculated the cumulative multipliers by dividing the cumulative responses of output by the cumulative response of the debt ratio. The multipliers are presented in Table 4.

With respect to the results in the related literature, the US multipliers are lower than what has been reported by Auerbach and Gorodnichenko (2012), Ferraresi et al. (2014) and the differences across regimes are smaller. The relatively low multipliers do have more causes. First, our sample is constrained on a period starting in the early 1980s when fiscal policy has been rarely used as a primary instrument for stabilizing the economy. In fact, monetary policy was more prevalent both in the disinflation of 1980s and expansionary policies followed several periods of financial stress of the 1990s. With the exception of the early 2000s recession and the Great Recession, policy makers repeatedly attempted to decrease government debt by means of gradual fiscal consolidations rather than stimulating the economy by means of fiscal expansion (see Auerbach 2009 for more detailed analysis on evolving policy perspectives).

Consequently, lower fiscal multipliers on this sample are in line with the narrative evidence and supported also by the empirical findings in Perotti (2005), Muscatelli et al. (2002) and Gechert and Will (2012). Most of the papers on the USA usually utilize samples that cover also the period of fiscal activism of the 1950s and 1960s, for example the sample by Auerbach and Gorodnichenko (2012) starts in 1950s and Ramey and Zubairy (2014) base their estimates on a dataset going back to the late nineteenth century.
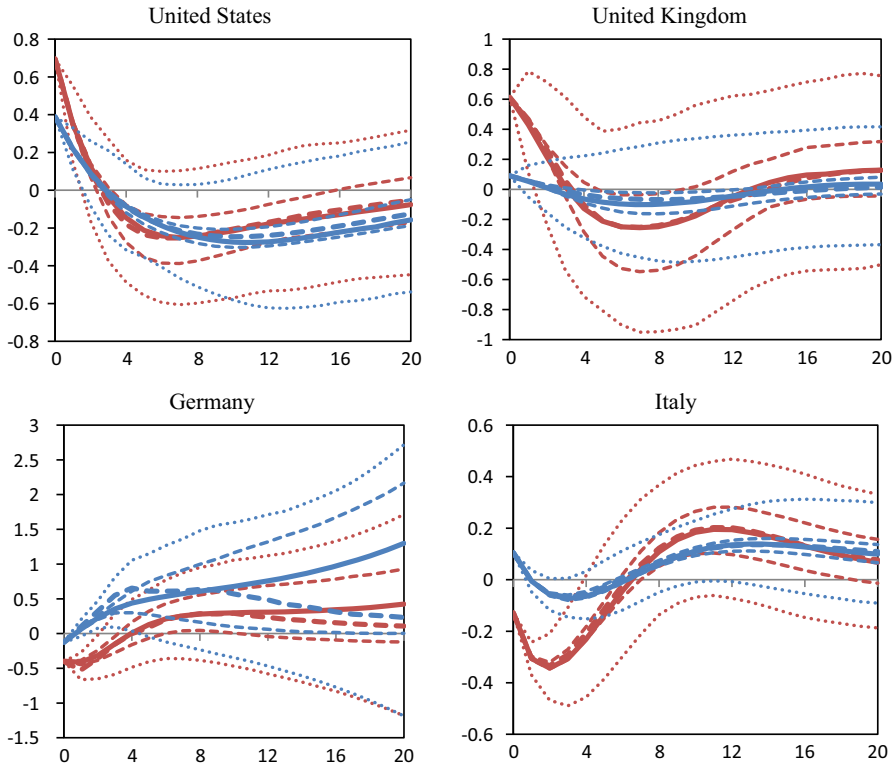
Fig. 2 Impact of fiscal shock on FSI. *Note*: High stress regime (*blue*), low stress regime (*red*). *Solid line* mean, *thick dashed line* median. Confidence bands 16, 25, 75 and 84%. The impulse responses are rescaled to a fiscal shock of 1% of GDP. (Color figure online)

Second, Ferraresi et al. (2014) in a study comparable to ours also rely on a sample starting in 1980s; however, they represent fiscal policy by real government consumption and investment. On the contrary, the debt ratio is a very broad representative of fiscal policy actions that covers instruments of fiscal policy that are known to have both high and low multipliers (military spending and tax cuts vs. government investment and transfers to low income households can serve as examples of fiscal instruments known to have diverse multipliers). We will describe the role of different fiscal instruments later.

The reaction of financial stress to a fiscal shock is more diverse across countries (Fig. 2). In the USA and in the UK, the fiscal shock leads to temporarily higher financial stress replaced by its moderate but persistent decrease after 3-4 quarters after the shock. On the other hand, in Germany and Italy, the financial stress immediately decreases after the shock, notably in the high stress regime, but then moderately increases.

Interestingly, the increase of financial stress is higher in Germany than in Italy, mainly when focusing on the low stress regime and the mean responses. The detailed investigation of simulated impulse responses reveals that this result is mainly driven

by the late 1990s characterized by a relatively fast rising debt ratio. Still, in the high stress regime, we do not document any sharp increase in financial stress implying that expansionary fiscal policy can cause rising financial stress. This finding suggests that the countries in our analysis were believed either to have sound public finances or to be able to cope with temporarily increased sovereign indebtedness in the future to secure sustainability of their public debt.

