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ECONOMETRIC ANALYSIS OF REGIME SWITCHES AND OF FISCAL MULTIPLIERS

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Econometric Analysis of Regime Switches and of Fiscal Multipliers

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Abstract

Debates on the appropriate response of fiscal policy to economic downturns, such as the debates on the merits of austerity measures in Europe, have been centered on the size of the fiscal multipliers. Indeed, empirical and theoretical evidence suggests larger multipliers at times of recession than in expansions, thereby conditioning the success of fiscal consolidation – the higher the multiplier, the more costly the austerity would be in terms of growth of output. We extend the technique of vector autoregressions (VARs) to account for the possibility of time-variant fiscal multipliers for France, Germany, Italy and the United States. We estimate a 3-variable non linear smooth transition vector autoregression, following Auerbach and Gorodnichenko (2012a). Our results suggest that the output multiplier of government purchases is significantly higher in recessions than expansions for the United States, France, and Germany.

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Contents

1 Introduction

Since 2007, Eurozone countries have seen their debt-to-GDP ratios increase substantially, if not skyrocketed. This has led to pressures on governments to consolidate their finances and budgets in European countries are now being consolidated rapidly. A vast fiscal policy debate has thus started raging on fiscal austerity and the macroeconomic effects of fiscal adjustments, centered on the question of whether austerity could be 'self-defeating', meaning that it could worsen the fall in activity. The debate has particularly crystallized around the notion of the 'Keynesian multiplier' , which measures the euro response of GDP to a 1€ exogenous spending increase or tax cut. The literature contains a variety of empirical and theoretical studies investigating the size of the fiscal multiplier, yet they present no unambiguous response. Indeed, in a survey of the literature, Perotti (2008) observes that "perfectly reasonable economists can and do disagree on the basic theoretical effects of fiscal policy and on the interpretation of existing empirical evidence." The multipliers themselves depend, along with the methodology used, on the nature of the shock, the monetary policy and the degree of openness of the economy. Christiano *et al.* (2011) find a higher multiplier effect near the zero lower bound, so does Woodford (2011), in a New Keynesian DSGE model with a Central Bank adjusting the path of the real interest rate. He demonstrates that fiscal expenditures are effective when there is a persistence of the zero lower bound interest rate (happening in recessions), and when there is a delay of price and wage adjustment. Corsetti, Meier and Müller (2012a) have shown that the higher the degree of openness of the economy, the lower the multiplier, because the effects of fiscal shocks leak to other countries, via an increase of imports and reduction of exports. Similarly, multipliers are shown to hinge on financial development, capital mobility and the exchange rate regime. All these empirical evidence support the Keynesian theory which suggests an evolution of the size of the multiplier according to the state of the economy. It states that the economy may not fully employ available resources because of insufficient demand. An increase in government spending raises resources use (or activates the use of idle factors of production), thereby implying a positive response of output, consumption and investment to a spending shock. Whence stems a state-dependence — we expect this effect to be larger when the economy is operating with slack. However, the literature has predominantly been focusing on a single multiplier, and multi-regimes models have come on stage only recently.

Hence, these arguments constituting grounds for heterogenous multipliers, we allow multipliers to be time-dependent in our model. We aim to contribute to the debate surrounding the quantitative effects of fiscal policies along the business cycle, given the fiscal discipline countries of the European Monetary Union have been committed to since the most acute phase of the crisis, as well as the "fiscal cliff" in the United States. Our starting point is the paper by Auerbach and Gorodnichenko (2012a) who estimate multipliers for government spending and taxes on U.S. data. They estimate a smooth-transition VAR (henceforth STVAR), in which the parameters of the VAR are a convex combination of two sets of parameters – one set for periods of output growth and one governing periods of recession. Following their study, we will extend the VAR specification by introducing a non-linearity, that is to say two regimes, which are determined through a switching variable, the moving average of GDP growth. We estimate a two-regime STVAR in log levels and allow regime to switch when a fiscal shock is implemented. We focus on the United-States (1947:1-2012:2), France (1960:1-2012:2), Italy (1991:4-2012:2) and Germany (1970:1-2012:2). In line with the literature, we identify our structural fiscal shocks through institutional information and a Cholesky decomposition (Blanchard and Perotti, 2002) of the VAR residuals. Our empirical results provide evidence that the size of the government multiplier in France and in the U.S. evolved significantly during our sample period, with higher multipliers in downturns, the difference being less marked for Germany and the results being inconclusive for Italy. We innovate from their study with a wider country coverage and enlarge the specification by: i) decomposing the effect between consumption and investment; ii) conditioning on monetary policy; iii) estimating the effect on other macroeconomic variables (private consumption and investment) and labor variables (unemployment rate). We observe a similar asymmetry in the response of the variables considered, following a spending shock.

