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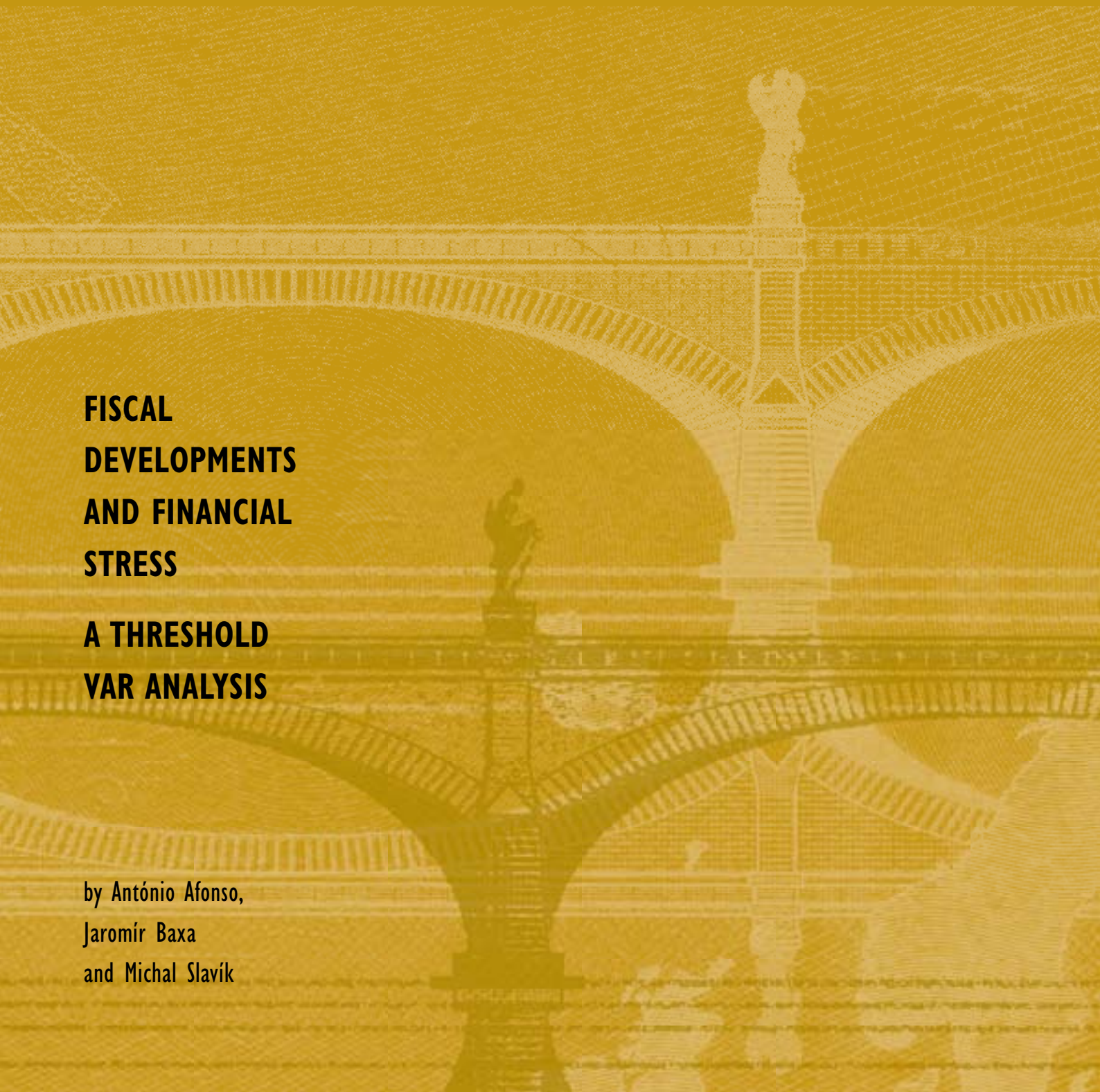

FISCAL DEVELOPMENTS AND FINANCIAL STRESS

A THRESHOLD VAR ANALYSIS

by António Afonso,
Jaromír Baxa
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In 2011 all ECB publications feature a motif taken from the €100 banknote.

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Macroprudential Research Network

This paper presents research conducted within the Macroprudential Research Network (MaRs). The network is composed of economists from the European System of Central Banks (ESCB), i.e. the 27 national central banks of the European Union (EU) and the European Central Bank. The objective of MaRs is to develop core conceptual frameworks, models and/or tools supporting macro-prudential supervision in the EU.

The research is carried out in three work streams:
1. Macro-financial models linking financial stability and the performance of the economy;
2. Early warning systems and systemic risk indicators;
3. Assessing contagion risks.

MaRs is chaired by Philipp Hartmann (ECB). Paolo Angelini (Banca d'Italia), Laurent Clerc (Banque de France), Carsten Detken (ECB) and Katerina Šmídková (Czech National Bank) are workstream coordinators. Xavier Freixas (Universitat Pompeu Fabra) acts as external consultant and Angela Maddaloni (ECB) as Secretary.

The refereeing process of this paper has been coordinated by a team composed of Cornelia Holthausen, Kalin Nikolov and Bernd Schwaab (all ECB).

The paper is released in order to make the research of MaRs generally available, in preliminary form, to encourage comments and suggestions prior to final publication. The views expressed in the paper are the ones of the author(s) and do not necessarily reflect those of the ECB or of the ESCB.

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CONTENTS

Abstract

We use a threshold VAR analysis to study whether the effects of fiscal policy on economic activity differ depending on financial market conditions. In particular, we investigate the possibility of a non-linear propagation of fiscal developments according to different financial market stress regimes. More specifically we employ a quarterly dataset, for the U.S., the U.K., Germany and Italy, for the period 1980:4-2009:4, encompassing macro, fiscal and financial variables. The results show that (i) the use of a nonlinear framework with regime switches is corroborated by nonlinearity tests; (ii) the responses of economic growth to a fiscal shock are mostly positive in both financial stress regimes; (iii) financial stress has a negative effect on output growth and worsens the fiscal position; (iv) the nonlinearity in the response of output growth to a fiscal shock is mainly associated with different behaviour across regimes; (v) the size of the fiscal multipliers is higher than average in the last crisis.

Keywords: fiscal policy, financial markets, threshold VAR.

JEL codes: E62, G15, H60.

Non-technical summary

During periods of economic downturn or stress in financial markets the effects of fiscal developments on economic activity might be different from what is usually observed in good or normal times. We can perceive "bad times" as periods of economic downturn or stress in financial markets. Evidence shows that economic downturns are often associated with periods of financial stress or even with financial crisis. During such periods, the quality of financial institutions' assets deteriorates, as the share of non-performing loans increases and negative sentiments in the markets depress the value of other financial assets. In some cases, the disruptions in financial markets or problems in the banks' balance sheets may trigger a recession by reducing the flow of credit to the other sectors. Therefore, it is important to assess the effects of fiscal developments and policies during the periods of market stress to check, whether there are some non-linearities at play and if the fiscal multipliers are different.

In this paper we contribute to the fiscally related vector autoregression (VAR) literature by estimating the effects of fiscal shocks using a threshold VAR approach (TVAR), including a measure representing financial instability, the Financial Stress Index. More specifically, we employ a quarterly dataset, for the US, the UK, Germany and Italy, for the period 1980:4-2009:4, encompassing macro, fiscal and financial variables.

The application of a nonlinear framework with regime switching was motivated by the lively debate on the ability of fiscal policy to shorten recessions and to facilitate a subsequent recovery. Furthermore, the identified periods of financial stress are also characterised by lower output growth and in a number of cases coincide with recessions.

The use of quarterly fiscal data is another relevant contribution in this context. Moreover, according to our knowledge there have been no attempts to investigate empirically the effects of fiscal developments associated with periods of financial crises within a multi-equation framework, which is the issue addressed in this paper.

Our analysis reveals several results worthwhile mentioning: (i) the use of a nonlinear framework with regime switches, determined by a financial stress indicator, is corroborated by nonlinearity tests; (ii) the responses of economic growth to a fiscal shock are mostly positive in both financial stress regimes; (iii) financial stress has a negative effect on output growth and it increases the government debt-to-GDP ratio; (iv) the nonlinearity in the response of output growth to a fiscal shock is mainly associated with different behaviour across regimes, while nonlinearities caused the by size and sign

of the shocks are small; (v) the size of the fiscal multipliers evolved over time and is higher than average during the most recent economic crisis in all countries, except in the United Kingdom.

Therefore, we have found evidence of nonlinearities in the effects of a fiscal shock on economic activity depending on the initial conditions, determined by the existence of financial stress, diverse levels of government indebtedness, and, of course implicitly assumed different monetary policy behaviour. In addition, both multipliers and the nature of these nonlinearities vary across countries and evolve over time.

1 Introduction

During periods of economic downturn or stress in financial markets the effects of fiscal developments on economic activity might be different from what is usually observed in good times. We can perceive "bad times" as periods of economic downturn or stress in financial markets. Evidence shows that economic downturns are often associated with periods of financial stress or even with financial crisis. During such periods, the quality of financial institutions' assets deteriorates, as the share of non-performing loans increases and negative sentiments in the markets depress the value of other financial assets. In some cases, the disruptions in financial markets or problems in the banks' balance sheets may trigger a recession by reducing the flow of credit to the other sectors. It is then important to assess the effects of fiscal developments and policies during the periods of market stress to check, whether there are some non-linearities at play and if the fiscal multipliers are different. Therefore, we focus in this study on the interactions between fiscal and financial developments in times of financial instability.

Certainly, the relation between financial instability and economic policy can be two-sided. On the one hand, irrespectively of the causes of financial instability, policy makers may try to soften its effect on the economy. On the other hand, so-called "bad" policies can also contribute to financial instability. For instance, a situation of large government indebtedness might cause a loss of confidence in the ability of the government to pay back orderly its the outstanding stock of debt, subsequent drops in government bond prices, rises in sovereign yields, and an economic downturn. Hence, it is relevant to examine whether and how the effects of fiscal developments on economic activity differ in times of financial instability.

In this paper we contribute to the fiscally related vector autoregression (VAR) literature by estimating the effects of fiscal shocks using a threshold VAR approach, including a measure representing financial instability, namely the Financial Stress Index (Cardarelli et al., 2010). More specifically we employ a quarterly dataset, for the U.S., the U.K., Germany and Italy, for the period 1980:4-2009:4, encompassing macro, fiscal and financial variables. Therefore the use of quarterly fiscal data is another relevant contribution in this context. Moreover, according to our knowledge, there have been no attempts to investigate empirically the effects of fiscal developments associated with periods of financial crises within a multi-equation framework, which is the issue addressed in this paper.

Our analysis reveals several results worthwhile mentioning: (i) the use of a nonlinear framework with regime switches, determined by a financial stress indicator, is corroborated by nonlinearity tests; (ii) the responses of economic growth to a fiscal shock are mostly positive in both financial stress regimes; (iii) financial stress has a negative effect on output growth and it worsens the fiscal position; (iv) the nonlinearity in the response of output

growth to a fiscal shock is mainly associated with different behaviour across regimes, while nonlinearities caused the by size and sign of the shocks are small; (v) the size of the fiscal multipliers evolved over time and is higher than average during the current crisis in all countries, except in the United Kingdom.

The paper is organised as follows. Section two reviews the related literature. Section three explains the methodology. Section four gives a brief overview of fiscal developments in the countries covered in the analysis. Section five conducts the empirical analysis and reports the VAR results. Finally, section six concludes.

2 Related literature

2.1 Fiscally related VARs

VAR models, in addition to the New Keynesian DSGE models, have become the most popular tool for investigating the effects of monetary policy during the 1990s, and a number of stylized facts have been broadly identified. In response to a contractionary shock in the short-term interest rate, (i) real GDP declines with a hump-shape pattern, with a maximum decline occurring between one and one and half year, (ii) the price level declines persistently, and (iii) there is an evidence for a strong liquidity effect, that is, the non-borrowed reserves drop in response to an increase of interest rates. A summary of the research in this field can be found in Christiano, et al. (1999).

However, no such broad consensus has emerged from the research on the effects of fiscal policy, notably regarding the qualitative responses of macroeconomic aggregates to changes in government expenditures or revenues. In this context, the main difficulties come from the approaches used to identify the changes in fiscal policy, since both government expenditures and revenues, to some extent, automatically respond to fluctuations in economic activity and thus these fluctuations need to be distinguished from deliberate policy changes. It is possible to separate these effects using estimated elasticities of tax revenues and government expenditures with regard to output developments or to use external information such as the expected contemporary effects of the fiscal variables. Nevertheless, the differences in the identification schemes in the VAR analysis often lead to different results. For instance, van Brusselen (2010) provides a broad overview of the effectiveness of fiscal policy, and an evaluation of fiscal multipliers notably in several VAR models.

Caldara and Kamps (2008) compared the four existing approaches to identify fiscal policy shocks in VAR models using a dataset for the United States: (i) the Structural Vector Autoregression (SVAR) following Blanchard and Perotti (2002) and Perotti (2005) with calibrated sizes of the au-

tomatic stabilizers, (ii) the recursive identification scheme with the Choleski decomposition,[1] (iii) the sign-restriction approach proposed for the analysis of monetary policy by Uhlig (2005) and applied by Mountford and Uhlig (2009), and (iv) the so called "narrative approach" assigning dummy variables associated with periods that are known for exogenous changes in fiscal policy, related to the increases in military build-ups. The authors argue that different identification and calibration schemes lead to similar results as far as the effect of government expenditures is concerned, e.g. the shock to government expenditures is likely to increase output. However, results are strongly diverging regarding the responses to changes in taxes.[2]

Romer and Romer (2007) applied a narrative approach in a similar fashion as they did in their 1989 paper on monetary policy. They went through the Congressional records and presidential speeches to identify both timing and size of the changes in taxation. Based on this identification, they find that tax increases were highly contractionary with multipliers that reached the value of three. This value is much higher than the values obtained from other VARs which are concentrated around one. Such discrepancy was explained by Favero and Giavazzi (2009) who argued that the results of Romer and Romer are caused by their estimation method based on one equation. After using the shocks by Romer and Romer within a multivariate framework, Favero and Giavazzi obtained results similar to those from traditional fiscal VARs.[3]

The fiscal VAR approach based either on the SVAR or on the recursive identification was applied for several countries in the European Union. Van Aarle et al. (2003) estimated the effects of fiscal and monetary policy for the members of the Economic and Monetary Union and found significant differences in reactions among the individual countries of the euro area. Muscatelli et al. (2002) found a significant decrease in the responsiveness of the fiscal policy variables in the U.S. since 1979, and similar decreases were also reported for Italy, Germany, France and the United Kingdom.

For Germany, Heppke-Falk et al. (2006), using a VAR approach, mention that government expenditure shocks increase output and private consumption on impact with low statistical significance, while they decrease insignificantly private investment. They also found for government investment - in contrast to government consumption - a positive output effect, which is statistically significant until 12 quarters ahead. In addition, antici-

[1] The ordering used in these studies is as follows: government expenditures, G, revenues, T, gross domestic product, Y (all in real per capita terms and natural logs; sometimes the share of G and T on Y is used and they are often augmented for transfers and interest payments), inflation, π (measured as the GDP deflator), and short-term interest rate i.

[2] For the case of the US Ramey and Shapiro (1999) and Edelberg, Eichenbaum and Fisher (1999) used one-period dummy variables for 1965Q1 and for the 1980Q1. Caldara and Kamps (2008) added one more for 2001Q3.

[3] In a somewhat similar vein, Agnello and Cimadomo (2009) provided an analysis for the European Union.

pated expenditure shocks have significant effects on output when the shock is realized, but not in the period of anticipation. The authors claim that the effects of expenditure shocks are only short-lived in Germany and government net revenue shocks do not affect output with statistical significance. However, they provide evidence that direct taxes lower output significantly, while small indirect tax revenue shocks have little effect. Moreover, the compensation of public sector employees is equally not effective in stimulating the economy.

For Italy, Giordano et al. (2007), also within a VAR framework, found that a shock to government purchases of goods and services has a sizeable and robust effect on economic activity: an exogenous 1% (in terms of private GDP) shock increases private real GDP by 0.6% after 3 quarters. The response declines to zero after two years, reflecting with a lag the low persistence of the shock. The authors also mention that the effects on employment, private consumption and investment are positive for Italy. In contrast, changes of public sector wages have no significant effect on output, while the effects on employment turn negative after two quarters. Shocks to net revenue were found to have negligible effects on all the variables.[4]

The baseline specification was extended for an analysis of the impact of the exchange rate (Monacelli and Perotti, 2006) and for government debt (Favero and Giavazzi, 2007 and Afonso and Sousa, 2009a). Afonso and Sousa (2009a, b) used quarterly fiscal data from the U.S., the U.K., Germany and Italy along with the feedback from government debt, and also included the effects on asset markets in a Bayesian VAR model.

For instance, Afonso and Sousa (2009b) using a Bayesian SVAR model provide some evidence that the government spending shocks have, *inter alia*, in general a small effect on real GDP; do not impact significantly on private consumption and have a negative effect on private investment in the U.S., U.K., Germany and Italy. On the contrary; they found that government revenue shocks have a positive (although) lagged effects on GDP and private investment. Interestingly, they found that when the debt dynamics is explicitly taken into account, (long-term) interest rates and GDP become more responsive and the effects of fiscal policy on these variables also become more persistent. Moreover, the results from Afonso and Sousa (2009b) also provide weak evidence of stabilizing effects of the debt level on the primary budget balance. They also find that government spending shocks, in general, have a positive, but small effect on GDP and also uncover a crowding out effect, which is present in all four countries.

Kirchner, Cimadomo and Hauptmeier (2010) use time-varying structural VAR techniques in the euro area for the period 1980-2008. They report

[4]More recently, Amisano at al. (2009) estimated a time-varying VAR model to assess the Italian relative performance compared to the rest of the euro area, originally including the public debt-to-GDP ratio, which was dropped for the purpose of their study.

that the short-run effectiveness of government spending in stabilizing real GDP and private consumption has increased until the end-1980s but it has decreased thereafter, and that government spending multipliers at longer horizons have declined substantially due to higher government debt-to-GDP ratios.

Regarding the possibility of negative fiscal spending multipliers, and the so-called non-Keynesian effects of fiscal policy, several authors have argued along those lines. For instance, it has been mentioned that high government debt implies additional fiscal stress and a higher probability of higher taxes in the future (see, Alesina and Perotti, 1996, Giavazzi and Pagano, 1998, 2005, and Mitra, 2006). Therefore, higher private savings may arise and lower output, and thus the effects of increased government expenditure on output might be negative. In addition, there is also some evidence of expansionary fiscal contractions, the most prominent examples are Denmark in 1993-1995 and Ireland in 1985-1988. Rzonca and Cizkowitz (2005) identified a similar pattern in the Central and Eastern European countries that have entered the EU in 2004-2006. However, Afonso (2010) reports that the empirical evidence for the EU15 countries is quite diverse in this respect, notably with alternative definitions of fiscal consolidation episodes.