4.3.2 The effects of financial stress shocks

The shock in financial stress causes decreasing output growth and rising debt as shown respectively in Figs. 3 and 4. The drop in output growth is quite general across countries and regimes, although the fall in the growth rates is more pronounced and significant at 1 SD (one standard deviation) in the high stress regime (except the UK). On the other hand, when the shock in financial stress occurs in the low stress regime, its effects are weaker or even not significantly negative as in the case of Italy. Such responses point to the fact that not all increases in financial stress in low stress regime lead necessarily
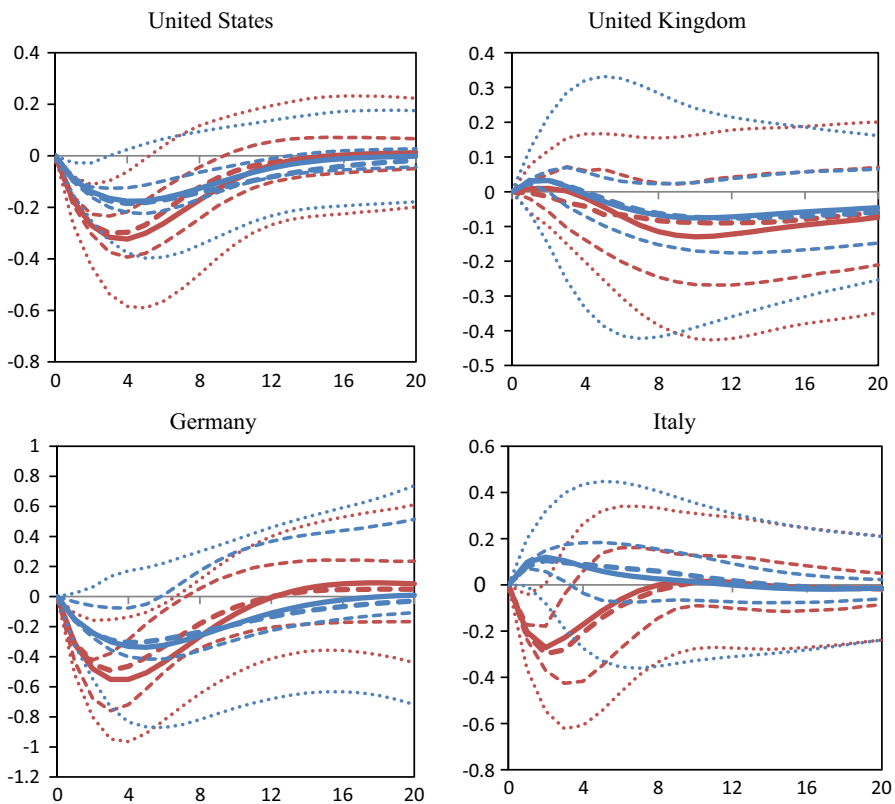

Fig. 3 Impact of a shock in financial stress on output growth. *Note*: High stress regime (*red*), low stress regime (*blue*). *Solid line* mean, *thick dashed line* median. Confidence bands 16, 25, 75 and 84%. The impulse responses are rescaled to a financial stress shock of one unit. (Color figure online)
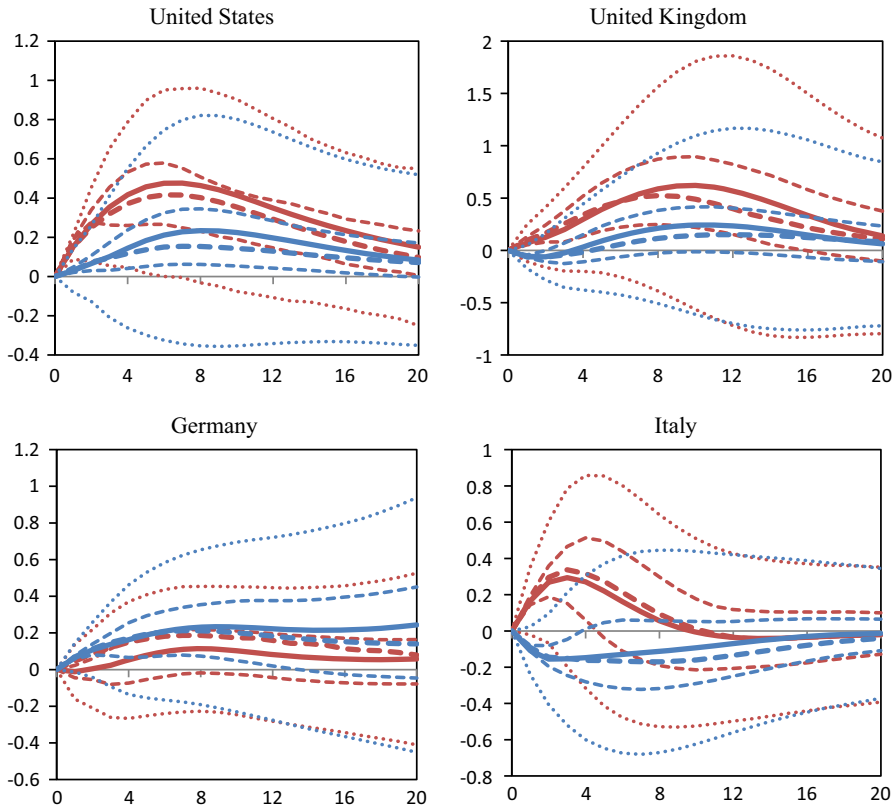
Fig. 4 Impact of financial stress shock on debt ratio. *Note*: High stress regime (*red*), low stress regime (*blue*). *Solid line* mean, *thick dashed line* median. Confidence bands 16, 25, 75 and 84%. The impulse responses are rescaled to a financial stress shock of one unit. (Color figure online)

to lower growth and do not cause a regime shift from the low stress regime to the high stress regime.