The paper is organized as follows: the second section will review the literature on fiscal multipliers and multi-regimes VAR. The analytical framework is presented in section 3. Section 4 describes the data and the construction of the budget variables – government spendings and revenues as well as data sources. Section 5 presents our empirical results, before conducting some further specifications in section 6. Section 7 concludes.

2 Literature review

There exists a voluminous literature related to fiscal multipliers, which can be divided in two strands. The first strand regroups models that are based on New Keynesian DSGE models. Most of these models present contrasted results, and the multipliers obtained from these models depend substantially on the structural features of the economy (e.g nominal or real rigidities), the exchange rate regime, the monetary policy, the nature of the fiscal shock (such as the persistence of the shock, permanent fiscal expansions yielding lower multipliers because of a stronger negative wealth effect) and other factors such as financial frictions. Prominent examples include Woodford (2011) as mentioned previously, who introduces price rigidities and finds larger multipliers[1] or Galí *et al.* (2007) who allow for a share of financially constrained households.

The other strand of the literature focuses on VAR models, relying on different methodologies for the identification of the shocks. A prominent example is Blanchard and Perotti (2002), who, using Cholesky decomposition and decision lags in policy making as an identification strategy of fiscal shocks, find both short-term and long-term multipliers of 0.5. Galí *et al.* (2007), using a Cholesky decomposition as well, find a short-term multiplier around 0.7 with a midterm-term multiplier more than twice that size, results that are similar to the ones found by Fatás and Mikhov (2001), who focus on shorter U.S. data (1960:1-1996:4). Mountford and Uhlig (2009), relying on sign restrictions on impulse responses as an identification strategy, present contrasting impact multipliers, around 0.65 and 0.46 in the short-term and negative (-0.22) in the medium-term, for a similar sample (1955:1-2000:4). An alternative method for identification of the exogenous shocks is also presented in a study by Romer and Romer (2010) focusing on events of large tax adjustments. Their tax shocks are based on narrative records (president speeches, executive-branch documents and congressional reports), which allow them to classify legislated tax changes into endogenous (short-run countercyclical policy) and exogenous concerns. Regressing output on contemporaneous and lags of the exogenous tax changes in an ordinary least squares, they find a high contractionary effect of the tax increase (with a multiplier greater than one), broader than when using changes in the cyclically adjusted revenues. Similarly, Ramey (2011) constructs two new variables (one based on news on military spending, the other on the Survey of

[1] It is justified by the fact that firms increase output and not prices as a response to increases in aggregate demand.

Professional Forecasts) to account for anticipations. She considers the effects of the defense news variable in a VAR and finds a multiplier around 1.1.

However, many of the studies mentioned previously assumed that the impact of fiscal policy was homogenous across the different states of the economy and employed linear time series models. Only recently did empirical studies have started focusing on the non-linearity of fiscal multipliers and on multi-regimes VARs. Three main tools are being used, namely threshold vector autoregression (TVAR), Markov switching models (MSVAR) and smooth transition VAR (STVAR). Baum and Koester (2011) use a TVAR, with output gap as the threshold variable, and follow a Blanchard-Perotti identification scheme to focus on fiscal multipliers in Germany. While their estimates are small, they find larger spending multipliers in times of negative output gap, reaching 1.04 four quarters after the shock, compared to 0.36 in expansion. Bouthevillain and Dufrenot (2011), focusing on quarterly data for France (1970:1-2009:4), estimate a Markov switching model with time-varying transition probabilities applied to various macroeconomic variables (GDP, private consumption, business investment and private employment). Their methodology presents some advantages, insofar as their two regimes are determined endogenously, and it enables determining the economic conditions that influence a switch from a state to another. Similarly, they conclude on asymmetric effect of spending multipliers (different magnitude, and even different signs). Turning to the STVAR literature, one landmark paper by Auerbach and Gorodnichenko (2012a) presents a regime-switching VAR with smooth transition from recession to expansion, with the transition driven by the logistic function. They control for the state of the business cycle with a moving average of output growth as the threshold variable and find higher multipliers in recessions, reaching 2.5 after 20 quarters, and close to 1 in expansions. They also find different multipliers according to the components of government purchase, especially when differentiating between defense and non-defense expenditure. The high multiplier during recessions seems to be driven by defense expenditures which represents 35% of government consumption in the United States, from 1960 to 1994. Mittnik and Semmler (2011) pursue the same analysis but go further and estimate a bivariate model for output and employment, with lagged output growth as the threshold variable and the threshold being equal to the mean output growth. Employment responses are found to be much larger in 'low' regimes. However, both study assume thresholds *a priori*. Fazzari *et al.* (2012) remedy to this issue by estimating