2.2 Fiscal policy and financial instability

The effects of fiscal policy can differ in times of financial instability. This links with the Keynesian-like story about countercyclical economic policy, and the possible positive impacts of fiscal stimuli. The idea is that the government steps in to compensate the decline in private sector demand in order to stabilize aggregate demand. Almunia et al. (2009), who compared the policies during the Great Depression and the 2008-09 crisis concluded that when fiscal policy was used in the 1930s it worked, while the evidence for the effectiveness of monetary policy is rather mixed.

Fiscal policy can contribute to financial instability if, for instance, fiscal stress and the issuance of substantial amounts of sovereign debt can cause a potential fiscal and/or financial crisis. In particular, unsustainable fiscal policies may undermine sovereign debt credibility and financial markets may refuse to buy new government debt, while transactions in the secondary market may also become less frequent. The inability to sell government bonds reduces its liquidity and weakens the balance sheet of the banks and of other financial institutions that hold government debt. The balance sheet losses related to the price drops in government debt securities affect negatively the lending capacities of the banks, which consequently might reduce the flow of credit to the private sector. Moreover, some related discussion drawing on the fiscal theory of price level (Leeper, 1991, Sims, 1994, and Woodford, 1994, 1995), and its application to Krugman's model of financial crisis

(1979) as introduced in Daniel (2001) and Corsetti and Mackowiak (2006) also highlights such possible links.

2.3 Fiscal policy and financial instability: empirics

The literature dealing with the effects of fiscal policy during periods of financial stress is relatively scarce, but growing. Baldacci et al. (2008) tried to answer the question of whether fiscal policy might shorten the recession caused by banking crisis. Using OLS estimation and truncated Logit on a dataset containing 118 banking crises in 99 countries 1980-2000, they have found that fiscal policy responses are significant for the duration of a financial crisis, and that the composition of the fiscal package is a key to success. In this respect their results are in line with Blanchard et al. (2009) who tried to summarize the policy recommendations from the empirical literature in order to give guidelines for the construction of fiscal stimuli packages that had been prepared at that time.

By contrast, Bouthevillain and Dufrénot (2010) who used a Markov switching model with time-varying probabilities within a single-equation framework have not found such differences in the efficiency of fiscal policy in France. Similarly Afonso, Grüner and Kolerus (2010), using a panel of OECD and non-OECD countries, for the period, could not reject the hypothesis that the effects of fiscal policy are essentially the same in the absence and during a financial crisis

Several papers also address financial instability in a SVAR context: Balke (2000), Atanasova (2003), Li and St-Amant (2008) and Berkelmans (2005). For instance, Berkelmans (2005) included a variable representing credit frictions in a small SVAR model of the Australian economy and has shown that monetary policy might in this case play a stabilizing role and it can reduce the effects of credit shocks on output.

Using a threshold vector autoregression with credit conditions as a threshold variable, Balke (2000) has shown that the U.S. output responds more to monetary policy in a credit-rationed regime. Atanasova (2003) analyzed the impact of credit frictions on business cycles dynamics in the U.K. and her results in many respects confirm the conclusions by Balke (2000). Finally, Li and St-Amant (2008) estimated a threshold vector autoregression for the monetary transmission mechanism in Canada with an indicator of financial stress (Illing-Liu, 2006) as a threshold variable, and have estimated explicitly the nonlinear properties of the system. Their findings indicated that there are nonlinear effects of contractionary and expansionary shocks and that the large contractionary shocks increase the likelihood of moving to high stress regime. Furthermore, the high stress regime is in their dataset typically associated with weaker output growth, higher inflation and higher interest rates. However, and as far as we can tell, there are no studies that inves-

tigate empirically the effects of fiscal developments associated with periods of financial crises within a multi-equation framework, and that is precisely what we do in this paper.

3 Methodology

3.1 Threshold Vector Autoregression

In this paper we follow the approach used by Balke (2000) and Li and St-Amant (2008) for the estimation of a threshold vector autoregression (TVAR). Thus, we include a threshold variable in the fiscal VAR, for which we have chosen the financial stress index (FSI), introduced by the IMF and described in Cardarelli, Elekdag and Lall (2009).

The TVAR 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 equilibria. 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:

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

where Y_t is a vector of endogenous 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 section 5.2. The VAR model in standard form can be written as:

$$Y_t = c + \sum_{i=1}^{p} V_i Y_{t-i} + \epsilon_t \tag{2}$$

where Y_t denotes the vector of the m endogenous variables given by $Y_t = [y_t\ \pi_t\ f_t\ i_t\ s_t]'$, c is a (5x1) vector of intercept terms, V is the matrix of autoregressive coefficients of order (5x5), 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.

The lag length of the endogeneous variables, p, is determined by the usual information criteria (Schwarz SIC), which gives a larger penalty to the number of coefficients estimated in the model, but we use only one or two lags given the low number of observations in the high stress regime. The main reason is that namely within the high financial stress regime the number of observations is too low to allow estimating a VAR model with five variables and the conventionally used four lags.

We tested whether the threshold indicator is statistically significant or not. If the threshold values γ were known, the conventional F-test for the null hypothesis $A^2 = B^2(L) = 0$ would give reliable results. However, in our case the threshold value is not known a priori,[5] and the testing procedure involves non-standard inference, because γ is not identified under the null hypothesis of no threshold.

Therefore, first, the TVAR model is estimated for all possible values of γ (to avoid over-fitting, the possible values were set so that at least 15% of the observations plus the number of coefficients is included in each regime), and the values of the Wald statistics testing the hypothesis of no difference between regimes are stored. Second, we constructed three test statistics, one with the maximum value of the Wald statistics (sup-Wald), another one with its average (avg-Wald) and the final one with the sum of exponen-

[5] Cardarelli et al. (2010) suggest the value of two for the FSI to distinguishe the periods of high and low stress,. Their judgement is based on the experience that such identification of stress periods mimics well the historical episodes of financial instability.

tial Wald statistics (exp-Wald). These values are then compared with the critical values obtained through simulating the empirical distribution, as in Hansen (1996). The estimated thresholds were those that maximized the log determinant of the structural residuals U_t.

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 (1994) and Koop, Pesaran and Potter (1996). The moving average representation of the TVAR is nonlinear in the structural disturbances U_t, because some shocks may lead to switches between 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-Pesaran and Potter (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:

$$NIRF_y(k, \epsilon_t, \Omega_{t-1}) = E(Y_{t+k}|\epsilon_t, \Omega_{t-1}) - E(Y_{t+k}|\Omega_{t-1}) \qquad (3)$$

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 formulation implies that the impulse response functions depend on the initial conditions and that there is no restriction regarding the symmetry of the shocks.

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 can 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 then we

compute averages over the initial conditions from each regime to get the average impulse responses for both regimes.[6]

Because the number of observations in the high stress regime is rather low (ranging from 26 to 45), following Koop et al. (1996) we derive the confidence bands from the quantiles of the distribution of the average impulse responses rather than assuming normality.

4 Fiscal developments' overview

Figure 1 provides some evidence about fiscal policies in the U.S., the U.K., Germany and Italy in the period 1970-2009,[7] based on the annual national accounts data from the European Commission Ameco database. In order to capture the main fiscal developments during this period we plot two charts: the first one with the general government debt-to-GDP ratio on the left-hand side axis and with government revenue and expenditure ratios on the right-hand side axis; the second one with the general government balance on the left-hand side axis and government debt on the right-hand side axis.

In the U.S., the periods with high financial stress broadly correspond to recessions. This is the case in particular for the recessions identified by the NBER between 1981Q3-1982Q4, 1990Q3-1991Q1, 2001Q1-2001Q4 and the latest recession that started in 2007Q4. However, the financial stress was identified also in the non-recession periods in 1987Q3, 1988Q1 and 1999Q2. The stress in the financial markets in 1987Q3 is related to the event "Black Monday", 19 October 1987, when the stock market in Hong Kong crashed and the effects spread globally. The second non-recession period of tension in 1988Q1 could be linked to the savings and loan crisis in the US. In that year, several banks located mainly in Texas and California went under (e.g. First Republic Bank, American Savings and Loan Bank and First City National Bank).

The government debt ratio was gradually declining until 1981 when a recession hit the U.S. economy and the debt ratio started to increase. In August 1982, the Congress approved the Tax Equity and Fiscal Responsibility Act and the previous tax cuts, which were implemented in the Economic Recovery Tax Act in 1981, were reversed. The recession finished in the autumn of 1982, but the debt ratio continued to increase until 1990 when another recession occurred. In the autumn of 1990, the U.S. government enacted legislation which targeted a cumulative deficit reduction of about USD500 billion over five years. In addition, the government improved also the fiscal framework and prepared the Budget Enforcement Act, which in-

[6] We estimated the VAR with WinRATS using a code provided by Nathan Balke, which we modified for our purposes. Further details are provided in Appendix A.1 .

[7] See van Riet (ed.) (2010) for more details on fiscal policy in the euro area during the 2008-2009 crisis.

troduced new fiscal rules to limit future budget deficits and discretionary expenditures. The recession finished in the spring of 1991 and the debt-to-GDP ratio peaked two years after, in 1993, at about 72%.

The following recovery brought the debt ratio on a declining path that lasted until 2001 when a recession emerged and contributed to the ensuing fiscal deterioration. Despite the fact that this recession was over already by the end of the same year, the government debt ratio gradually increase to 62% of GDP in 2007, when the subprime debt crisis severely affected the U.S. economy. In 2008, the U.S. administration faced a serious recession and adopted fiscal stimulus packages consisting of federal tax cuts and spending increases of about 5% of GDP. As a consequence, the general government deficit jumped to about 11% of GDP in 2009, the highest number since 1970 and well above the deficits of 5.4% of GDP in 1983 and 5.7% of GDP in 1992, which can be linked to previous recessions.

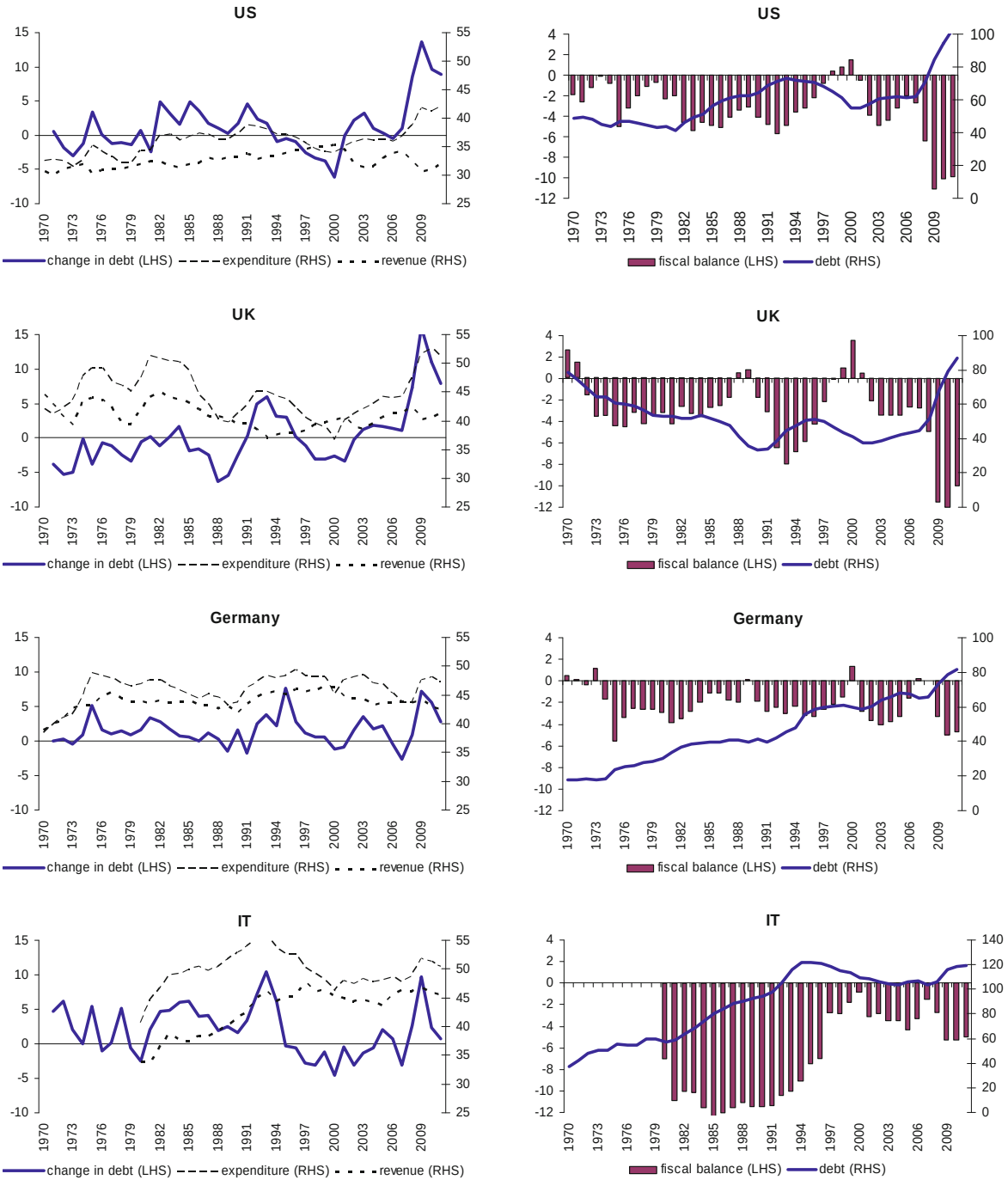
Interestingly, for the U.S. Favero and Giavazzi (2007) point to different effects of exogenous tax policy shocks on output in the period 1980-2006, when compared to the previous period. In the 1950s, 1960s and 1970s the contractionary effect of a tax hike was larger when monetary policy shocks, government spending, and oil prices were endogeneized in a model that included the level of the debt and the government intertemporal budget constraint. Since the beginning of the 1980s, when the burden of debt stabilization falls on expenditure, an exogenous increase in taxes was compensated by a subsequent expenditure accommodation. This could explain why, analyzing the effects of shocks in a model with endogenous monetary policy, government spending, oil prices, and fiscal policy, produced much smaller output effects. Favero and Giavazzi (2007) argued that in fact since the beginning of the 1980s, an initial positive tax shock is accompanied by further tax changes in the opposite direction in the U.S. Following the initial shock taxes decline and the effect on the budget is compensated by increases in spending.

In the U.K., government debt had been continuously declining from high levels of around 80% at the beginning of the 1970s to around 33% in 1990. A particularly strong fiscal consolidation was carried out in 1988 and 1989 when the fiscal balance recorded surpluses of about 0.5 and 0.8% of GDP, respectively.

However, the orientation of British fiscal policy has changed several times since the 1970s. In the 1970s, fiscal policy was the key policy instrument used for aggregate demand management. When a new conservative government took office in 1979 Keynesianism was replaced by monetarism as the leading economic paradigm. The fiscal policy strategy changed and focused on reducing the size of the government in the economy in addition to suppressing the role of fiscal policy in demand management.

In Germany it is possible to identify a few periods of fiscal consolidation episodes, notably the period 1982-83 when the cyclically adjusted primary

Figure 1: **General government debt, revenue, expenditure and fiscal balance developments, in % of GDP**



Source: European Commission Ameco.

budget balance improved more significantly (see also Figure 1 for the overall fiscal balance). The debt ratio increased gradually from a very low level, less than 20% of GDP in 1970, to about 70% of GDP over the sample period with only four relatively short periods of debt ratio reduction in 1979, around 1989-1991, in 2000-2001 and 2006-2007 which coincide with the peaks of the business cycle. In 1979, the real GDP growth rate reached almost 5% and in 1990 peaked at 5.25% in West Germany. However, the period which followed the German reunification in 1990, in which the exchange rate stress component of FSI was particularly high, must be interpreted with caution, because the German economy had to cope with the economic transition of the former East Germany from planned to market economy. The economic transition required large amounts of public spending which stimulated an economic boom in several German regions. The following peaks of real GDP growth rate that led to GDP ratio reductions were recorded in 2000 and 2006 when the growth rate reached 3.2%. From a fiscal policy perspective, important changes followed the ambitious and large tax reform in 2000 in which the German government passed the most ambitious tax reform and the tax burden was reduced for both individuals and companies. As a consequence, the revenue-to-GDP ratio decline by almost 3 p.p. of GDP between 1999 and 2008. The changes in the German fiscal policies are more complex due to fiscal federalism, where fiscal decisions of local governments play a more important part.

In Italy, the debt ratio increased from about 37% of GDP in 1970 to about 122% of GDP in 1994, then declined to about 104% of GDP by 2004 and further increased to 115% of GDP in 2009. This was mainly due to a more relaxed fiscal policy in the 1980s with the occurrence of budget deficits of 10-12% of GDP each year. The consolidation effort started to materialize in 1995 when the debt ratio declined by 0.3% of GDP. One of the main drivers of the Italian fiscal consolidation in the 1990s was the effort to fulfil the Maastricht fiscal criteria, which are necessary to qualify for the euro area membership. For more details on fiscal consolidation process that was characterised by a large number of corrective measures with only temporary effects, see, for instance, Balassone et al. (2002).

The period of fiscal prudence between 1995 and 2004 delivered a notable reduction in the government debt ratio, which declined by about 18 p.p. during that period. This reduction of government debt decreased, inter alia, government interest expenditures from typically around 11-12% of GDP in the 1980s to less than 5% of GDP since 2004. The interest payments usually constituted a substantial part of government expenditures in the past. For example in the 1980s, the interest expenditures corresponded to about 70% of the overall fiscal deficit and in the beginning of the 1990s, the ratio of government interest expenditures to GDP typically exceeded the fiscal deficit ratio, allowing the delivery of primary budget surpluses. In those years, the financing of government interest expenditures consumed about 1/3 of total government revenues.

Contrary to the German experience, where the debt reduction occurs in a short two-year period that reflect mostly the business cycle, the debt reduction in Italy has a different pattern mainly due to the downward trend in nominal interest rates and consolidation efforts in mid-1990s (see Figure 1). A similar patter can be found in the UK, where the debt ratio declined in almost twenty consecutive years since 1970 with only one interruption of this declining trend in 1984. While economic growth seems to be the major factor of debt reductions in Germany, the decline of interest expenditures also played a significant role in the Italian fiscal consolidation efforts. For an assessment of fiscal consolidation episodes in the EU countries, see Afonso (2010).

5 Empirical analysis

5.1 Variables and data

A relevant issue with fiscal VARs is the choice of the variables that describe fiscal policy and fiscal developments. In monetary policy VARs, the variable included in the model is usually the central bank's key interest rate, a single variable that sufficiently describes monetary policy. On the contrary, fiscal policy is hard to be described by a single policy variable. 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, as is usually the case, it is not possible to build too extensive VAR models with an excessive number of endogenous variables to describe fiscal policy.

In order to describe fiscal policy in the most aggregated form we preferred to work with a parsimonious VAR structure and capture fiscal developments by only one variable. Therefore, we used the government debt-to-GDP ratio because of the following reasons. The debt ratio is a complex fiscal indicator that reflects the developments both in revenue and expenditure. The government debt ratio is usually not a policy variable, since governments tend to concentrate on fiscal balance developments rather than the development of stock of government debt when forming their policies (e.g. government typically announce their targets in terms of fiscal deficit improvements). Moreover, the government debt ratio captures also the extraordinary government actions that may not be fully reflected in the fiscal 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. In addition, the debt ratio and its dynamics is a key variable which determines fiscal sustainability.