Similarly to the responses of output growth to changes in the debt ratio, the differences between the high and low stress regime are significant only on horizons up to four quarters, the UK with fairly identical response in both regimes is an exception.

Correspondingly, the debt ratio rises in response to a shock in financial stress and the increase is overall quite sharp when the shock occurs in a period characterized by a higher stress already, and only Germany is somewhat different. The median responses of the high and low stress regime overlap while the mean response of the debt ratio in the low stress regime is actually slightly higher than the response of the low stress regime. Again, we link this result mainly to rising debt of the 1990s due to the costs of German unification.[17]

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[17] Although we have cleaned the data for the impact of German unification on the level of GDP and for the transfer of the debt of social institutions of the former GDR to the federal debt in the mid of 1990s,

The response of output is negative, and the deterioration of economic growth is significant in all countries but the UK. The low stress regime provides a less clear-cut conclusion. While the response is negative in the USA and in Germany, in Italy and in the UK, the response of output is insignificant and somewhat positive in few periods after the shock to financial stress. These results point to the fact that not all increases in financial stress in low stress regime lead necessarily to lower growth and do not cause a regime shift from the low stress regime to the high stress regime.

The effects of financial stress on output growth and on the debt ratio are quite in line with our expectations: the correlation between periods of financial stress and recessions has been demonstrated previously in our study (similar findings can be found in Cardarelli et al. 2011).

Furthermore, the rise in the debt ratio is also unsurprising. When the financial conditions deteriorate, the same happens to economic activity and automatic stabilizers start working, which leads to budget deficits and moderate rises in the debt ratio. On top of that, Reinhart and Rogoff (2009) find a close link between financial instability and public debt using historical evidence of periods of financial crises in the past, caused by bailouts of financial institutions to avoid panic and deeper recession.

The sizes of the impulse responses do not look dramatic at first sight—an increase of the debt ratio by 0.5% of GDP is not much. Nevertheless, we shall consider the fact that in the financial crisis preceding the Great Recession the financial stress index rose by 18 points in the USA, by 17 points in the UK, by 13 points in Germany while in Italy, the increase was relatively moderate by 6.5 points.[18] Hence, we conclude that the financial stress leads to substantial deterioration of fiscal position.

4.3.3 On the time variation of the responses

The impulse responses in Figs. 1, 2, 3 and 4 were derived as moments estimated from nonlinear impulse responses simulated for each observation in our sample. The fact that the impulse responses are simulated for each observation allows us to perform a more detailed analysis of the interactions of fiscal policy, output growth and financial stress. In particular, we can investigate the evolution of impulse responses not only across regimes but also over time.

The evolution of nonlinear impulse responses of output growth to fiscal shocks is presented via 3D plots in Fig. 5. It can be seen that the responses vary not only across regimes but also within each regime, depending on the history utilized in simulations.

For example, we can observe that in the USA the responses associated with the high stress regime were substantially higher in the 2000s than in the 1980s. On the other hand, following the adoption of the Budget Control Act in 2011, the multipli-

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Footnote 17 continued

there were numerous other large spending programs in the former GDR financed either through new taxes or deficits. These expenditures include: costs of privatization, social benefits, investment into infrastructure etc.

[18] When we multiply the size of the rise in FSI in the Great Recession by a size of the peak of the impulse response of debt ratio to a shock in financial stress, we obtain the following increases of the debt ratio: USA 8.7% of GDP, UK 10.7% of GDP, Germany 1.5% of GDP, Italy 2% of GDP. With the simulated impulse responses for the year 2000, the increase in the debt ratio is about twice as large.