the threshold from the data, but at the cost of estimating a discrete change in regime instead of a smooth transition, which is less general. However, they find similar results. Finally, several empirical studies broaden the previous analysis to a larger set of countries. In Auerbach and Gorodnichenko (2012b), they estimate multipliers for a larger set of OECD countries, and adapt their previous methodology to use direct projections, thereby relaxing the assumptions on impulse response functions. Their results confirm their previous findings but they provide average multipliers across countries, which mask the hetereogeneties. Finally, Batini, Callegari and Melina (2012) present estimates for the U.S., Europe and Japan on a country-by-country basis, following a similar methodology as Auerbach and Gorodnichenko (2012a), based on a smooth transition VAR, with the regimes defined in terms of the sign of real GDP growth. Their findings for the U.S. are in lines with Auerbach and Gorodnichenko's study, since they find a multiplier of 2.2 after 8 quarters, in recession but -0.5 in expansion. For France, the multiplier reaches 2.1 in recession, and 1.6 in expansion.

Our study is therefore in the continuity of the on-going "non-linear literature" and tests whether the position in the business cycle does affect the impact of fiscal policy on output. Given that most research have focused on U.S. data, with some exceptions, such as Ilzetzki *et al.* (2009) who carry out a cross-country comparison of multiplier effects, we enlarge the literature by focusing on several European countries and the United-States. They estimate bivariate VARs for developed and developing countries, with specific characteristics such as the openness to trade or the level of debt. The countries we choose have specific features as well: two of them are "core" countries (France, Germany with France facing the need of an important fiscal adjustment), one is part of the "PIIGS" (Italy), and the Unites States. This choice of countries might help us to understand how the magnitude of fiscal multipliers could vary with the level of debt, tax and expenditures.

3 Regime-dependent multipliers: STVAR approach

3.1 Benchmark specification

3.1.1 A regime-switching VAR with two regimes

We aim to extend the standard structural vector autoregression model (SVAR) by using a regime-switching model to allow for state dependence as in Auerbach and Gorodnichenko (2012a) (hereafter AG(2012a)), therefore allowing for a multiplicity of regimes. These VARs are appealing insofar as they control for endogenous movements in fiscal policies and their identification scheme of structural shocks relies on a minimal set of assumptions. We dichotomize the economy in two regimes - expansion and recession. More precisely, the approach that we follow is a nonlinear smooth transition vector autoregression that will allow parameters to switch according to whether the threshold variable crosses a predetermined threshold. That way, the model utilizes the entire sample to estimate the coefficients rather than splitting the sample into two. The rationale for smooth transition instead of discrete change in regime is that this specification is more general, albeit making it difficult to estimate the smoothness parameter in such a model (given the relative scarcity of the data on recessions). We will fix the smoothness parameter as well as the threshold. After estimating the equations in the STVAR, the resulting coefficients will be used to get the impulse response functions.

In line with AG (2012a) specification, we control for the state of the business cycle by using a 7-quarter moving average of output growth as a threshold variable, and the threshold around which the behavior changes is equal to the mean of output growth[2]. Based on that dichotomy criterion, we assign observations associated with below and above-threshold to respectively regime R and E. Our specification is the same:

$$X_t = (1 - F(z_{t-1}))\mathbf{\Pi}_E(L)X_{t-1} + F(z_{t-1})\mathbf{\Pi}_R(L)X_{t-1} + \mathbf{\Pi}_Z(L)z_{t-1} + u_t \quad (1)$$

[2]For the United-States and Germany, we use the mean which is equal to the median, approximately, with the exception of France, for which we rather choose the median as the threshold, that is slightly lower than the mean. In the case of France, the mean is driven up by some outliers in 1968-1969, we suspect a structural break around these years, hence we use the median which is more robust, that is to say less sensitive to outliers to better match the episodes of recessions as determined by the OECD Composite Leading Indicator.