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 not only about the current fiscal policy but about past fiscal policies. Finally, 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 as well interest rates.[8]

The other variables that we include in the VAR are the already mentioned FSI (see next section for more details), GDP, the short-term interest rate and inflation. In some cases, and instead of the change in the debt ratio, we also used the budget balance ratio itself for robustness. However, on quarterly basis such measure is more difficult to construct for some countries than the debt ratio.[9]

Regarding the time span we use a quarterly dataset, for the U.S., the U.K., Germany and Italy, for the period 1980:4-2009:4. Again, for some cases, instead of the FSI we also use alternative financial variables for the threshold in order to allow for a longer time span. The variables used in those cases were a measure of the stock returns and the so-called TED spread (the difference between the short-term interbank interest rate and treasury bills rate). The sources and the details of these variables are explained in Appendix A.3.

5.2 The Financial Stress Index

The financial stress index (FSI) was developed by the IMF as an approximation to potential instability of financial markets (Cardarelli, Elekdag and Lall, 2009). The FSI contains three main components: the bank related stress, the securities related stress and the exchange rate stress: (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. (ii) Securities related stress: corporate bond spread, stock market returns and stock-market volatility. (iii) Exchange rate stress: exchange rate volatility. The FSI index is then constructed as a sum of normalized value of all these sub-components. The larger value of the FSI, the higher is the stress during each period. The authors have shown, that these components are relatively uncorrelated and,

[8] In Appendix A.2 we illustrate the linkages between the change in the debt ratio and the budget balance ratio for the countries under analysis.

[9] Naturally, the statistical concepts currently used in the EU (ESA 95 methodology) were not available when fiscal policy was carried out in the 1980s or are not used in the US (where our analysis focuses on federal debt). For example, certain fiscal operations (e.g. recapitalisations) or entities (e.g. general government) are classified differently than it would be the case of the concepts used in the past.

importantly, adding different variable does not change the resulting path of the FSI significantly.[10]

Furthermore, the authors defined a binary variable identifying periods of significant stress that corresponds to all periods, where the FSI exceeds the band of 2 standard errors

Figure 2 shows the evolution of the financial stress indicator for the U.S., the U.K, Germany, and Italy.[11]

Cardarelli, Elekdag and Lall (2009) describe the effects of 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. Baxa, Horvath and Vasicek (2010) studied the reaction of central bank inflation targeting to financial stress using the framework of the augmented Taylor rule with time-varying coefficients. They found that the central banks normally do not react to financial stress, but their behaviour changes in times of large and longer stress such as the Bank of England during the ERM crisis and the current crisis, for example.

5.3 VAR analysis

5.3.1 Testing the Threshold VAR model

We tested whether the data indicate the presence of a statistically significant threshold γ as defined by the values of the financial stress index, and whether the optimal threshold values are reasonable in terms of identifying high and low stress periods that will be related to output fluctuations. Our estimated threshold values range from 0.92 in case of Germany to 2.38 in case of the U.S. and the threshold is almost always significant with a p-value less than 0.0001 for all the Wald statistics.[12] These values are not far from the value of 2 proposed by Cardarelli, Elekdag and Lall (2009).

The threshold splits the sample into a high stress regime with about one fourth of observations (from 24 to 39) and a low stress regime with the remaining portion. Such division seems to be well in line with the fact that the duration of expansions is higher than the duration of recessions. The number of observations of the high stress regime makes the VAR model less

[10] Regarding the exchange component we do not observe, for the cases of Germany and Italy, any significant changes around the adoption of the euro in 1999. Interestingly, for Italy, some relevant 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.

[11] For instance, we could observe that periods of financial stress are located around the NBER recessions in the U.S. except for the late 1980s.

[12] The optimal values are those that maximize the log determinant of residuals for all countries except the U.K. where the value maximizing the Wald statistics was chosen. In this case, the maximized log determinant of residuals implied a threshold equal to 0.2585, but the maximum Wald statistics was for the threshold γ= 1.2369. The latter value is more in line with other countries and leads to a similar share of observations in both regimes as in other countries.

Table 1: **Thresholds per country**

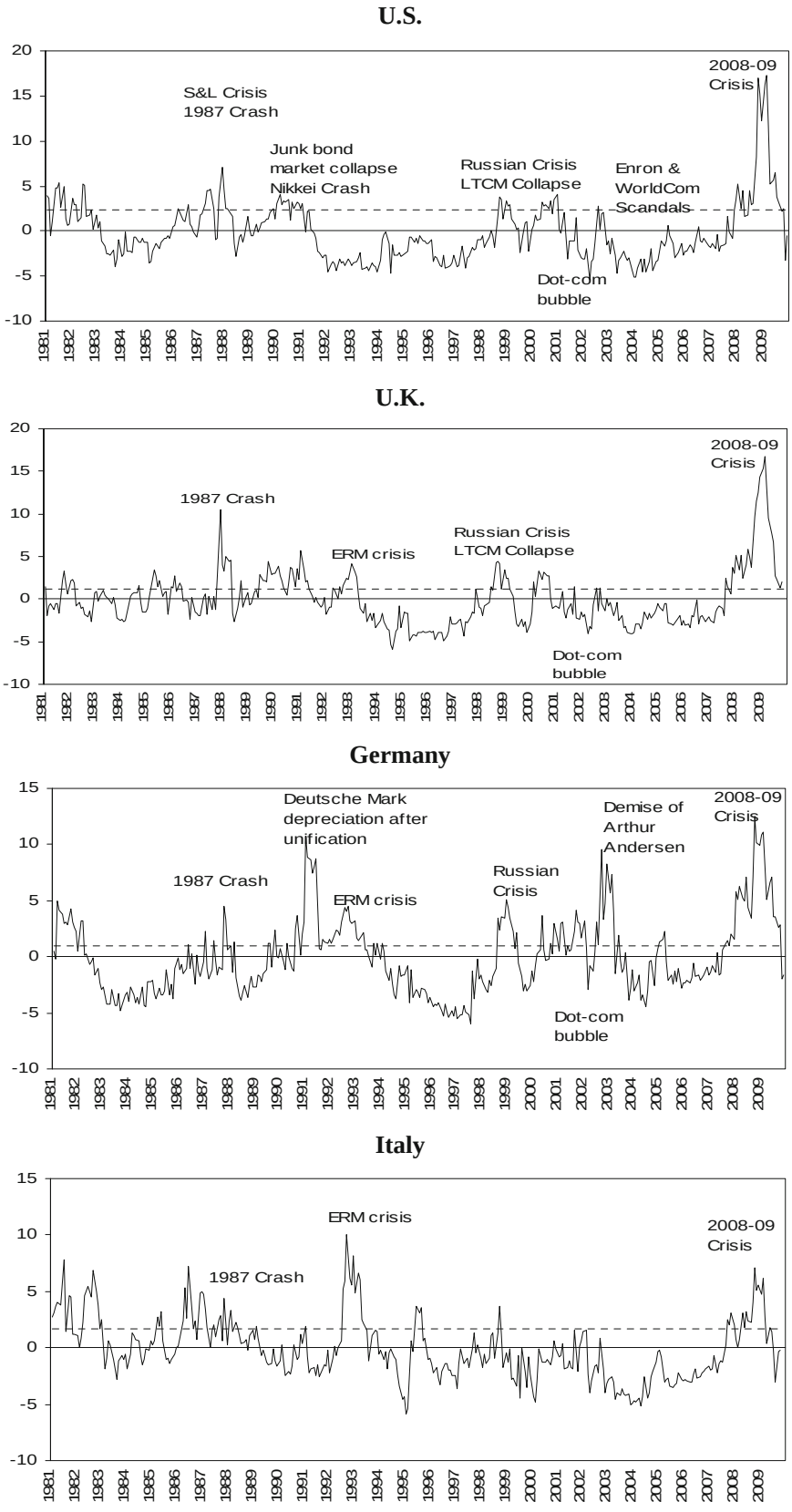
Threshold variable	Estimated Threshold	Sup-Wald	Avg-Wald	Exp-Wald	VAR order	Sample	N. observations Low Stress	N. observations High Stress
United States								
FSI	2.3822	100.85	62.11	47.11	1	1980Q4 - 2009Q4	88	24
TED	1.62	331.49	102.93	161.32	2	1971Q1 - 2009Q4	125	35
Stock Ret.	-0.1622	166.64	138.97	78.54	2	1956Q1 - 2009Q4	147	67
United Kingdom								
FSI	1.2369	179.65	109.37	85.81	2	1980Q4 - 2009Q3	81	29
TED	0.3143	200.86	132.12	96.58	1	1979Q1 - 2009Q3	92	29
Stock Ret.	1.2531	138.23	111.17	65.77	2	1978Q2 - 2009Q3	77	44
Germany								
FSI	0.9167	121.63	94.81	57.75	2	1980Q4 - 2009Q4	77	39
Stock Ret.	1.3067	148.51	105.04	70.27	2	1979Q1 - 2009Q4	79	72
Italy								
FSI	1.725	72.51 (0.016)	47.2 (0.136)	32.8 (0.016)	1	1980Q4 - 2009Q3	113	26
TED	-0.4898	114.73	90.72	53.94	1	1979Q1 - 2009Q3	87	35

Notes: TED - spread between the short-term interbank interest rate and the treasury bills rate. Stock returns: US - based on Dow Jones Industrial Index; UK - based on the Financial Times Stock Exchange (FTSE) 100 index; Germany - based on the IMF IFS share prices indicator. p-values were always less than 0.0001, if not, their values are in parentheses.

parsimonious in this regime. To address possible biases in our results, caused by the limited number of observations within the high stress regime, we estimated the threshold VAR also for other variables representing instability on financial markets, whose time series went further back in time than the FSI (available since the fourth quarter of 1980). These variables were: a measure of stock returns, and the TED spread measuring the spread between the interest rate on Eurodollar papers and treasury bills and for the U.S. also the spread between the commercial paper rate and the treasury bills. To anticipate our results, these experiments basically confirmed our main findings about the effects of fiscal policy in both regimes.

In Table 1 we report the estimated thresholds for each country, both using the FSI indicator and alternative financially related variables.

Figure 2: **Financial Stress Indicator**



Source: Cardarelli et al. (2009) and the authors.

5.3.2 The effects of fiscal shocks

Broadly, the responses of output growth to a fiscal shock are positive in both regimes and in all countries in our sample, although in some cases the response is either initially negative or uncertain within the first few quarters after the shock.

Figure 3 reports the median impulse response functions of a fiscal policy shock, both for a high and for a low financial stress regime. We opted for the median impulse response functions and the respective confidence bands derived from the empirical distribution of the responses rather than from the normal distribution due to the lower number of observations namely in the higher stress regime sample.

In the U.S. the responses of output growth to an increase in the budget deficit are similar in terms of their peak effect in both regimes. However in the high stress regime, the impulse response is negative in the first quarter after the shock. On the other hand, the increase in output growth is faster in comparison to the low stress regime. The impulse response functions are significant at 50%, in the high stress regime after the 4 quarters.

When the budget balance is used instead of the change of the debt ratio in the threshold VAR, the results change only slightly. The response of output to a fiscal shock does not have the initial small negative effect and it is always positive. The low stress regime is different and the effect of a positive fiscal shock is temporarily negative and it turns into a positive effect after three quarters. In this specification the different behaviour is caused by a switch in contemporaneous terms of the VAR: the FSI drops after a positive fiscal shock in the high stress regime, but it temporarily increases in the low stress regime. Thus, our result that fiscal policy effects are stronger in the high financial stress regime survives this sensitivity check.[13]

In the United Kingdom, fiscal policy causes an increase in output growth when the economy is in the low stress regime. However, the impulse response of output in the high stress regime exhibits a similar pattern to the U.S., and initially output growth decreases. This decrease lasts for six quarters and the 75% quantile of the simulated impulse responses is even below zero (see Figure A.4.2 in Appendix A.4). Contrary to the low stress regime, financial

[13]For robustness, we also replaced the change in the debt ratio by a change in the debt itself and the results were unchanged. We also used the first differences of GDP and of the price level together with the budget balance. This was the only specification when a 1% fiscal shock had larger effects on output growth in a higher stress regime than in the lower one. Again the amplitude of the impulse response of output was reached earlier in the high stress regime than in the lower one. Furthermore we estimated the effects of a very large shock of 5 standard deviation (SD) in the high stress regime, corresponding to about 3.5% of GDP. The magnitude of the effect was roughly proportional to the 2 SD shock, but the peak was reached even faster, within 6 quarters after the shock (for a 2 SD shock it was 8 quarters).

stress does not decrease in response to a fiscal shock in the high stress regime. Therefore, the impact of fiscal policy on output growth seems to be initially larger in the low stress regime and also the peak of the response of output occurs 4 quarters earlier than in the high stress regime.

For Germany, the effect of a positive fiscal policy shock on output is positive, when the economy is in the high stress regime. The response of output in the low stress regime is oscillating during the first eight quarters from a positive to a negative impact, but then the response becomes positive. Table 2 reports multipliers confirming that fiscal policy has larger effects on output in the high stress regime than in the low stress regime. The different responses in both regimes are caused by a number of factors. First, the dynamics of the fiscal shock is different and somewhat increasing endogenously after the initial shock in the high stress regime, and monotonously decreasing in the low stress regime. Second, the financial stress indicator reacts differently. On the one hand, when the economy is in a high financial stress regime, it increases to a value above 1, and it is positive for the first three periods and negative afterwards. This explains the temporary decrease in the response of output growth. In the low stress regime the financial stress indicator decreases in a hump-shaped pattern.[14]

The results for Italy show that notwithstanding the high level of government debt, the responses of output to a fiscal shock follow the Keynesian pattern. In both financial stress regimes, the response of output is positive with a hump-shaped pattern. In addition, in the high stress regime the effects of fiscal policy are twice as large as in the low stress regime (see Appendix A.4). Moreover, fiscal policy shocks initially and briefly increase the financial stress indicator in the high stress regime, although in a longer horizon, from two to three years, the financial stress decreases by 0.3.

As far as the effects of the size of the fiscal shock are concerned, Figure 3 does not provide evidence of important asymmetries between small and large shocks with the exception of Germany. Moreover, one and two standard deviations shocks practically coincide in the United States and in Italy. The effect of positive two standard deviations shocks on output growth in the United Kingdom, in the high stress regime, is slightly larger than proportional, with cumulative multipliers 0.301 and 0.242 respectively for a two standard deviation (2SD) shock and for a one standard deviation (1SD) shock.

When a negative fiscal shock is considered, responses coincide in the high stress regime and only relatively smaller differences arise in the low stress regime. Germany is somewhat different. The impulse responses of positive fiscal shocks are slightly dissimilar, but in terms of the cumulative multipliers over three years the differences are negligible. However, large fiscal contractions in the low stress regime lead to non-proportionally larger

[14] For example, a change in the debt ratio could reflect efforts to reduce financial stress, rather than to stabilise economic output.

effects on output and their cumulative multipliers are almost twice the ones corresponding to small fiscal shocks.

We also provide evidence about the responses of financial stress to fiscal shocks (see Figure 4). The contemporaneous effect is positive in the high stress regime in all countries but Germany, where it is close to zero. In the low stress regime the contemporaneous effect is positive only in the United States, whereas in the other countries it is close to zero. In response to a positive fiscal shock the financial stress decreases and then it returns back to zero.

Some additional points are worthwhile mentioning. First, a positive fiscal shock leads to a temporary increase of financial stress in Germany, but after few quarters the path of FSI reverts and follows the scenario related to the low stress regime. Second, the financial stress indicator reacts only moderately in Italy, when the economy is in the low stress regime.

Tables 2 and 3 summarize the values of the multipliers for the responses of output and FSI at one, two and three years after a fiscal shock, and also a cumulated response over three years. The impulse responses are normalized to the same size of the initial fiscal shock set to 1% of GDP for a direct comparison between two (High and Low stress) regimes and different signs and sizes. We use one standard deviation (1SD) and two standard deviations (2SD) as proxies for small and large shocks.

The size of fiscal multipliers varies across countries and across regimes. The multipliers are largest in Italy with a size of the cumulative multiplier after three years of about 0.82-0.87 for the high stress regime and 0.48-0.49 for the low stress regime. In Germany the cumulative fiscal multiplier is 0.3 in the high stress regime and almost zero when the economy is initially in the low stress regime, implying strong crowding-out effects in the economy. The United States have cumulative multipliers between 0.45-0.46 with minor differences between signs and sizes of shock. The United Kingdom has the lowest effects of a fiscal policy shock on output growth in the high stress regime, with the cumulative multiplier over three years being between 0.22 and 0.3. Interestingly, if the fiscal shocks occur in the low financial stress regime, the cumulative multipliers are around 0.50-0.54.