Fig. 5 Impact of fiscal shock on output growth: simulated impulse responses over time. **a** United States, **b** United Kingdom, **c** Germany, **d** Italy
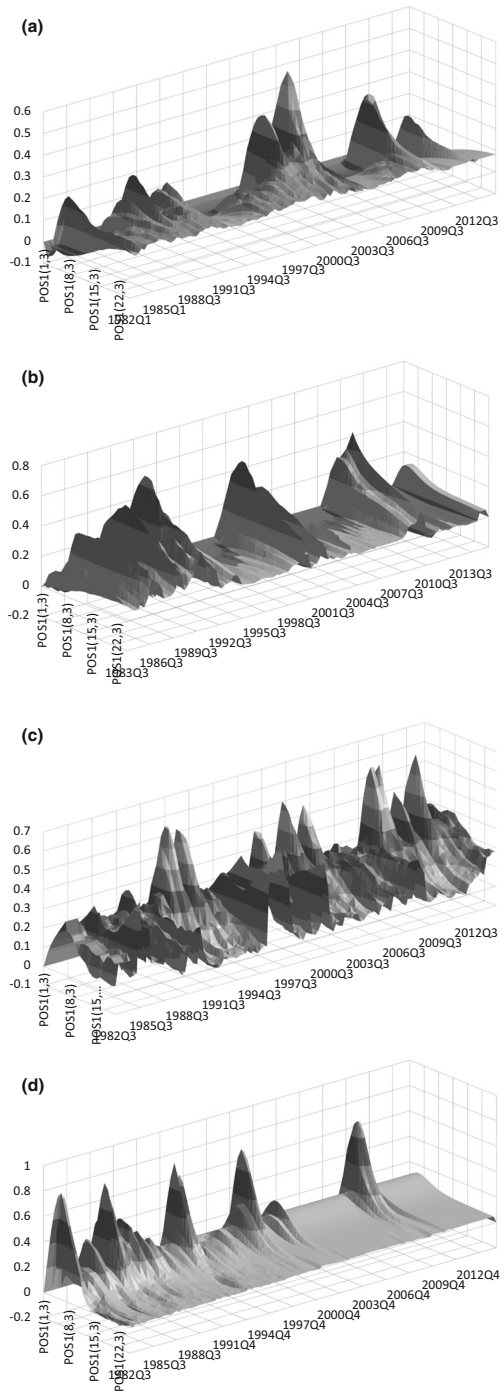
ers decreased again. Also in other countries time variation within regime is visible, although it is relatively hard to derive any clear-cut tendency in their evolutions.

Consequently, the multipliers for the period of the Great Recession were calculated (Table 4). The multipliers show that in the USA and in Germany, the multipliers were about twice so high in the Great Recession than the average across the high stress regime, in Italy remained roughly the same and in the UK, the multipliers were actually somewhat smaller in the Great Recession.

4.3.4 Sensitivity analysis

Finally, we investigated to what extent our results are driven by the choice of changes in the debt ratio as the main variable capturing fiscal developments. Most of the sensitivity tests were performed for the USA and we considered changes in the real debt to check, whether the results will change when the fiscal variable is converted to the same units as a change in the output after the estimation. Next, we compared our baseline results to the model with variables in first differences.

Lastly, to explore the role of different fiscal measures in the threshold VAR model, we have chosen the real government consumption and gross investment expenditures (GCE), thus fiscal instruments with a more specific coverage than the debt ratio. Since government consumption and expenditures are in principle part of national accounts and are not prone to endogenous reactions to output such as tax revenues or unemployment benefits are, we ordered GCE prior to output. The lag length has been determined by the BIC, and the threshold value was set to the same value as in our baseline exercise.[19]

The resulting impulse responses are presented in Fig. 6 and the relevant multipliers in Table 5. In general, the results for the real debt are pretty much equivalent to the baseline specification, but the differences across regimes are moderately lower. The model with variables in the first differences indicates very small and negative values of multipliers in most horizons, although the impulse responses become positive after a few quarters after the shock. Still, the model reveals higher multiplier in the Great Recession than average with a value of 0.3 at the horizon of 16 quarters after the shock.

The use of the GCE as the main instrument of fiscal policy in the threshold VAR model ends up with high impact and cumulative multipliers in the high stress regime that range from 1.4 to 2.5 depending on the horizon, while the multipliers in the low stress regime are slightly above 0.5. These results confirm our expectations that narrower measures of fiscal policy, in particular among expenditures, can have significantly higher effect on output than the debt ratio.

Then, we estimated the threshold VAR models also for other countries in the sample with changes in the real debt instead of the debt ratio. The results are summarized in Fig. 7 and Table 6. Resulting impulse responses confirm our previous results with generally positive responses of output to changes in the real debt and with somewhat