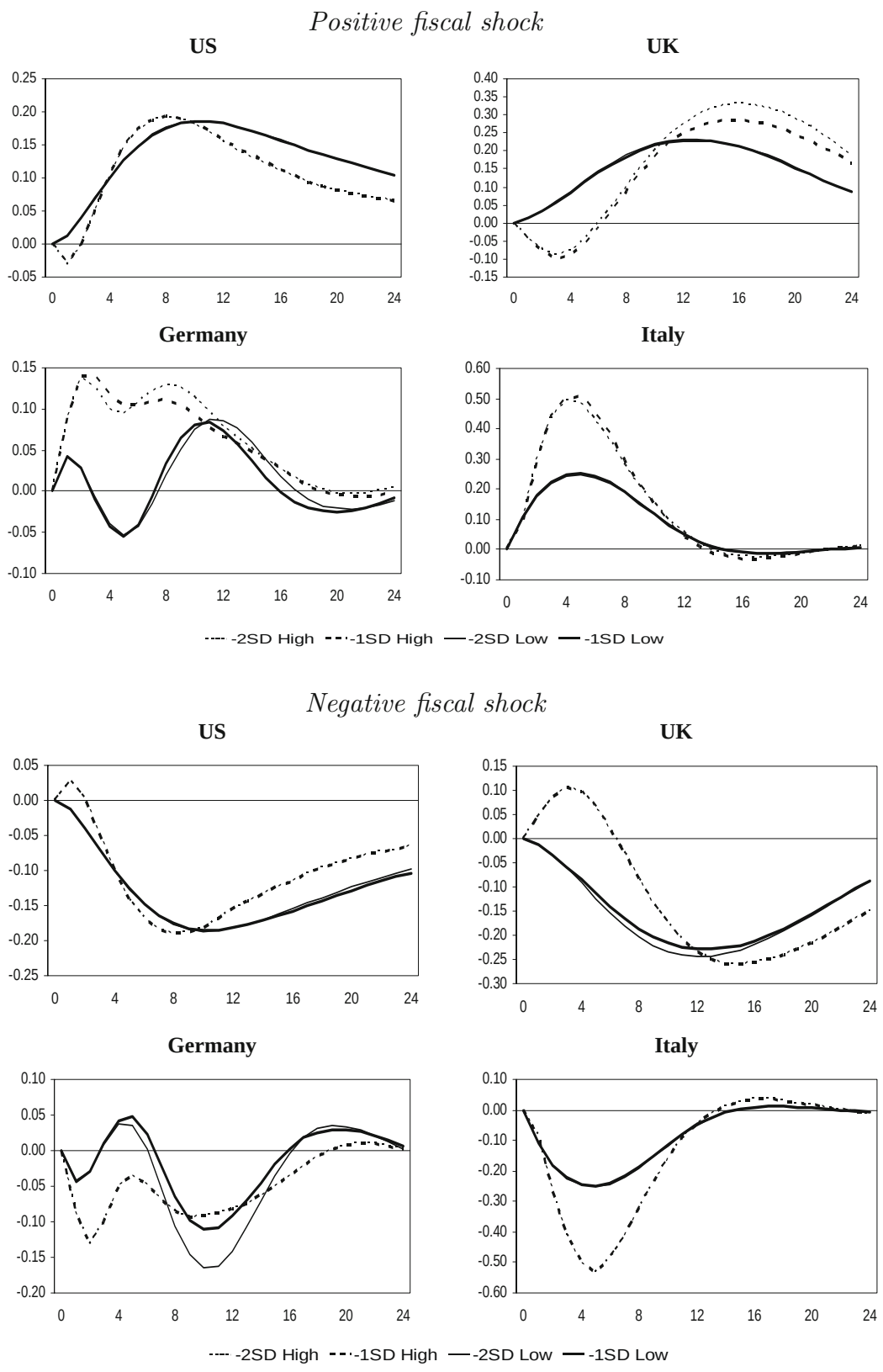
Table 2: **Responses of output to a 1% of GDP fiscal shock**

	4 Quarters		8 Quarters		12 Quarters		Cumulative (12 quarters)	
	2SD	1SD	2SD	1SD	2SD	1SD	2SD	1SD
United States								
Positive Shock								
High	0.103	0.105	0.193	0.194	0.153	0.157	0.449	0.456
Low	0.1	0.1	0.177	0.176	0.182	0.182	0.46	0.458
Negative Shock								
High	-0.101	-0.101	-0.19	-0.19	-0.155	-0.155	-0.445	-0.445
Low	-0.1	-0.1	-0.177	-0.175	-0.182	-0.182	-0.459	-0.457
United Kingdom								
Positive Shock								
High	-0.076	-0.091	0.103	0.087	0.275	0.246	0.301	0.242
Low	0.088	0.085	0.189	0.184	0.23	0.229	0.507	0.497
Negative Shock								
High	0.097	0.097	-0.085	-0.085	-0.234	-0.234	-0.222	-0.222
Low	-0.091	-0.085	-0.203	-0.186	-0.243	-0.229	-0.537	-0.5
Germany								
Positive Shock								
High	0.099	0.117	0.13	0.113	0.079	0.067	0.308	0.296
Low	-0.039	-0.042	0.02	0.033	0.086	0.074	0.068	0.065
Negative Shock								
High	-0.051	-0.051	-0.085	-0.085	-0.082	-0.082	-0.218	-0.218
Low	0.037	0.041	-0.107	-0.065	-0.141	-0.091	-0.211	-0.115
Italy								
Positive Shock								
High	0.491	0.498	0.281	0.295	0.054	0.043	0.826	0.836
Low	0.248	0.244	0.193	0.19	0.053	0.049	0.494	0.483
Negative Shock								
High	-0.501	-0.501	-0.324	-0.324	-0.045	-0.045	-0.871	-0.871
Low	-0.247	-0.244	-0.192	-0.187	-0.049	-0.048	-0.488	-0.479

Table 3: **Responses of financial stress to a 1% of GDP fiscal shock**

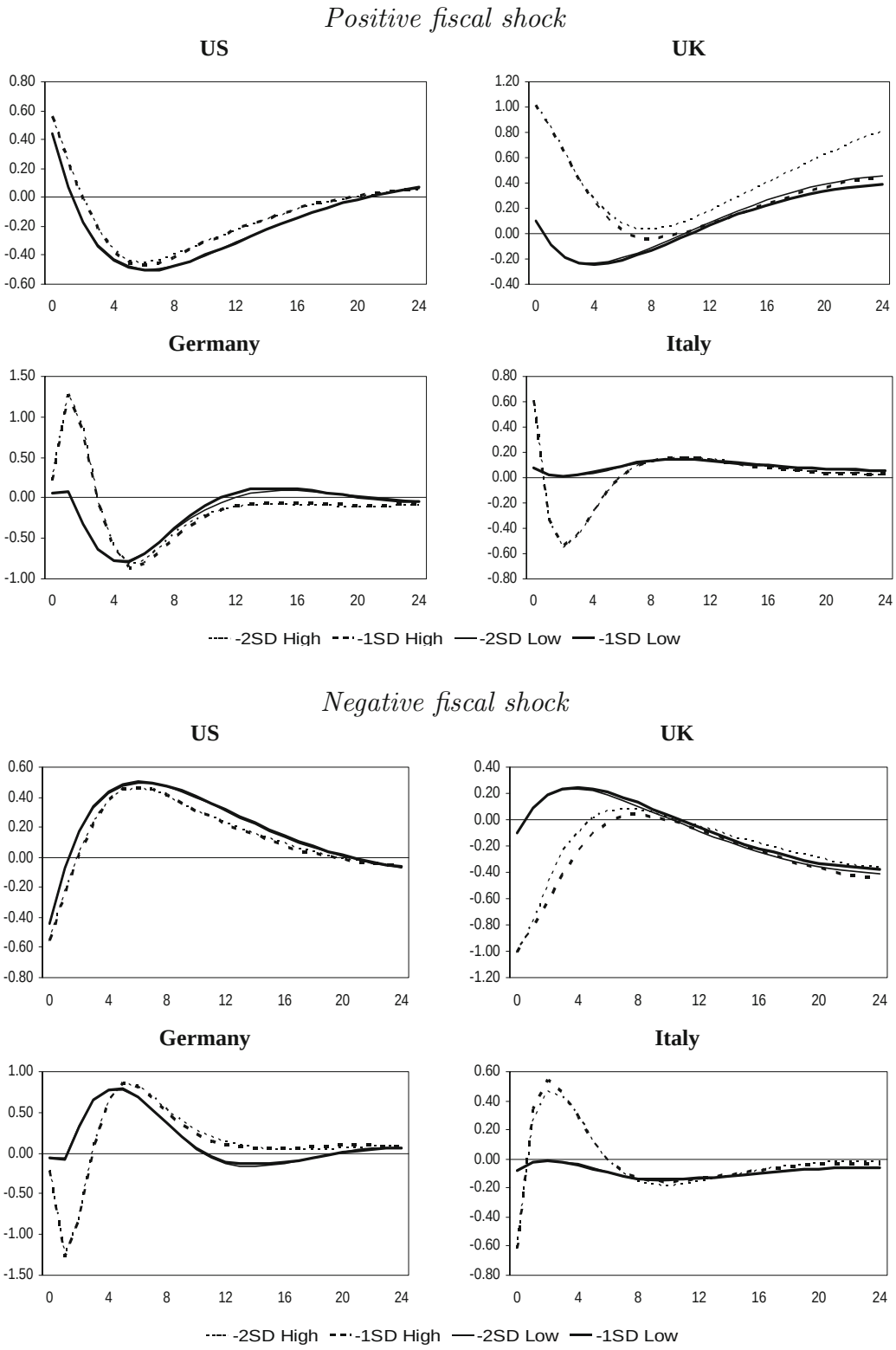
	4 Quarters		8 Quarters		12 Quarters		Cumulative (12 quarters)	
	2SD	1SD	2SD	1SD	2SD	1SD	2SD	1SD
United States								
Positive Shock								
High	-0.371	-0.377	-0.399	-0.411	-0.228	-0.224	-0.998	-1.013
Low	-0.428	-0.43	-0.475	-0.476	-0.313	-0.313	-1.215	-1.219
Negative Shock								
High	0.376	0.377	0.403	0.411	0.232	0.224	1.01	1.013
Low	0.426	0.43	0.47	0.476	0.308	0.314	1.204	1.22
United Kingdom								
Positive Shock								
High	0.264	0.243	0.03	-0.039	0.179	0.073	0.473	0.276
Low	-0.237	-0.245	-0.108	-0.129	0.086	0.062	-0.259	-0.311
Negative Shock								
High	-0.094	-0.243	0.076	0.039	-0.054	-0.073	-0.072	-0.276
Low	0.236	0.246	0.1	0.129	-0.085	-0.056	0.251	0.319
Germany								
Positive Shock								
High	-0.622	-0.642	-0.448	-0.498	-0.11	-0.104	-1.18	-1.244
Low	-0.781	-0.78	-0.397	-0.382	0.014	0.067	-1.164	-1.095
Negative Shock								
High	0.635	0.642	0.533	0.498	0.138	0.104	1.306	1.244
Low	0.778	0.779	0.367	0.371	-0.129	-0.103	1.015	1.047
Italy								
Positive Shock								
High	-0.288	-0.287	0.126	0.131	0.147	0.14	-0.014	-0.016
Low	0.032	0.041	0.133	0.136	0.138	0.134	0.303	0.31
Negative Shock								
High	0.303	0.287	-0.155	-0.131	-0.16	-0.14	-0.013	0.016
Low	-0.036	-0.044	-0.137	-0.136	-0.136	-0.134	-0.309	-0.313

Figure 3: **Fiscal Shock, Response of Output Growth**



Note: Fiscal shocks rescaled to initial +/-1%GDP shock

Figure 4: **Fiscal Shock, Response of Financial Stress Indicator**

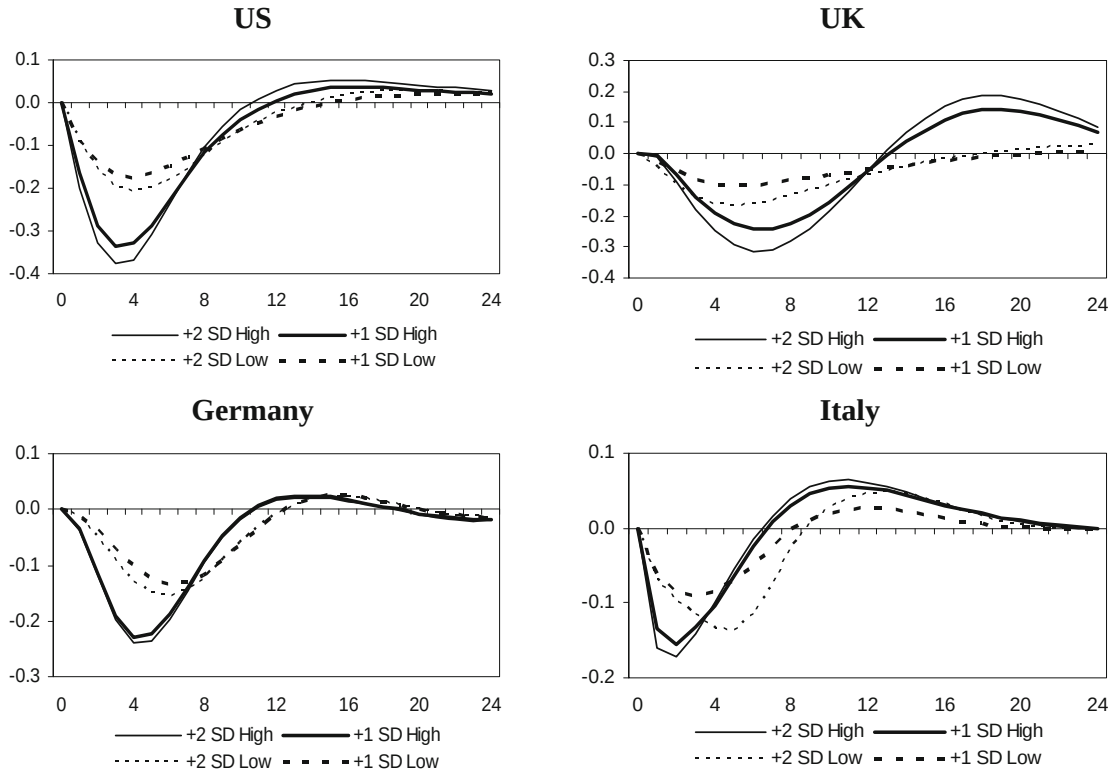


Note: Fiscal shocks rescaled to initial +/-1%GDP shock

5.3.3 The effects of financial stress shocks

The responses to a shock in the financial stress indicator are in accordance with our expectations. The effect on output is negative and it erodes after 6-10 periods, when it temporarily becomes positive, namely in the U.K. and in Italy. As we can see in Figure 5, there is some evidence of asymmetric reactions between large and small shocks, and also between the two regimes. The impulse responses in Figure 5 were rescaled to show the effects of an initial positive, one-unit shock to the financial stress index, if the overall shock had the size either of one or two standard deviations, to allow a direct comparison among countries and regimes.

Figure 5: **Responses of output to a Positive Shock in Financial Stress, High and Low Regimes**



Note: The impulse responses were rescaled to the size of the shock of one unit of FSI.

Table 4 reports the values of the impulse responses of output at different horizons. Several conclusions can be drawn from these results. First, the effect on output growth of increased financial stress is larger in the high stress regime than in the low stress regime. In the high stress regime, the impact of a financial stress shock is, in principle, proportional to the size of the initial shock with an exception of large increases in financial stress in the U.S. and in the U.K. In these countries the output falls more in response to increases in financial stress by 2SD than by a 1SD increase (the more

Table 4: **The Effects on Output Growth and on the Debt Ratio of a Shock in Financial Stress**

		4 Quarters				8 Quarters			
		+2 SD	+1 SD	-1 SD	-2 SD	+2 SD	+1 SD	-1 SD	-2 SD
					Output Growth				
United States	High	-0.366	-0.326	0.329	0.310	-0.102	-0.118	0.127	0.139
	Low	-0.208	-0.175	0.166	0.161	-0.122	-0.106	0.105	0.106
United Kingdom	High	-0.249	-0.193	0.191	0.137	-0.283	-0.227	0.221	0.156
	Low	-0.161	-0.100	0.081	0.063	-0.134	-0.085	0.076	0.069
Germany	High	-0.239	-0.231	0.248	0.237	-0.094	-0.091	0.135	0.132
	Low	-0.130	-0.102	0.090	0.086	-0.123	-0.116	0.106	0.104
Italy	High	-0.100	-0.104	0.158	0.140	0.040	0.030	-0.023	-0.018
	Low	-0.136	-0.085	0.092	0.082	-0.030	-0.004	0.008	0.007
					Change in Debt Ratio				
United States	High	0.536	0.420	-0.401	-0.304	0.357	0.296	-0.290	-0.278
	Low	0.135	0.087	-0.067	-0.058	0.200	0.136	-0.124	-0.118
United Kingdom	High	0.735	0.632	-0.554	-0.397	0.907	0.773	-0.679	-0.531
	Low	0.249	0.123	-0.086	-0.057	0.337	0.195	-0.155	-0.133
Germany	High	0.087	0.098	-0.137	-0.140	0.081	0.083	-0.112	-0.108
	Low	0.097	0.146	-0.164	-0.175	0.064	0.086	-0.085	-0.081
Italy	High	0.166	0.142	-0.208	-0.158	0.080	0.073	-0.110	-0.109
	Low	0.146	0.061	-0.072	-0.057	0.134	0.029	-0.036	-0.028

Note: The impulse responses were rescaled to the size of the shock of one unit of FSI.

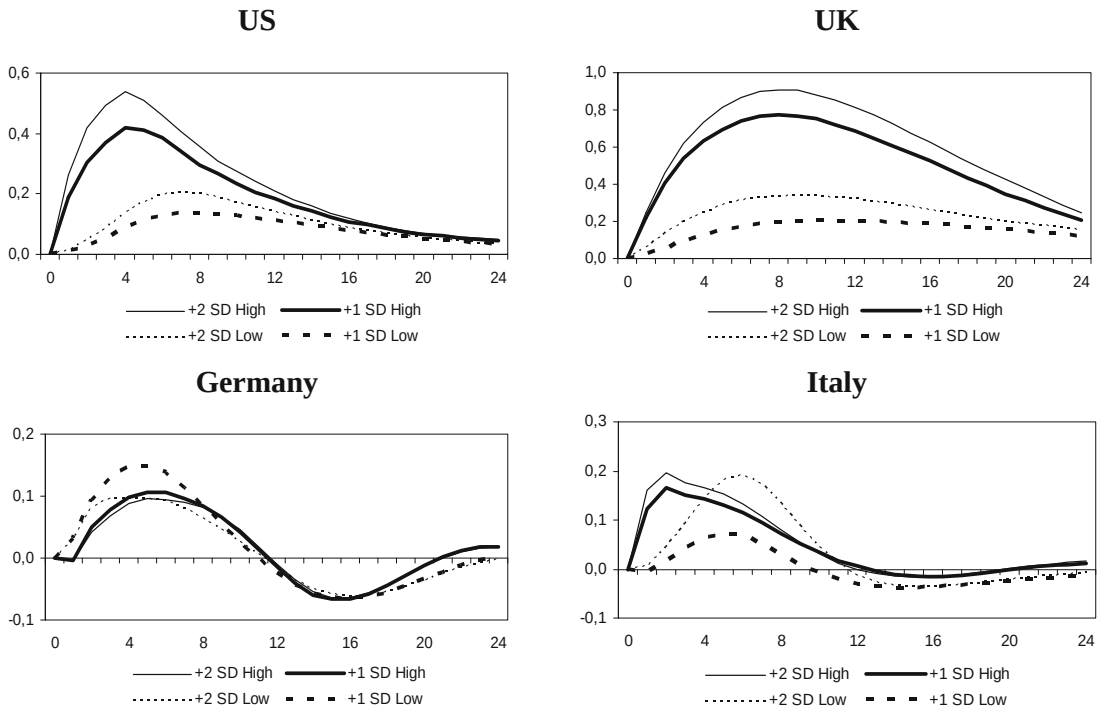
detailed figures available in Appendix 4 show, that the effect of a 2SD shock is about 2.5 times larger than a 1SD shock). The responses to decreases in financial stress are in principal proportional to a +1SD shock except in the U.K. at both horizons. In this case, the impact on output growth of decreasing the financial stress by 2SD is less than proportional. Similarly to Figure 5, we have rescaled the values to a one-unit initial shock (positive and negative), hence we have similar (absolute) values for +/- 1 and 2 SD shocks indicate proportionality in signs and sizes.

The differences among the effects of different shocks are more pronounced in the low stress regime, where the effect of a positive 2SD shock in financial stress is more than proportional in all countries. This suggest a possibility that the economy is more likely to fall into a recession after a financial stress shock, if initially a low stress regime is in place. On the contrary, output increases proportionally in response to reductions in the stress indicator in all countries except in the U.K., where the effect on output growth of an additional decrease in the financial stress measure is minor.

In line with this asymmetry in the response of output growth, the debt ratio rises after a positive shock in the FSI in both regimes (Figure 6). Generally, these increases are non-proportionally larger for a 2SD positive shock in comparison to a 1SD shock. On the other hand, improvements of the conditions in the financial markets decrease government debt, but the difference between a -1SD and a -2SD is rather small. The only exception is Germany, where the increase of the financial stress indicator by a 1SD and

a 2SD causes a similar increase in debt when the economy is initially in the low stress regime. In the case of a high stress regime, the effects of financial stress shocks seem to be proportional both in sign and in size (further results are provided in Appendix A.5).

Figure 6: **Responses of Debt to a Positive Shock in Financial Stress, High and Low Regimes**



Note: The impulse responses were rescaled to the size of the shock of one unit of FSI.

5.3.4 Responses over time

Nonlinear impulse responses depend not only on the estimated model coefficients but also on initial conditions, i.e. whether the economy is in the high financial stress regime at the time of the fiscal shock or not. Likewise, the impulse responses depend also on the entire history of the variables. For example, the persistence of financial stress, as well as its size, might affect the ability of fiscal policy to accomplish a switch from a high stress regime back to a low stress regime.

In the previous sections we presented the overall nonlinear impulse responses derived as the full sample average median impulse responses over both regimes. However, the fact, that nonlinear impulse responses are simulated for each point in time, allows us to investigate the time variation in the fiscal shock effects even in a model with constant parameters in the two

Table 5: **Peak multipliers for the response of output to a fiscal shock**

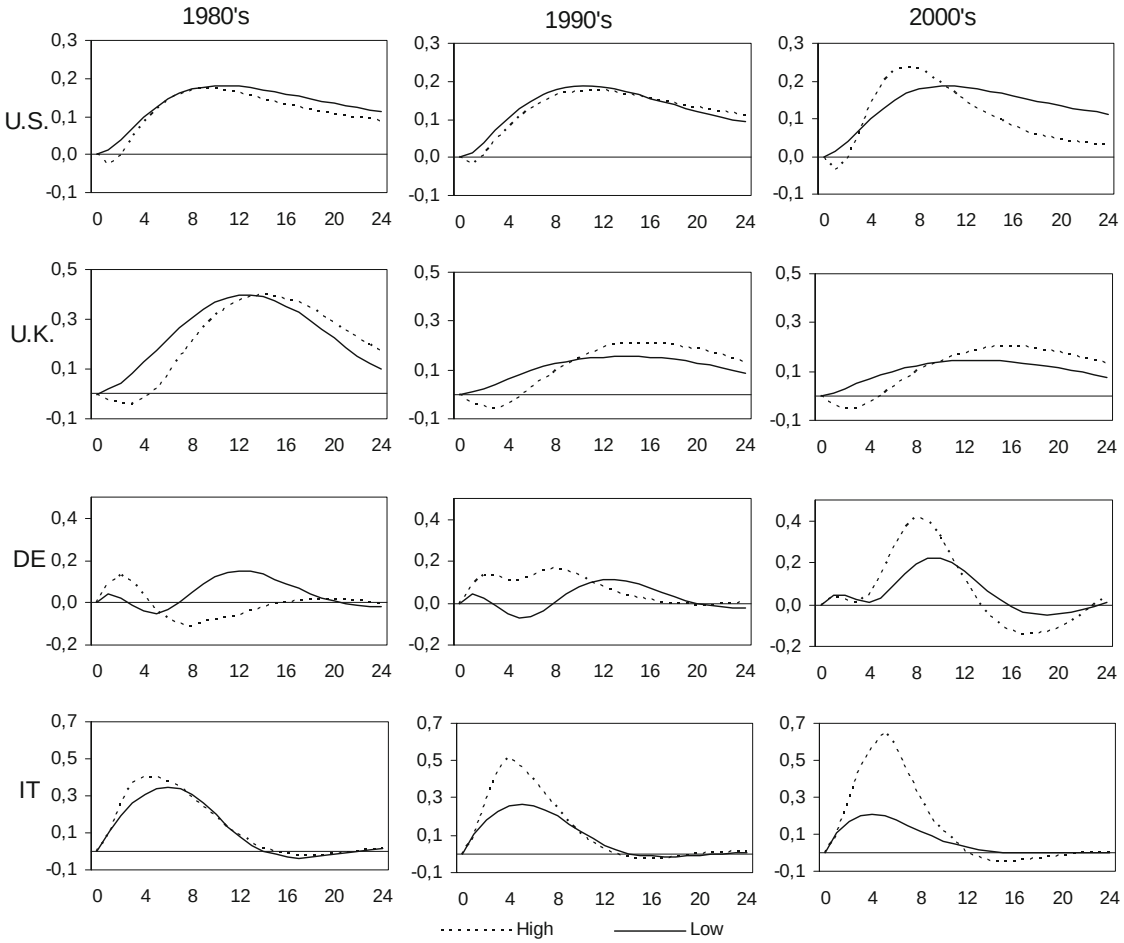
	Financial stress regimes	1980s	1990s	2000s
United States	High	0.174	0.176	0.237
	Low	0.182	0.187	0.187
United Kingdom	High	0.395	0.211	0.204
	Low	0.398	0.155	0.148
Germany	High	0.129	0.166	0.417
	Low	0.152	0.114	0.223
Italy	High	0.403	0.517	0.657
	Low	0.346	0.269	0.207

regimes. For instance, for the U.S., the financial stress periods of the 80's and 90's are associated with lower impulse responses, contrary to periods without stress (1981, 1987-1988, 1990).

Figure 7 shows the impulse responses of output growth to an initial 1 percentage point of GDP debt increase for three periods: 1981Q3-1989Q4, 1990Q1-1999Q4 and 2000Q1-2009Q4 in all countries. Broadly, the effects of fiscal policy on output growth in the high financial stress regime are larger within the first two and half years, after the shock, than in the low stress regime after 2000 in all countries but the United Kingdom. However, the initially larger effect is offset either by lower persistence of the effect (in the United States) or the impact on output growth becomes negative in the long term as in Germany and to some extent in Italy as well. Otherwise the evidence of a larger positive impact of fiscal policy on output growth in times of higher financial stress is weak and country specific. This can also be seen from Table 5 that shows the peak multipliers corresponding to impulse responses (from the Figures and Tables in Appendix A.6, notably for the multipliers at horizons of one, two and three years after the shock; and Figure A.6.5 illustrating time variation with 3D plots).

In the U.S., the difference in the impact of fiscal policy on output in the low financial stress regime is negligible across periods with peak multipliers ranging from 0.182 to 0.187. When the financial stress was above the threshold, the multipliers were slightly lower in the 1980's and in the 1990's with values respectively of 0.174 and 0.176. Hence, the effect of fiscal policy on output growth was actually lower in periods with high stress than with low stress. In the last decade the situation was reversed. For the first three quarters the effect of fiscal policy is still below the impulse response of the low stress regime, but then it increases and the peak multiplier reaches 0.237

Figure 7: **Time variation of nonlinear impulse responses (high and low financial stress regimes): response of GDP to an initial 1 percentage point of GDP debt increase**



earlier than two years after the shock. However, the impact of a fiscal policy shock is not that persistent and returns to zero slightly faster in the high financial stress regime. A more detailed analysis of the simulated impulse responses in the post 2000 decade shows that fiscal policy became more effective in the periods of higher stress, which matches the 2001 recession and the 2008-2009 crisis. The peaks of the impulse responses starting in early 2001 were the largest of the entire sample. The impulse responses associated with starting points in 2008-2009 are depicted in Appendix A.6.

The sharpest fall in the size of the fiscal multiplier occurred in the United Kingdom where it fell, in the low stress regime, from 0.398 in the eighties to 0.148 in the last decade, and from 0.395 to 0.204 in the high stress regime. We should note that this decrease in the size of the multipliers started in 1989 during a period of fiscal consolidation. In the case of the U.S. the multipliers remained lower than average during the 2008-2009 crisis as well.

In Germany, the impulse responses of output growth to a fiscal policy shock are relatively consistent in the 1980s and in the 1990s in the low stress regime. The impact was uncertain for the first two years after the shock with oscillations between positive and negative values, with a peak occurring more than three years after the shock. The high stress regime shows different patterns when comparing these two decades. In the 1980s, a fiscal policy shock increased output growth by a small margin (peaking just after two quarters at 0.129), but these positive effects quickly turned negative. On the other hand, in the 1990s the effects of a debt increase were larger and persistent. After 2000, the effect of a fiscal shock is uncertain for the first year after the shock but then it jumps up to 0.223 in the low financial stress periods and to 0.417 in the high stress periods. Such positive effect lasts up to 12-15 quarters after the shock and then both impulse responses turn into negative values.

The impact of fiscal policy on output growth has a hump-shaped pattern in Italy and it is consistent over time and across regimes. In this case, throughout time the size of the peak multiplier decreased in the low financial stress regime, from 0.346 to 0.207, and the opposite holds for the high stress regime, where it increased from 0.403 to 0.657. As far as the 2008-2009 crisis is concerned, both Italy and Germany depict impulse responses suggesting larger than average impacts on output growth in 2008 but in 2009 sizes of fiscal multipliers decreased.

6 Conclusion

In this paper we analyzed the interactions between fiscal and financial developments in times of financial instability. The effects of fiscal policy were estimated using a threshold vector autoregression with macro, fiscal and financial variables and with regime switching determined by a measure of financial stress. The application of a nonlinear framework with regime switching is motivated by the debate on the ability of fiscal policy to shorten recessions and to facilitate a subsequent recovery, and its empirical adequacy was confirmed by formal nonlinearity test in TVAR model. Furthermore, the identified periods of financial stress are also characterised by lower output growth and in a number of cases coincide with recessions.

To evaluate the impact of both fiscal developments and financial instability on output growth, a set of nonlinear impulse response functions were estimated. Unlike their linear counterparts, nonlinear impulse responses are differences between the simulated paths of endogenous variables with and without an initial shock, either in fiscal policy or in financial stress conditions. Given its nature, this approach allows to take into account future regime switches caused by a shock on any endogenous variable and not only on financial stress, which determines the alternative regimes in our model.

The other advantage is that the framework of nonlinear impulse responses can be used to recover time variance in impulse responses.

The empirical results and the implications of our model are threefold. First, the differences among the fiscal multipliers of various sizes and signs of shocks are small in all countries. However, the initial state of the economy matters and both multipliers and the estimated responses to fiscal shocks differ across regimes. The results are also quite country specific. The difference between the high and low financial stress regimes is lowest in the United States, but the peak of the response is reached earlier in the high stress regime compared to the low stress regime. Moreover, fiscal policy shocks have a larger effect on output growth in both Euro area countries, Germany and Italy, although the multipliers for Germany are lower. On the other hand, in the United Kingdom, the multipliers are much lower in the high financial stress regime.

Second, the ability of fiscal policy to affect output growth evolved over time. Indeed, the fiscal multipliers increased since the 1990's in the high stress regime in all countries except in the United Kingdom where they were stable. The multipliers associated to the responses with initial conditions in the low financial stress regime decreased over time in the United Kingdom and in Italy, remained stable in the United States, and increased in Germany.

Third, financial stress has strong negative effects on output growth and its effects are also nonlinear. The negative effect is largest in the high stress regime, but it is still rather proportional, and the difference between small and large increases of financial stress is small. In the low stress regime, output growth falls much more in response to a large increase in financial stress suggesting an increased probability of a shift in the regime.

Therefore, we have found in our dataset the evidence of nonlinearities in the effects of a fiscal shock depending on the initial conditions, determined by the existence of financial stress, diverse levels of government indebtedness, and, of course, implicitly assumed different monetary policy behaviour. In addition, both the multipliers and the nature of these nonlinearities vary across countries and evolve over time.

Finally, one should also note that since the Financial Stress Index captures three different forms of financial stress: the banking, securities, and exchange rate related stress, the transmission mechanism of fiscal developments may work differently depending on the form of stress. In particular, the impact of fiscal policy in a period of bank stress may differ from the impact under an exchange rate stress depending also on the economy's openness.

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A Appendix

A.1 Algorithm to compute nonlinear impulse responses

1. The shocks for the periods from 0 to q are drawn from the residuals of the estimated VAR model.

2. For each initial value this sequence of shocks is fed through the model to produce forecasts conditional on initial conditions.

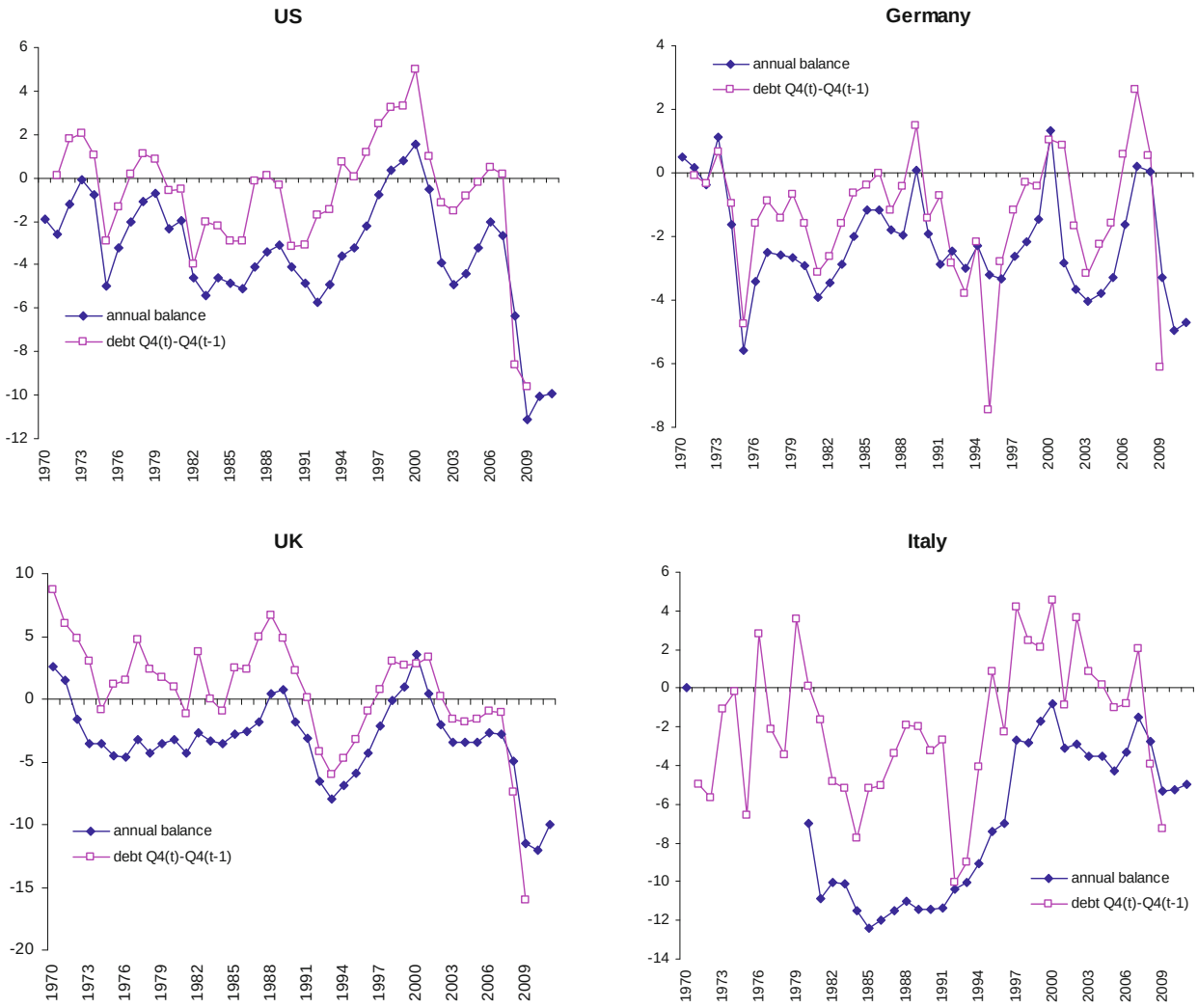
3. Repeat step 2) with the initial shock into one variable equal to +/- 1 or 2 SD to get forecasts if there was an initial shock.

4. The difference between the forecasts from step 2 and 3 is the impulse response function. Repeat this 500-times and derive an average impulse response for this particular initial condition

5. Repeat steps 2-4 for each initial conditions. Final impulse responses are average impulse responses over initial conditions of each regime. Confidence bands derived from quantiles of empirical distribution. We use a 50% confidence bands here.

A.2 Fiscal data compared

Figure A.2.1: **Government debt and budget balance ratios, in % of GDP**



Note: inverted scale for the change in the debt ratio.
Sources: AMECO database (annual budget balance data) and national central banks (quarterly government debt data).

A.3 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.

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.

Data Sources

United States

Nominal GDP:	IMF IFS (IFS.Q.111.9.9B.B$C.Z.F.$$$).
GDP deflator:	IMF IFS (IFS.Q.111.9.9B.BIR.Z.F.$$$).
Interest rate:	Federal funds rate, FRED, series FEDFUNDS.
Government debt:	Federal Debt held by the Public, FRED, series FYGFDPUN.
Stock prices:	Dow Jones Industrial Index, quarterly averages.
TED spread:	Spread between treasury bills rate (3M) and interbank interest rate represented by the Eurodollar 3M rate, IMF IFS.

United Kingdom

Nominal GDP:	IMF IFS (IFS.Q.112.9.9B.B$C.Z.F.$$$), rolling sum of 4 quarters to calculate the annual GDP.
GDP deflator:	IMF IFS (IFS.Q.112.9.9B.BIR.Z.F.$$$).
Interest rate:	End of quarter Sterling interbank lending rate, 1 month, average; Bank of England, series IUQVNEA.
Government debt:	Since 2000 Quarterly Government Debt (Maastricht Debt) for General Government, Eurostat; older data from other sources, merged using growth values in overlapping periods (Public sector debt, National Statistics, series BKQK; Quarterly amounts outstanding of General Government sterling and all foreign currency consolidated gross debt total (in sterling millions), Bank of England, series DPQG004).
Stock prices:	Financial Times Stock Exchange (FTSE) 100 Index - Historical close, end of period, UK pound sterling, provided by DataStream.
TED spread:	Spread between treasury bills rate (3M) and interbank interest rate represented by LIBOR 3M rate, IMF IFS.

Germany

Nominal GDP:	Federal Statistical Office, DeStatis, National Accounts, Gross Domestic Product since 1970, Quarterly and Annual Data. The time series before the German Unification was rescaled to the post-unification period using growth rates of quarterly data that overlap in 1991. The GDP deflator was calculated as the ratio of nominal and real GDP (available as index of 2000=100 only), rescalled to the post unification period using quarterly growth rates as well.
CPI:	IMF IFS (IFS.Q.134.6.64).
Interest rate:	Money market rates reported by Frankfurt banks, monthly average of overnight money.
Government debt:	Statistische Angaben: Umrechnungsart: Endstand, Euro, Millionen, Bundesbank. SeriesBQ1710, BQ1720, Central, state and local government debt; Total debt (excluding hospitals).
Stock prices:	Share prices, IMF IFS.

Italy

Nominal GDP:	OECD (OEO.Q.ITA.GDP).
GDP deflator:	IMF IFS (OEO.Q.ITA.PGDP).
Interest rate:	money market rate, IMF IFS.
Government debt:	General Government debt, Banca d'Italia.
Stock prices:	Share prices, IMF IFS.