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[19] The BIC selects 1 lag for models with y-o-y changes and 2 lags for the model in first differences. We also tested whether the nonlinearity is significant in these models, and the nonlinearity has been supported by the tests again. The multipliers were retrieved from the impulse responses via multiplication by the average GDP/debt and GDP/GCE ratio.
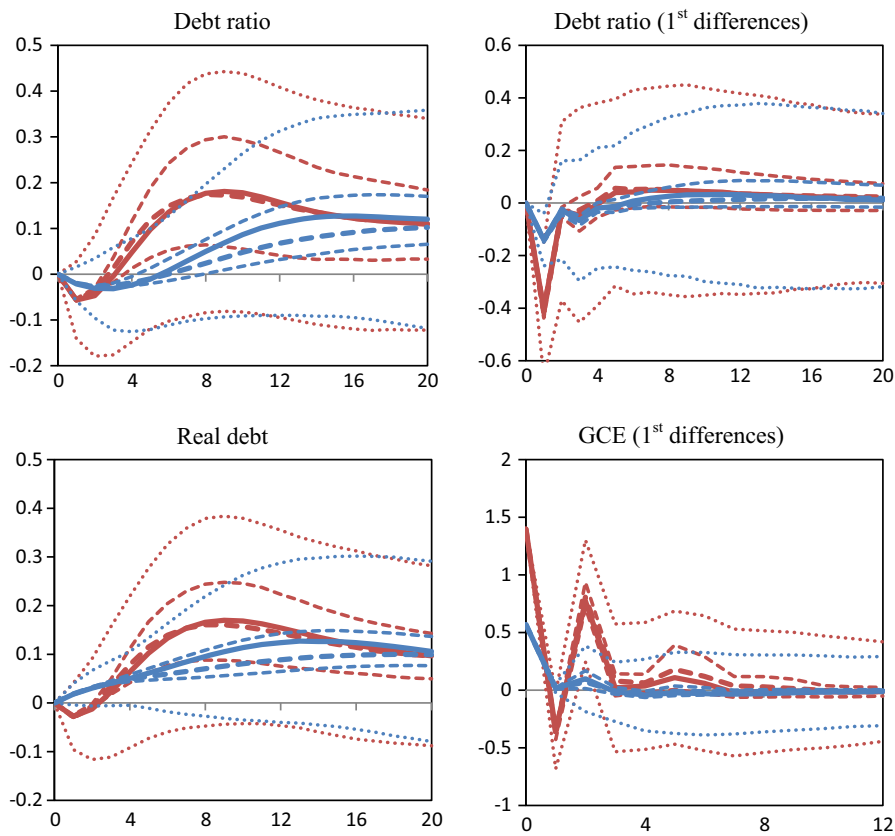
Fig. 6 Sensitivity analysis: United States response of output growth. *Note*: High stress regime (*red*), low stress regime (*blue*). *Solid line* mean, *thick dashed line* median. Confidence bands 16, 25, 75 and 84%. The impulse responses are rescaled to a fiscal shock of 1% of GDP. GCE: government consumption and gross investment, ordering GCE, output growth, inflation, interest rate, FSI. (Color figure online)

Table 5 Multipliers in the great recession

	4Q	8Q	12Q	16Q
United States	0.129	0.305	0.415	0.501
United Kingdom	0.202	0.329	0.464	0.638
Germany	0.570	0.994	1.246	1.359
Italy	0.753	1.134	1.133	1.495

Germany 2008:2–2009:1, United States 2007:4 –2009:2, United Kingdom 2008:2–2009:4, Italy 2007:3–2009:1. The time period follows the ECRI turning points chronology available at the www.businesscycle.com (July 2015 edition)
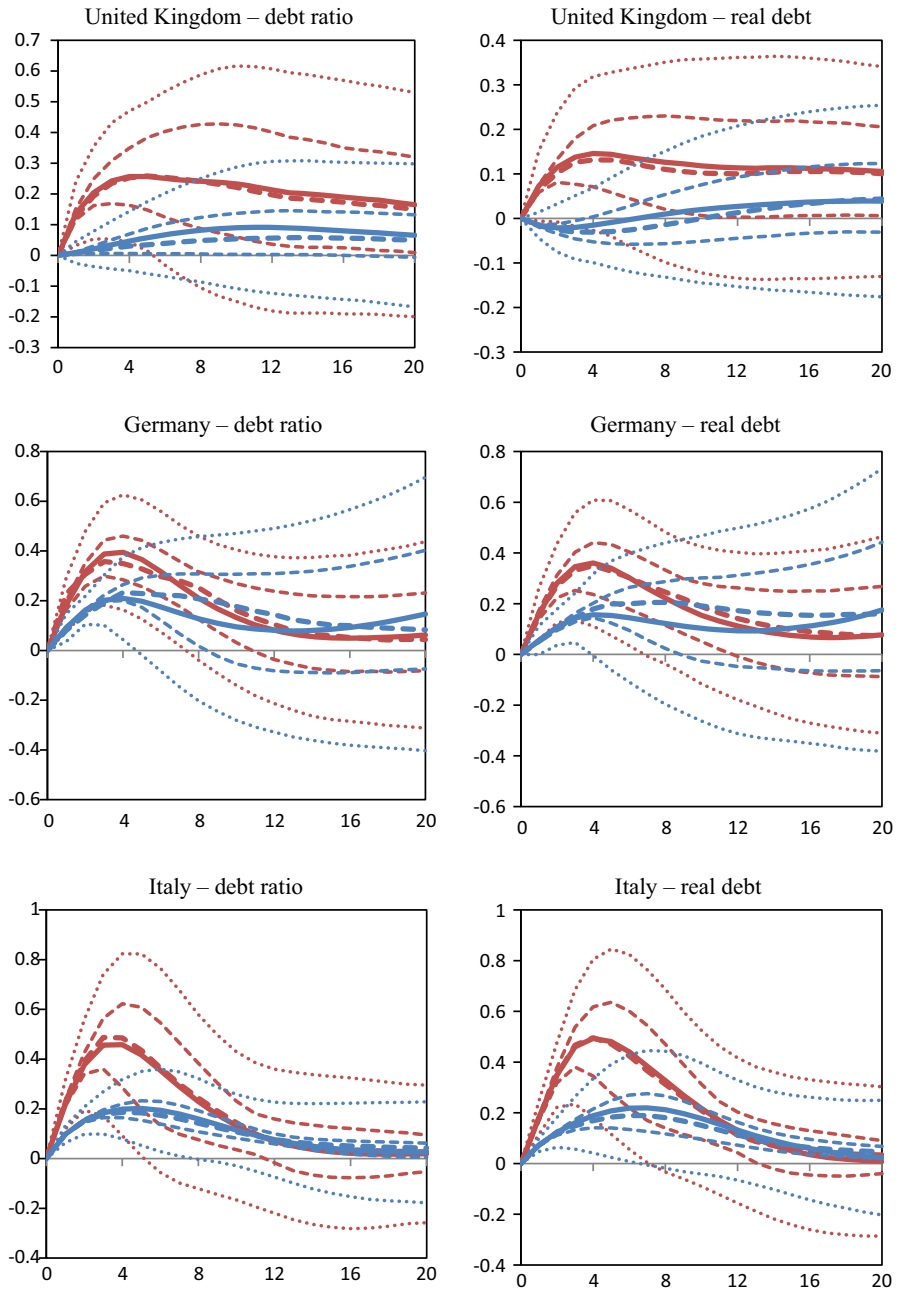
Fig. 7 Sensitivity analysis: United Kingdom, Germany, Italy: response of output growth. *Note*: High stress regime (*red*), low stress regime (*blue*). *Solid line* mean, *thick dashed line* median. Confidence bands 16, 25, 75 and 84%. The impulse responses are rescaled to a fiscal shock of 1% of GDP. (Color figure online)

Table 6 United States: alternative fiscal variables

	Impact	4Q	8 Q	1 2Q	1 6Q
Debt ratio—High (baseline)	0.0	0.027	0.105	0.167	0.217
Debt ratio—Low (baseline)	0.0	−0.013	0.011	0.052	0.097
Real debt—High	0.0	0.036	0.103	0.157	0.201
Real debt—Low	0.0	0.029	0.067	0.110	0.154
Debt ratio (1st diff)–High	0.0	−0.581	−0.240	−0.078	0.018
Debt ratio (1st diff)–Low	0.0	−0.355	−0.269	−0.191	−0.125
GCE–High	1.397	1.806	2.392	2.541	2.514
GCE–Low	0.568	0.618	0.572	0.541	0.517

Significant differences between impulse responses at given horizons and at 5% were the following: Debt ratio, 4Q, 8Q, real debt 4Q, (8Q at 10%), GCE at impact

Table 7 Multipliers at selected horizons, real debt

	4Q	8Q	12Q	16Q
United Kingdom—High	0.108	0.177	0.245	0.342
United Kingdom—Low	−0.026	−0.034	−0.028	−0.011
Germany—High	0.311	0.452	0.504	0.514
Germany—Low	0.112	0.201	0.257	0.287
Italy—High	0.370	0.591	0.693	0.715
Italy—Low	0.133	0.233	0.291	0.313

Significant differences between impulse responses at given horizons were the following: UK 4Q, 8Q; Germany 4Q, Italy 4Q

stronger response in the high stress regime. The corresponding multipliers are lower in comparison with those derived from a model with the debt ratio.[20]

5 Conclusion

In this paper we analysed the interactions between fiscal policy, output growth and financial stress within a framework of a threshold VAR model on a panel of four countries: the USA, the UK, Germany and Italy. The model has two distinct regimes, and, in contrast to other papers (Auerbach and Gorodnichenko 2012; Baum et al. 2012, among others), the regimes are determined by conditions on financial markets represented by a composite index of financial stress (Cardarelli et al. 2011. The financial stress index is also included among the endogenous variables; hence, the regime switching is endogenous in our model because the regime shifts are driven by a variable affected by other variables within VAR as well.

To track the stance of the fiscal policy, we use changes in the debt-to-GDP ratio in our model. Both levels of debt and the ratio of the debt to GDP were central to many policy discussions in the past either when the decisions about bailout of any financial institution, fiscal stimulus or fiscal consolidation were made. Therefore, the analysis encompassing the debt ratio rather than narrower specific variables of fiscal policy,

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[20] There are, unfortunately, no equivalent data to the GCE series also for other countries in our sample that would be available for a sample from the 1980s and on quarterly frequency Table 7.

can help to shed light on a question whether it is worth to increase the debt ratio in bad times to finance a variety of policies or not.

We show that the nonlinear framework determined by the financial stress is corroborated by formal statistical tests (Hansen 1996; Tsay 1998). Additionally, the estimated thresholds split the sample in a way that the recessions have their counterparts in the periods of financial stress, pointing to the fact that majority of the recessions in the recent decades were closely related, if not directly caused, to severe financial stress. In this respect, our empirical analysis is close to ideas by Minsky (1974) and Reinhart and Rogoff (2009).

Moreover, our results imply that an increase in financial stress causes decreasing output growth and rise in the debt/GDP ratio and these effects are stronger when the economy is already in the high stress regime.

With respect to fiscal policy, we show that the increases in the debt ratio have positive impact on output growth, notably in the high stress regime. The resulting multipliers rarely exceed unity even in the high stress regime and in particular for the USA, the multipliers are lower than for example in Auerbach and Gorodnichenko (2012) or Ferraresi et al. (2014). Still, our results provide useful complementary evidence on the positive effects of deficit-financed fiscal policy on output growth in periods of financial stress or slowdowns in general.

Importantly, our findings point to the relevance of financial variables for policy makers as it demonstrates that the timely and readily available information from the financial markets can be relevant for policy decisions. Although the financial variables are believed to be noisy, proper combination of indicators of financial conditions that may include various spreads, slope of the term structure or indicators of negative sentiments on financial markets can mitigate the risk of false signals and bring the information about the state of the economy when the output growth and output gap are uncertain.