A.4 Effects of Fiscal Policy Shock

Figure A.4.1: **Effects of the Fiscal Policy Shock in the U.S. (+/- 1,2SD shock, High vs. Low Stress Regime)**

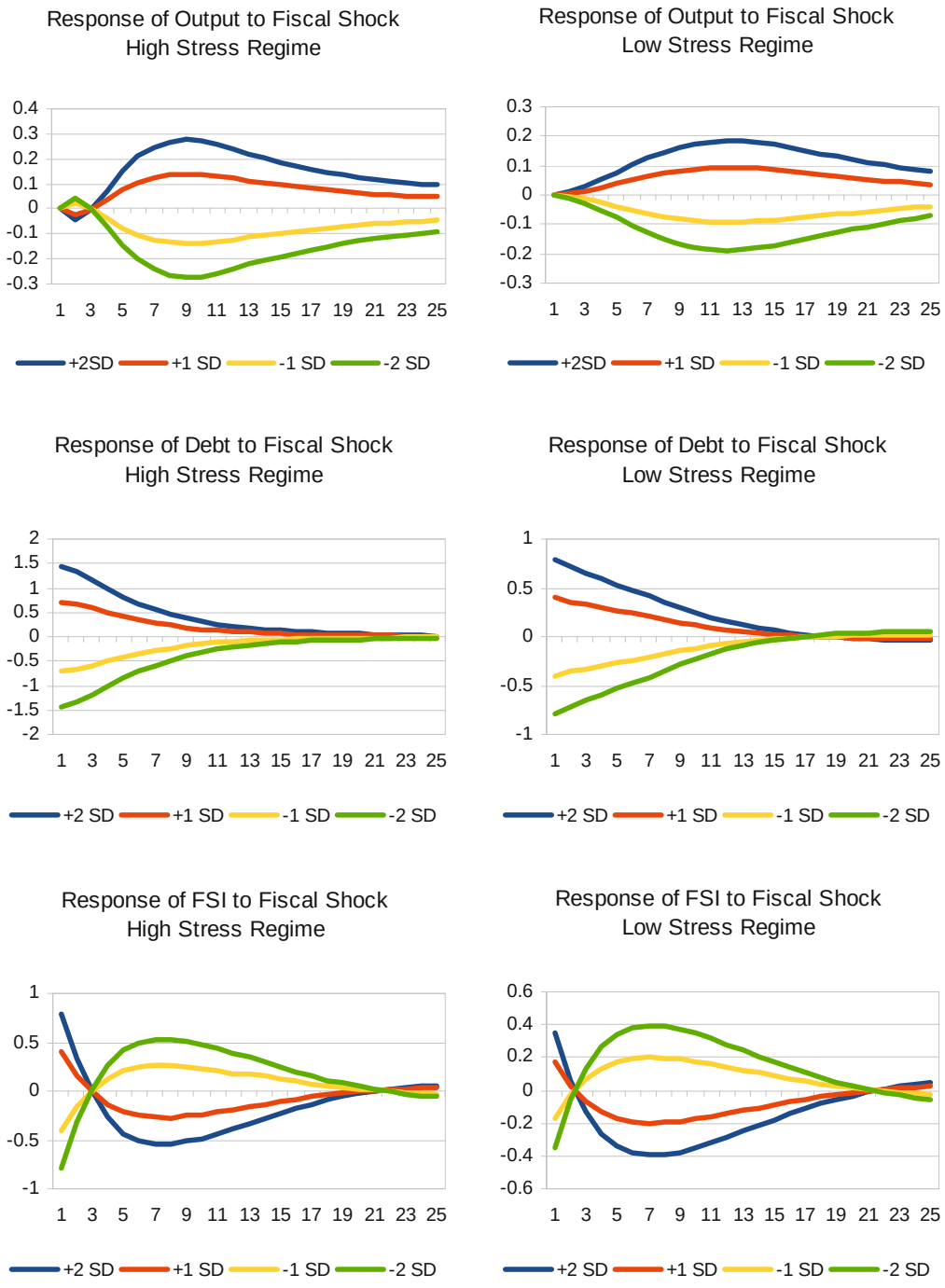
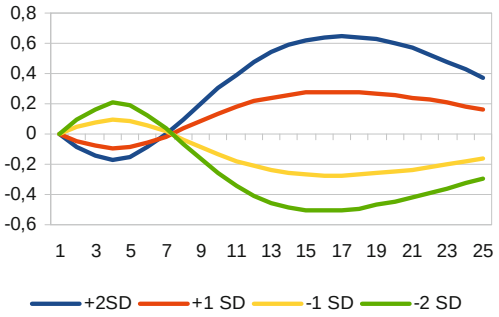
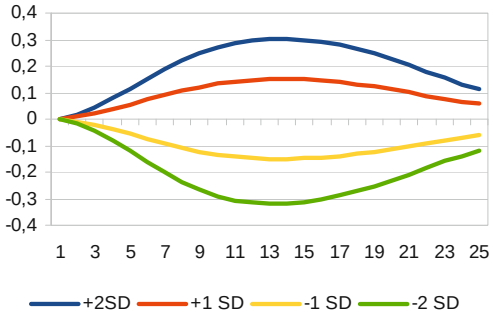


Figure A.4.2: **Effects of the Fiscal Policy Shock in the U.K. (+/- 1,2SD shock, High vs. Low Stress Regime)**

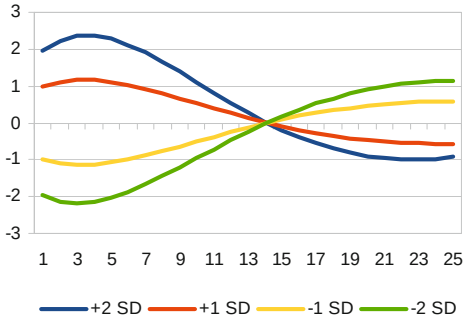
Response of Output to Fiscal Shock
High Stress Regime



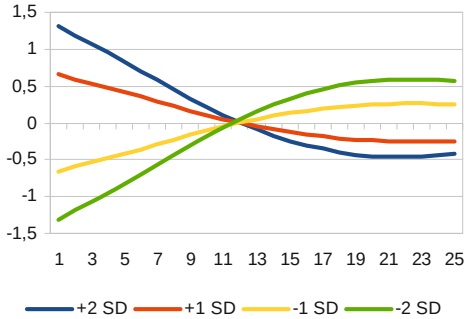
Response of Output to Fiscal Shock
Low Stress Regime



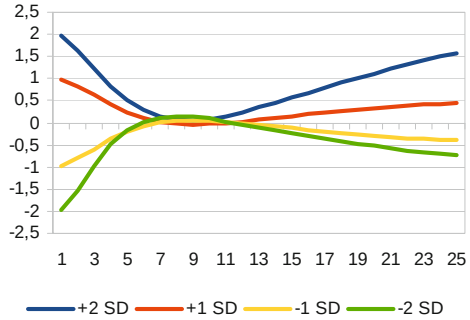
Response of Debt to Fiscal Shock
High Stress Regime



Response of Debt to Fiscal Shock
Low Stress Regime



Response of FSI to Fiscal Shock
High Stress Regime



Response of FSI to Fiscal Shock
Low Stress Regime

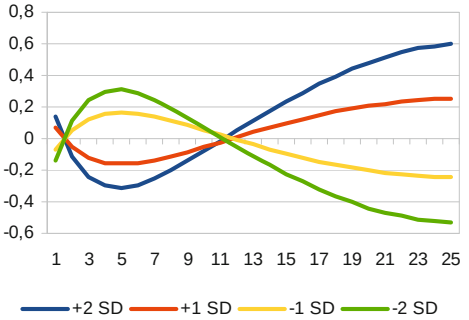
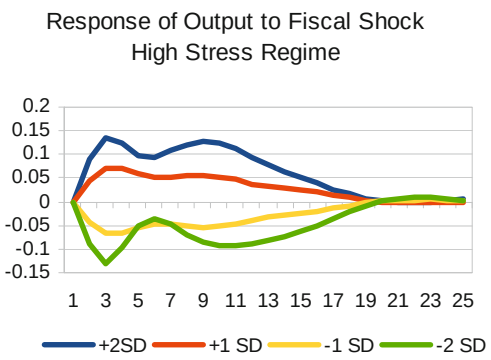
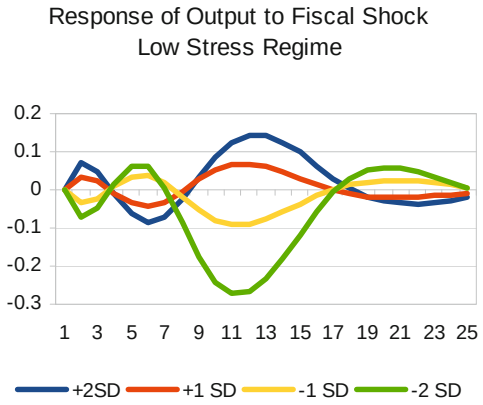
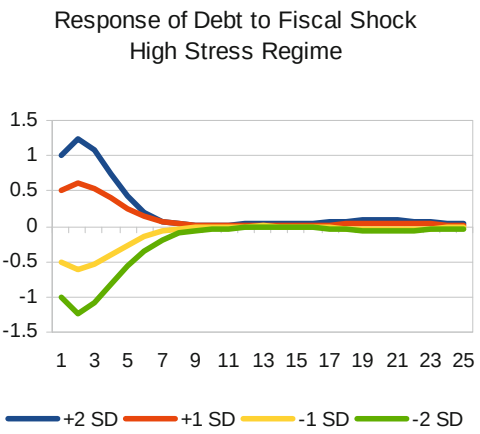
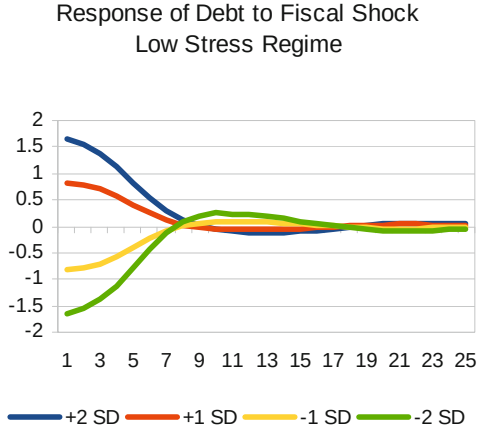


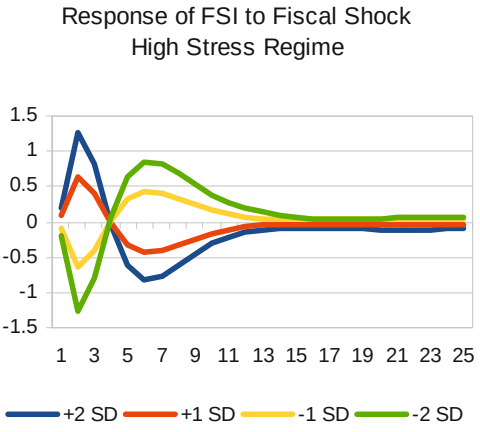
Figure A.4.3: **Effects of the Fiscal Policy Shock in Germany (+/- 1,2SD shock, High vs. Low Stress Regime)**











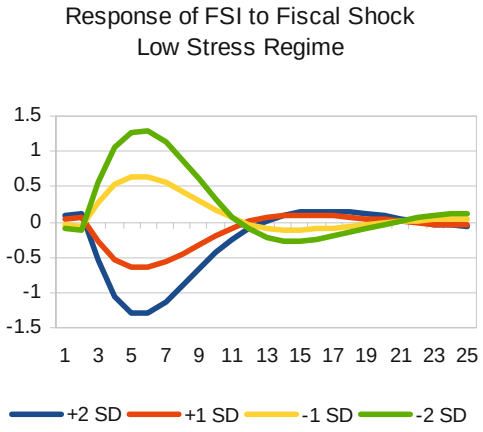
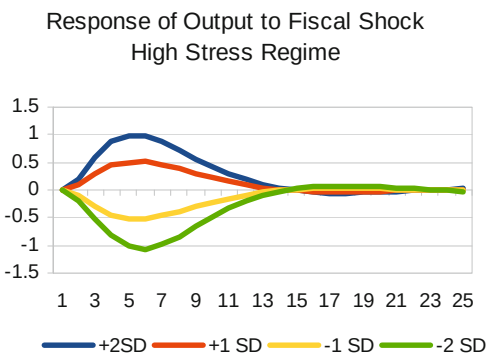
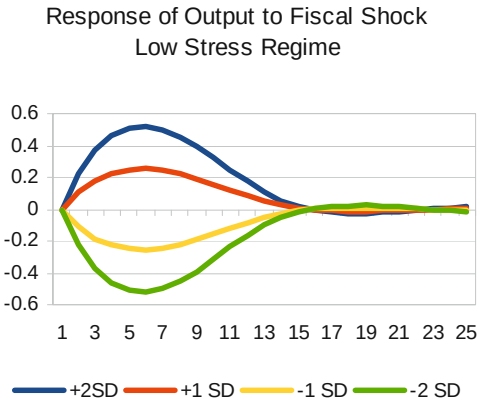
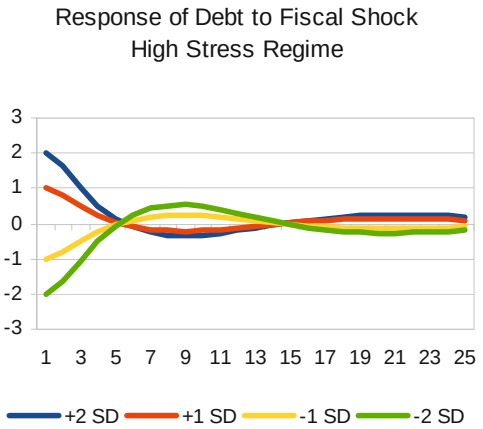
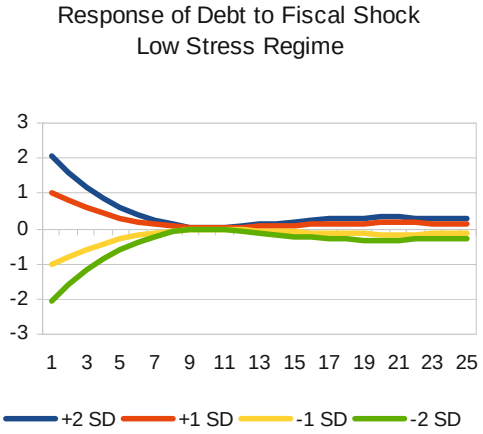


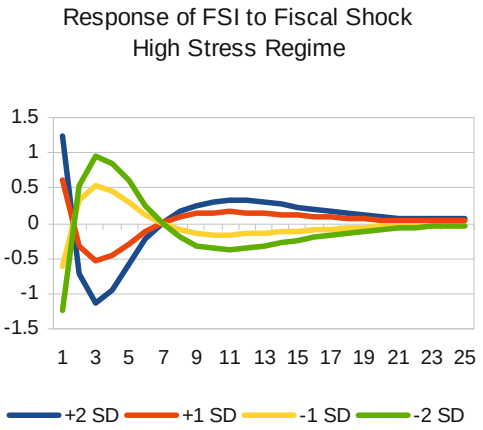
Figure A.4.4: **Effects of the Fiscal Policy Shock in Italy (+/- 1,2SD shock, High vs. Low Stress Regime)**











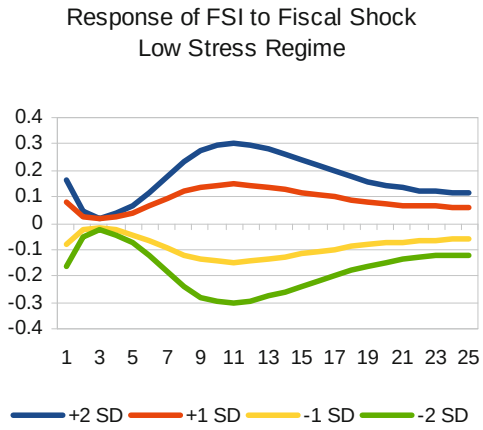
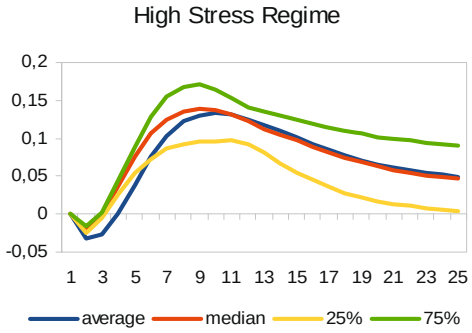
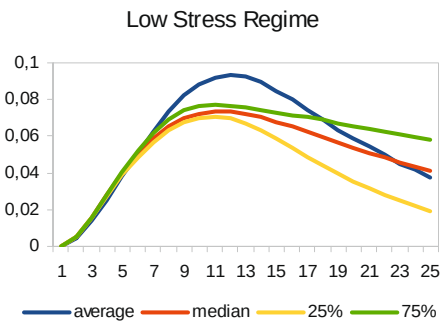


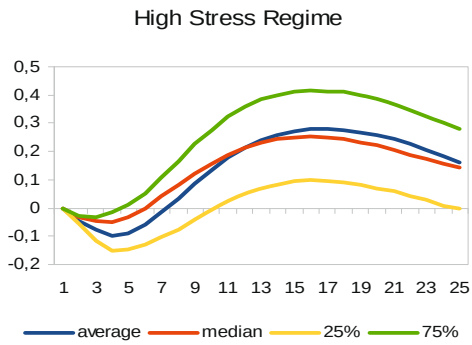
Figure A.4.5: **Distribution of the Responses of Output to Fiscal Policy Shock (+/- 1 SD shock)**

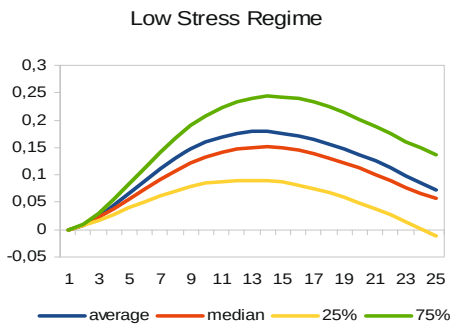
United States



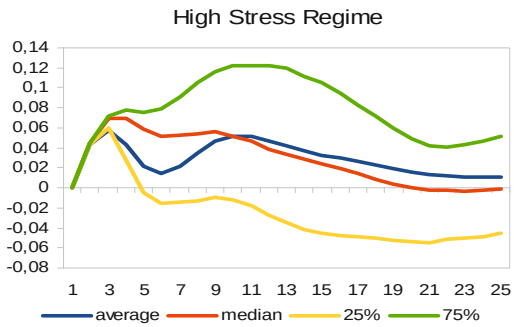


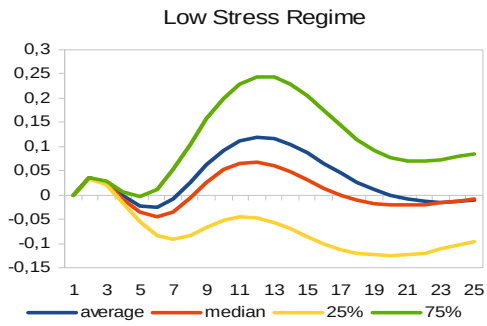
United Kingdom



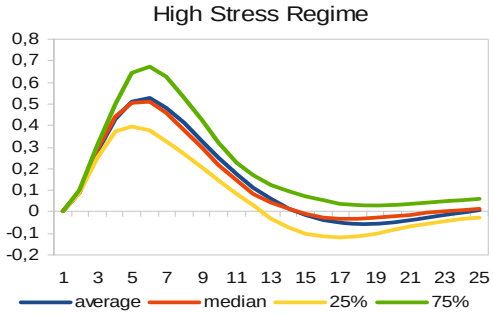


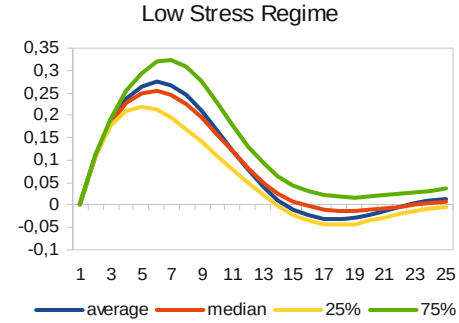
Germany





Italy





A.5 Effects of shock in FSI

Figure A.5.1: **Financial Stress Shock (+/- 1,2SD shock, High vs. Low Regime), U.S.**