Appendix 1: Data description and sources

Variables in threshold VAR

y_t GDP, annual growth rate of the log of the real GDP (Y) used: $y_t = log(Y_t) - log(Y_{t-4})$.
p_t Price level (P), annual growth rate of logs used: $p_t = log(P_t) - log(P_{t-4})$.
i_t Short-term interest rate.
f_t Annual change in the debt to GDP ratio: $f_t = D_t - D_{t-4}$.
s_t Financial stress index.

Sources: IMF IFS, OECD, Bundesbank, Bank of England, Banca d'Italia, Federal Statistical Office in Germany.

Financial stress variables

FSI (sum of subsequent components).
Bank stress (normalized beta of stocks of banking sector + normalized TED spread + normalized inverted term structure).

Stock market stress (volatility of stocks + returns of stock + spread of corporate bonds, all normalized).

Exchange rate volatility.

Source: International Monetary Fund, DataStream.

Appendix 2: Financial stress index
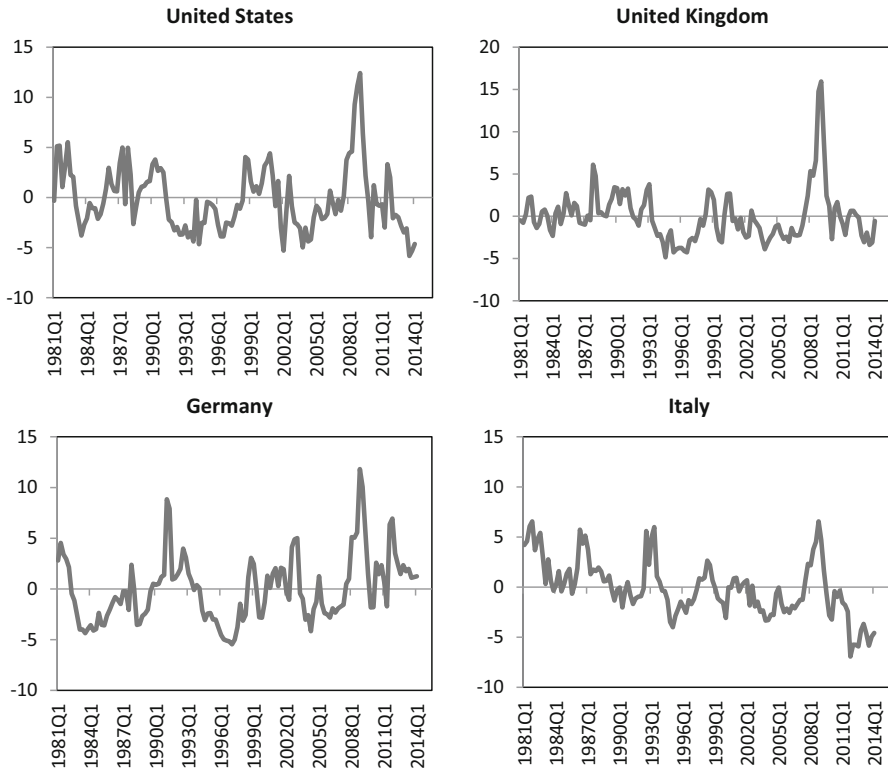
References

Afonso A, Gruner H, Kolerus C (2010) Fiscal policy and growth: Do financial crises make a difference? European Central Bank, working paper 1217

Afonso A, Jalles J (2014) Assessing fiscal episodes. Econ Model 37:255–270

Afonso A, Martins L (2016) Monetary developments and expansionary fiscal consolidations: evidence from the EMU. Int J Finance Econ 21:247–265

Alesina A, Ardagna S (1998) Tales of fiscal adjustments. Econ Policy 13(27):489–545

Alesina A (2010) Fiscal adjustments: lessons from recent history. In Ecofin meeting in Madrid (vol 15)

Arghyrou M (2014) Is Greece turning the corner? A theory-based assessment of recent Greek macro-policy, CESIfo WP 4995

Atanasova C (2003) Credit market imperfections and business cycle dynamics: a nonlinear approach. Stud Nonlinear Dyn Econom 7(4):1–22

Auerbach A (2009) Fiscal policy in recession. CESifo Forum, 2/2009, pp 3–8. https://www.cesifo-group.de/portal/pls/portal/docs/1/1191490.PDF

Auerbach A, Gorodnichenko Y (2012) Measuring the output responses to fiscal policy. Am Econ J Econ Policy 4(2):1–27

Balakrishnan R, Danninger S, Elekdag S, Tytell I (2009) The transmission of financial stress from advanced to emerging economies. IMF working paper, 09/133

Baldacci E, Gupta S, Mulas-Granados C (2009) How effective is fiscal policy response in systemic banking crises? IMF working paper, 09/160

Balke N (2000) Credit and economic activity: credit regimes and nonlinear propagation of shocks. Rev Econ Stat 82(2):344–349

Barro R, Redlick CJ (2009) Macroeconomic effects from government purchases and taxes. NBER working paper no. 15369

Batini N, Callegari G, Melina G (2012) Successful austerity in the United States, Europe and Japan. IMF working paper 12/190

Baum A, Poplawski-Ribeiro M, Weber A (2012) Fiscal multipliers and the state of the economy. IMF working paper 12/286

Baxa J, Horvath R, Vasicek B (2013) Time-varying monetary-policy rules and financial stress: does financial instability matter for monetary policy? J Financ Stab 9(1):117–138

Berkelmans L (2005) Credit and monetary policy: an Australian SVAR. RBA research discussion papers 2005–06, Reserve Bank of Australia

Bernanke B, Gertler M, Gilchrist S (1996) The financial accelerator and the flight to quality. Rev Econ Stat 78(1):1–15

Blanchard O, Perotti R (2002) An empirical characterization of the dynamic effects of changes in government spending and taxes on output. Quart J Econ 117(4):1329–1368

Bouthevillain C, Dufrenot G (2010) Fiscal multipliers in times of crisis and non-crisis: Are they different? The French case. mimeo, Banca d' Italia 12th public finances workshop on "fiscal policy: lessons from the crisis", Perugia, 25–27 March 2010

Caldara D, Kamps C (2008) What are the effects of fiscal shocks? A VAR-based comparative analysis. European Central Bank Working Paper 877

Candelon B, Lieb L (2013) Fiscal policy in good and bad times. J Econ Dyn Control 37(12):2679–2694

Cardarelli R, Elekdag S, Lall S (2011) Financial stress and economic contractions. J Financ Stab 7(2):78–97

Carrillo J, Poilly C (2013) How do financial frictions affect the spending multiplier during a liquidity trap? Rev Econ Dyn 16(2):296–311

Christiano L, Eichenbaum M, Rebelo S (2011) When is the government spending multiplier large? J Polit Econ 119(1):78–121

Fernandez-Villaverde J (2010) Fiscal policy in a model with financial frictions. Am Econ Rev 100(2):35–40

Ferraresi T, Roventini A, Fagiolo G (2014) Fiscal policies and credit regimes: a TVAR approach. J Appl Econom. doi:10.1002/jae.2420

Gechert S, Will H (2012) Fiscal multipliers: a meta regression analysis. IMK working paper (No. 97)

Gerchert S, Rannenberg A (2014) Are fiscal multipliers regime-dependent? A meta regression analysis. IMK working paper, No. 139

Giavazzi F, Pagano M (1990) Can severe fiscal contractions be expansionary? Tales of two small European countries. In: NBER macroeconomics annual 1990, Vol 5. MIT Press, pp 75–122

Guajardo J, Leigh D, Pescatori A (2014) Expansionary austerity? International evidence. J Eur Econ Assoc 12(4):949–968

Hansen B (1996) Inference when a nuisance parameter is not identified under the null hypothesis. Econometrica 64(2):413–430

Hebous S (2011) The effects of discretionary fiscal policy on macroeconomic aggregates: a reappraisal. J Econ Surv 25(4):674–707

Kara E, Sin J (2012) Fiscal multiplier in a credit-constrained new Keynesian economy (No. 12/634). Department of Economics, University of Bristol, Bristol

Kilponen J, Lozej M, Maria J, Pisani M, Schmidt S (2015) Comparing fiscal multipliers across models and countries in Europe. ECB working paper No. 1760

Kiyotaki N, Moore J (1997) Credit cycles. J Polit Econ 105(2):211–248

Koop G, Pesaran M, Potter S (1996) Impulse response analysis in nonlinear multivariate models. J Econom 74:119–148

Li F, St-Amant P (2010) Financial stress, monetary policy and economic activity. Bank of Canada Review, Autumn, 9–18

Minsky HP (1974) The modeling of financial instability: an introduction. Model Simul 5(1):267–272

Mittnik S, Semmler W (2012) Regime dependence of the fiscal multiplier. J Econ Behav Org 83(3):502–522

Mountford A, Uhlig H (2009) What are the effects of fiscal policy shocks? J Appl Econom 24(6):960–992

Muscatelli A, Tirelli P, Trecroci C (2002) Monetary and fiscal policy interactions over the cycle: some empirical evidence. CESifo working paper 817

Perotti R (2005) Estimating the effects of fiscal policy in OECD countries. CEPR discussion paper 4842

Potter SM (2000) Nonlinear impulse response functions. J Econ Dyn Control 24(10):1425–1446

Ramey V, Shapiro R (1999) Costly capital reallocation and the effects of government spending. NBER working paper 6283

Ramey V, Zubairy S (2014) Government spending multipliers in good times and in bad: evidence from U.S. historical data. NBER working paper no. 20719

Reinhart CM, Rogoff K (2009) This time is different: eight centuries of financial folly. Princeton University Press, Princeton

Romer C, Burstein (2009) The job impact of the American recovery and reinvestment plan". mimeo

Tsay RS (1998) Testing and modeling multivariate threshold models. J Am Stat Assoc 93(443):1188–1202

Uhlig H (2005) What are the effects of monetary policy on output? Results from an agnostic identification procedure. J Monet Econ 52(2):381–419

Van Brusselen P (2010) Fiscal stabilisation plans and the outlook for the world economy. mimeo, Banca d'Italia's 12th public finance workshop on "fiscal policy: lessons from the crisis", Perugia, 25–27 March, 2010