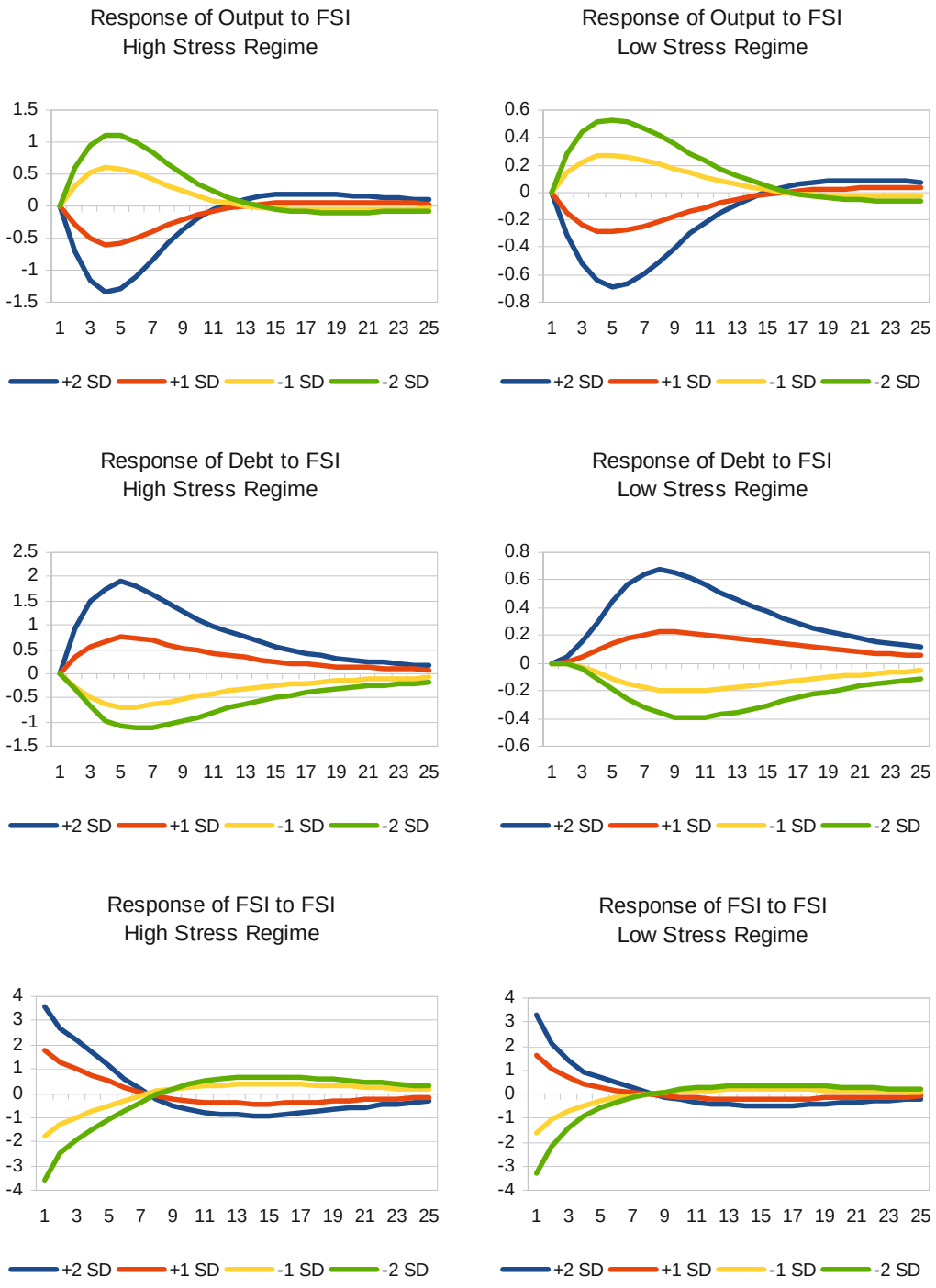


Figure A.5.2: **Financial Stress Shock (+/- 1,2SD shock, High vs. Low Regime), U.K.**

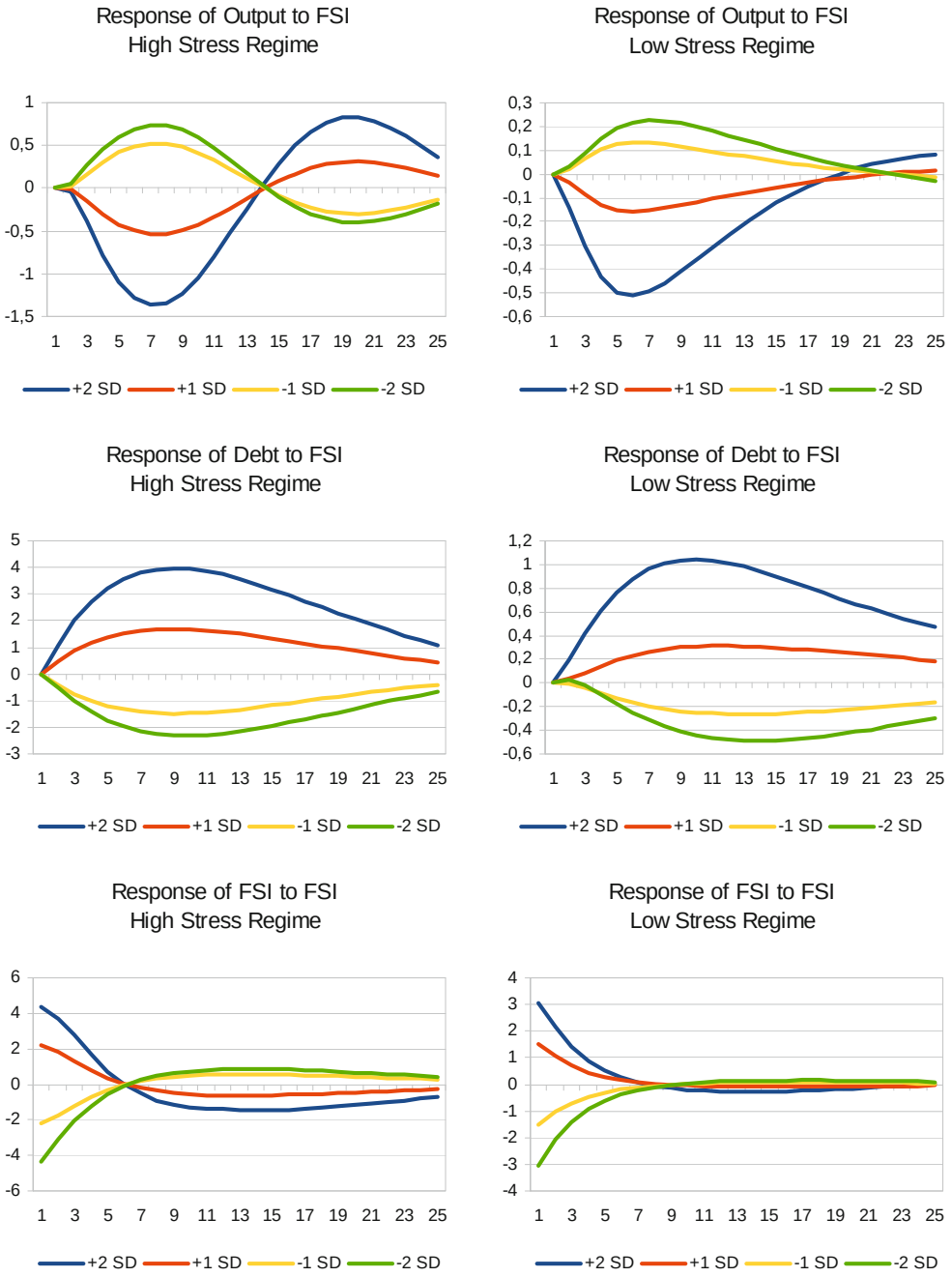


Figure A.5.3: **Financial Stress Shock (+/- 1,2SD shock, High vs. Low Regime), Germany**

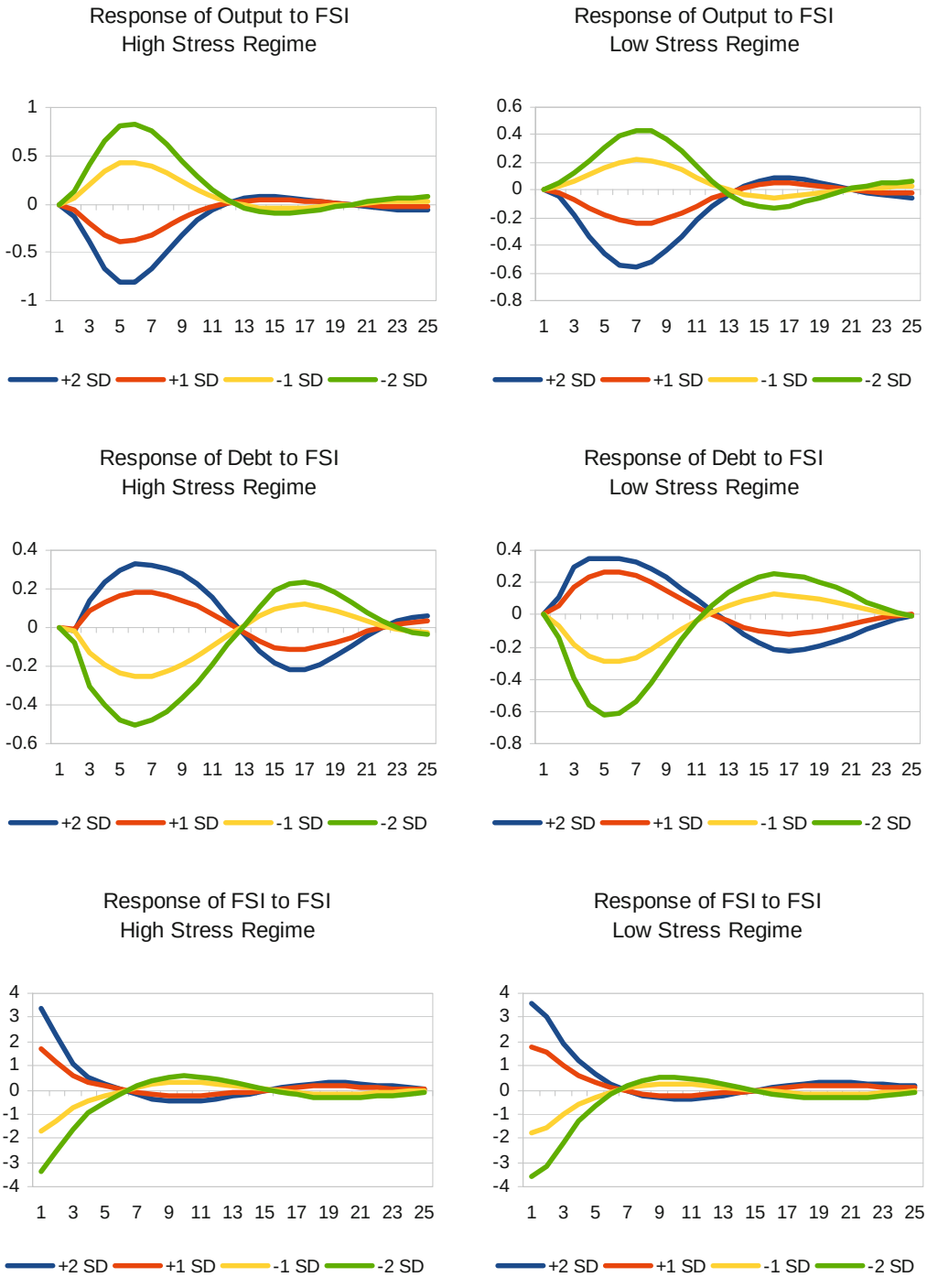
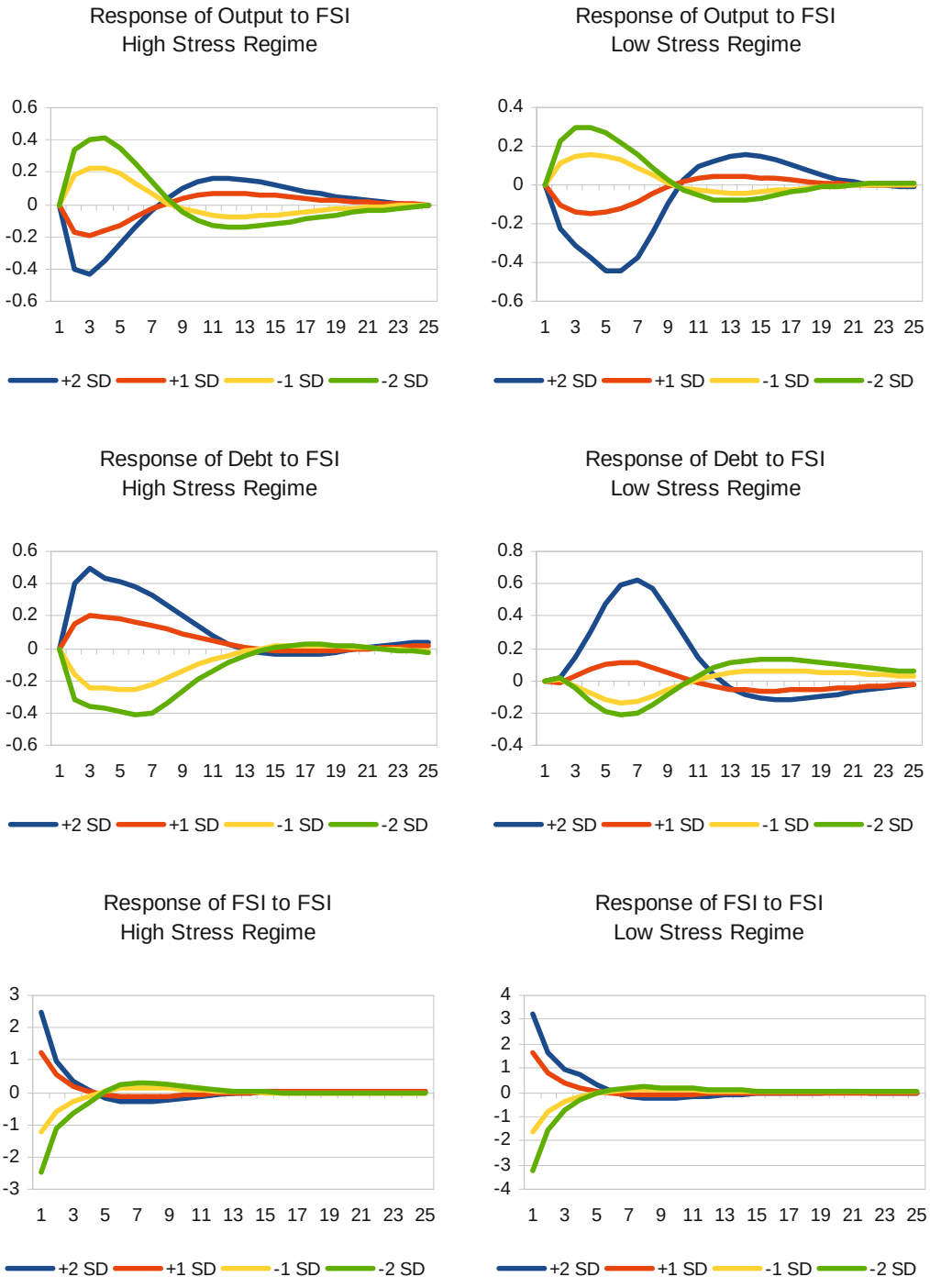


Figure A.5.4: **Financial Stress Shock (+/- 1,2SD shock, High vs. Low Regime), Italy**



A.6 Impulse Reponses of Output to Fiscal Shock, sub-samples

Table A.6.1: **Multipliers at selected horizons, for the response of output to a fiscal shock**

	Regimes	1981Q3:1989:Q4			1990Q1:1999Q4			2000Q1:2009Q4		
		4Q	8Q	12Q	4Q	8Q	12Q	4Q	8Q	12Q
United	High	0.084	0.168	0.16	0.076	0.161	0.175	0.139	0.233	0.145
States	Low	0.099	0.172	0.18	0.101	0.177	0.184	0.1	0.178	0.184
United	High	-0.02	0.211	0.375	0.076	0.161	0.175	-0.03	0.096	0.176
Kingdom	Low	0.126	0.307	0.398	0.101	0.177	0.184	0.066	0.124	0.145
Germany	High	0.034	-0.11	-0.058	0.108	0.166	0.075	0.044	0.417	0.116
	Low	-0.041	0.046	0.152	-0.049	0.003	0.112	0.013	0.195	0.162
Italy	High	0.403	0.294	0.083	0.517	0.24	0.024	0.573	0.294	0.003
	Low	0.307	0.31	0.076	0.257	0.204	0.045	0.207	0.116	0.029

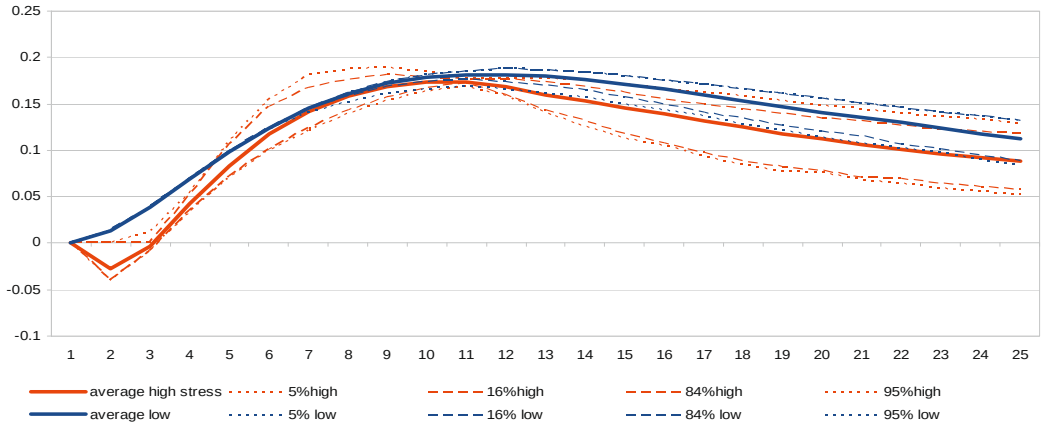
Table A.6.2: **Peak multipliers, for the response of output to a fiscal shock: the 2008-2009 recession**

	2008Q2	2008Q3	2008Q4	2009Q1	2009Q2	2009Q3	2009Q4	average
United States	0.268	0.289	0.263	0.23	0.2	0.181	0.18	0.189
United Kingdom	0.286	0.221	0.212	0.217	0.187	0.121		0.279
Germany	0.392	0.367	0.342	0.228	0.192	0.185	0.212	0.139
Italy	0.81	1.031	1.097	0.536	0.308	0.228		0.505

Figure A.6.1: **Impulse responses of output to an initial 1% GDP debt increase, U.S.**

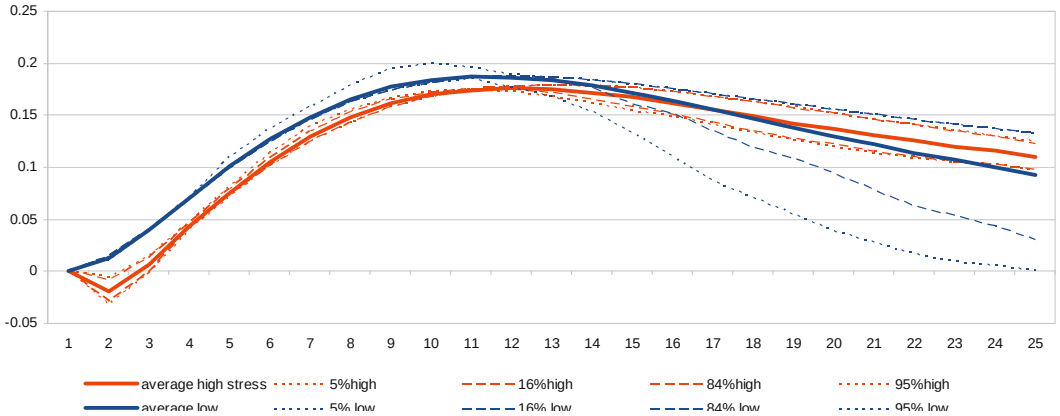
1981Q3 - 1989Q4

Response of Output to Fiscal Shock +1% GDP



1990Q1 - 1999Q4

Average Responses of Output to Fiscal Policy Shock +1% GDP



2000Q1 - 2009Q4

Average Responses of Output to Fiscal Shock +1% GDP

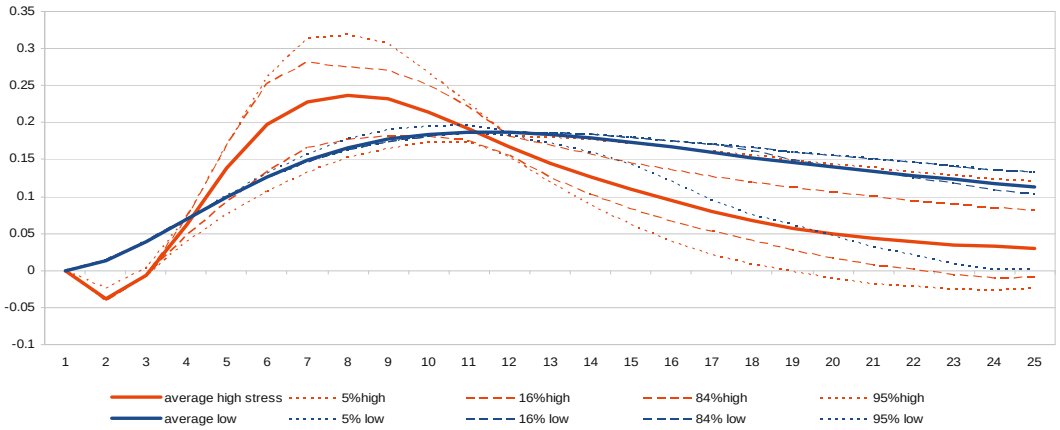
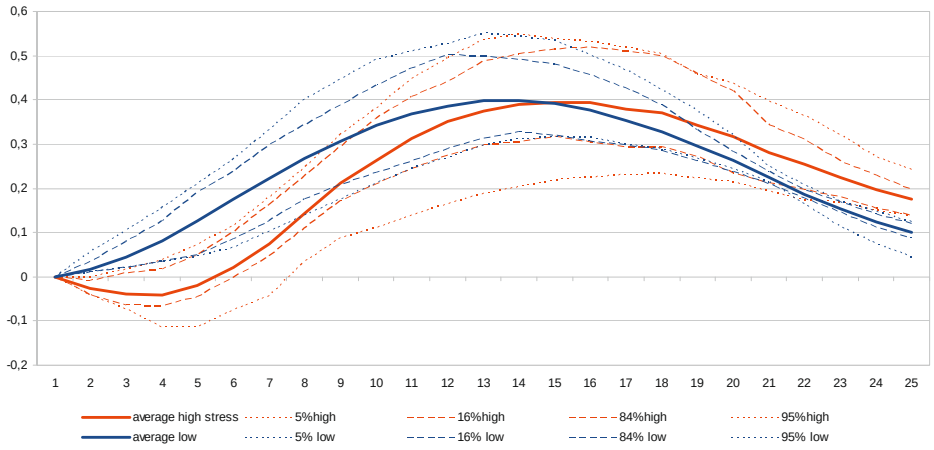


Figure A.6.2: **Impulse responses of output to an initial 1% GDP debt increase, U.K.**

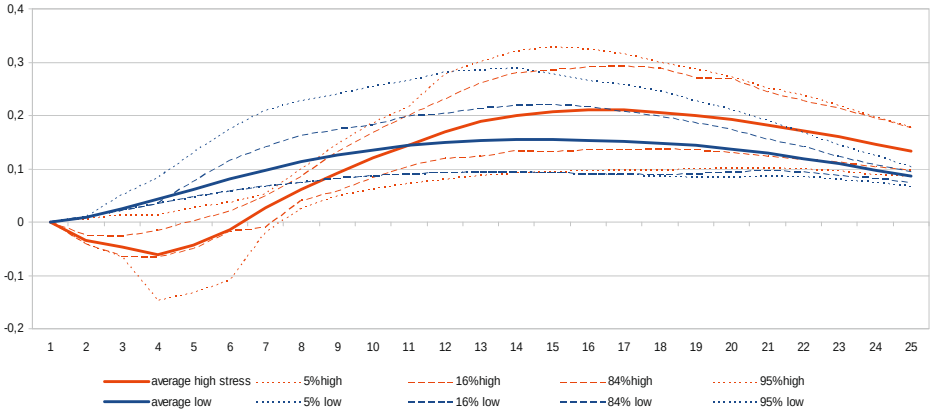
1981Q3 - 1989Q4

Response of Output to Fiscal Shock +1% GDP



1990Q1 - 1999Q4

Average Responses of Output to Fiscal Policy Shock +1% GDP



2000Q1 - 2009Q4

Average Responses of Output to Fiscal Shock +1% GDP

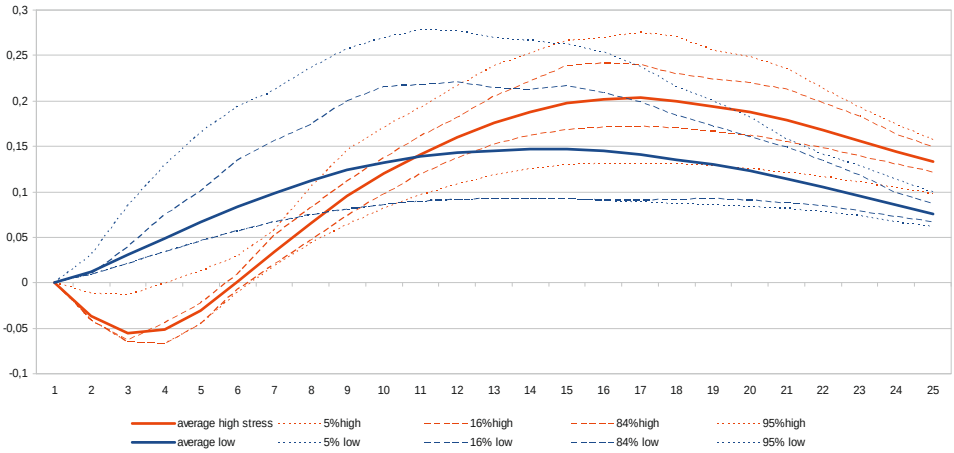


Figure A.6.3: **Impulse responses of output to an initial 1% GDP debt increase, Germany**

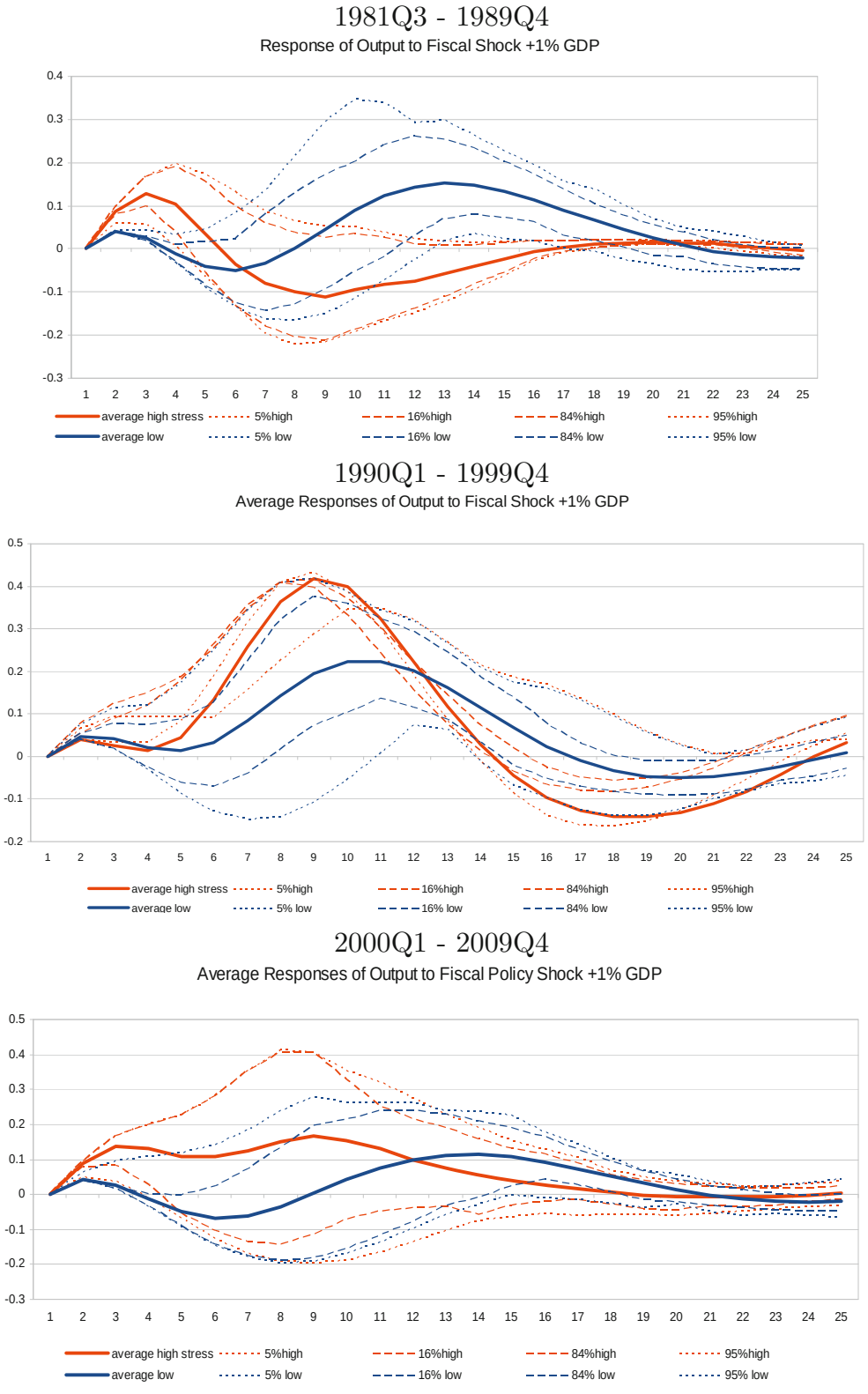


Figure A.6.4: **Impulse responses of output to an initial 1% GDP debt increase, Italy**

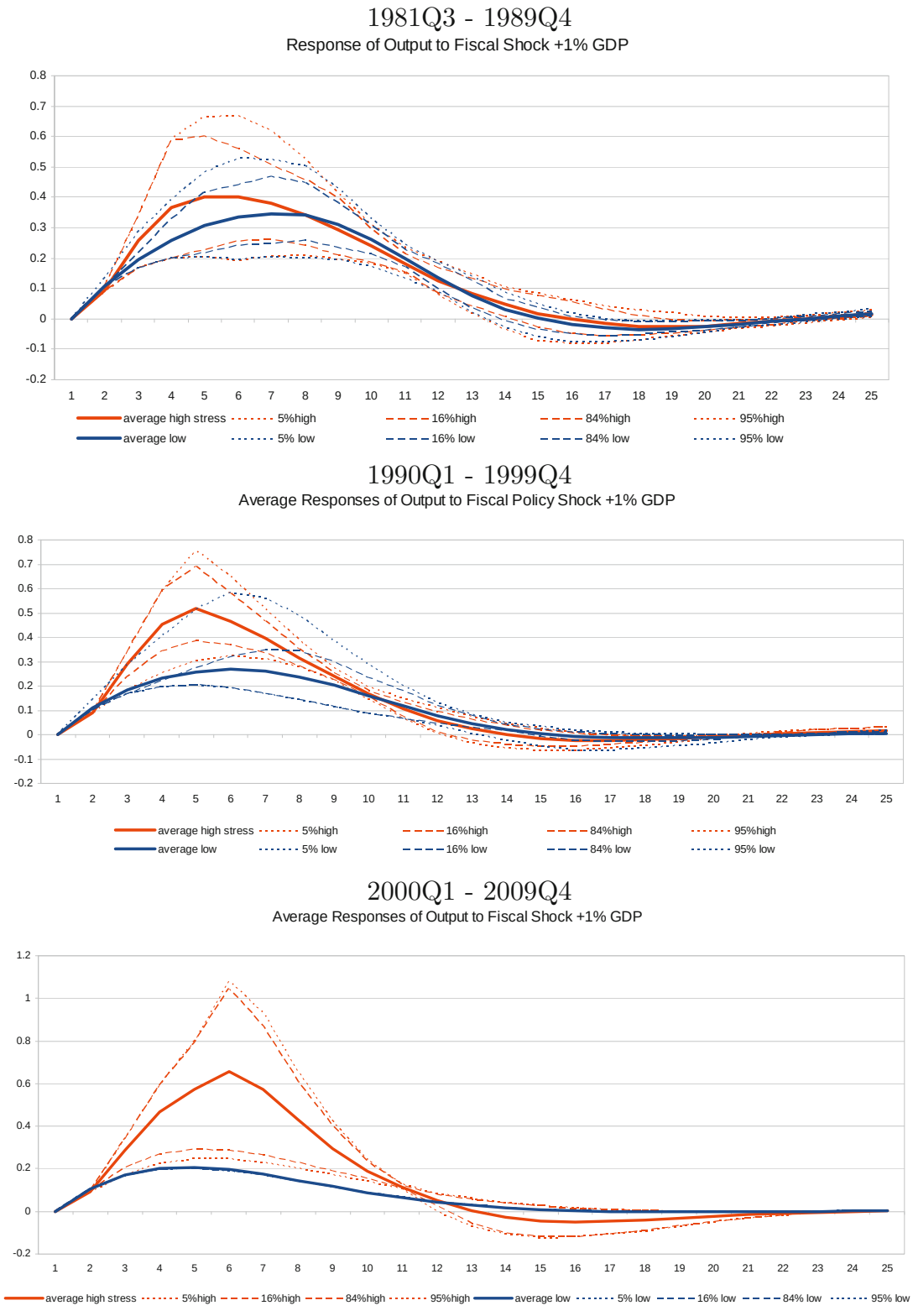
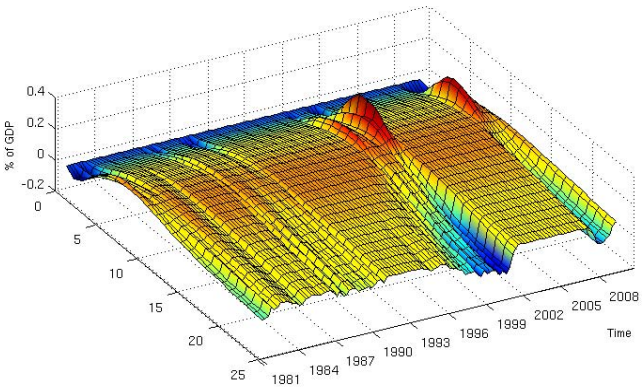
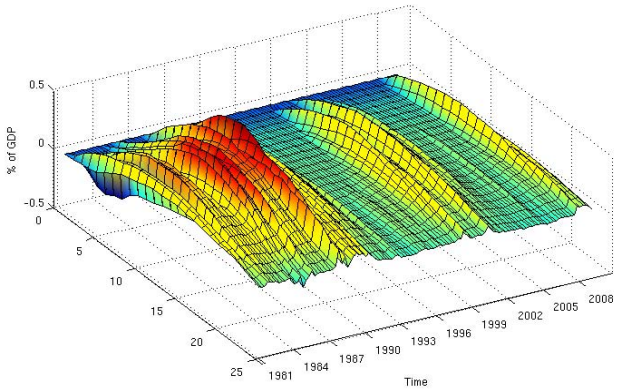


Figure A.6.5: **Median impulse responses of 1% fiscal shock over time**

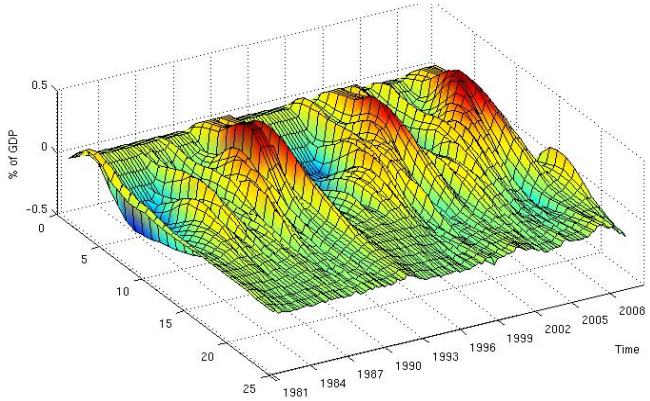
United States



United Kingdom



Germany



Italy