$$u_t \sim N(0, \mathbf{\Omega}_t) \tag{2}$$

$$\mathbf{\Omega}_t = \mathbf{\Omega}_E(1 - F(z_{t-1})) + \mathbf{\Omega}_R F(z_{t-1}) \tag{3}$$

$$F(z_{t-1}) = \frac{exp(-\boldsymbol{\gamma} z_t)}{1 + exp(-\boldsymbol{\gamma} z_t)}, \boldsymbol{\gamma} > 0 \tag{4}$$

$$var(z_t) = 1, E(z_t) = 0 \tag{5}$$

With R and E standing respectively for Recession and Expansion. We choose the logistic function for the transition function. For the sake of identification of our fiscal shock with a Cholesky decomposition, we order the vector X_t the following way, $X_t = [G_t\, T_t\, Y_t]$' with G_t being the logarithm of real government expenditures, T_t the log of real government tax revenues and Y_t standing for the log of real GDP. This ordering is consistent with the assumptions of Blanchard and Perotti (2002) that the shocks in T and Y have no contemporaneous effects on G. z is the threshold variable, defined as the 7-quarter moving average of output growth rate and we normalize it to have a mean equal to zero and a variance of 1. The threshold series is expressed with one lag to account for economic rigidities. The smoothness parameter γ[3], which determines the speed of the transition from one state to another, is determined exogenously so that the economy of the United States is approximately 20% in recessions ($Pr(F(z_t) > 0.8) = 0.2$), as indicated by the NBER recession indicator. Similarly, the OECD has established a chronology of euro area countries business cycles; based on its Composite Leader Indicators, which suggests that over our sample period France experienced 40% of recession (($Pr(F(z_t) > 0.55) = 0.4$), Germany 44% ($Pr(F(z_t) > 0.5) = 0.44$) and Italy 47% ($Pr(F(z_t) > 0.2) = 0.47$). We end up with a value of γ around 1.5, determining the speed of the switch between regimes.

We use maximum likelihood as well as Bayesian inference to estimate the model, given the large number of parameters, and more precisely a Monte Carlo Markov Chain method, with a Minnesota prior. Bayesian inference starts with forming prior beliefs about the parameters of the model and then updates these beliefs via the likelihood function. The prior and likelihood combine to give

[3]The threshold and the smoothness parameters are determined *a priori* as in Auerbach and Gorodnichenko (2012a) and Mittnik and Semmler (2012) since estimating them is challenging in a smooth transition model. Fazzari *et al.* (2012) are able to estimate them endogenously but with a discrete transition. In a smooth transition model, the likelihood function is flat when the true smoothness parameter is large, hence providing unreliable estimates.

the posterior distribution of our vector of parameters. Thus, it will enable us to estimate the uncertainty about the parameter values when we construct the impulse response function. For the model prior, we choose a Minnesota prior because of the non-stationarity of our variables of interest $[G_t\, T_t\, Y_t]$, taken in logarithm and not in first difference[4]. Therefore, our times series are represented as random walks, given its intrinsic quality in forecasting macroeconomic time series, and the variance-covariance matrix is imposed to be a diagonal.

3.1.2 Lag selection criteria

The lag length is selected using statistical criteria, namely the Aikake Information Criterion and Schwarz Bayesian Information Criterion. To select the lags for each regime, we simulate the VAR using pre-specified model parameters and lag length, and generating random numbers through Monte Carlo Markov Chain. The Monte Carlo simulation employed 100000 draws for each of our model.

The formula in our non-linear model are as follows:

$$AIC = log\left(det(\Omega_t)\right) + \frac{2}{length(r)} length(\beta)$$

$$BIC = log(det(\Omega_t)) + \frac{log(length(r))}{length(r)} \times length(\beta)$$

with $det(\Omega)$ standing for the determinant of the estimated covariance matrix Ω_t of the residuals; r denotes the residuals and β are the estimated coefficients (computed in a usual OLS as $\left[X_m' X_m\right]^{-1} \times \left[X_m' X_0\right]$ with X_m the first order expansion (curvature in the transition function) and X_0 our vector of endogenous variables).

[4] Auerbach and Gorodnichenko (2012a) mention this drawback in their paper, and suggest a method to correct for possible bias by first differencing and using an error correction term, but they recognize that this complicates substantially the model.

3.2 Identification of fiscal policy shocks

We take off the shelf Blanchard and Perotti (2002) methodology to identify fiscal policy shocks separately for each of the regimes. The identification of the fiscal policy shock will rely on structural identification, exploiting institutional information about tax and transfer systems, the timing of tax collection and tax revenues elasticities. Then, after redefining reduced-form shocks through this methodology, the identification scheme will be based a Cholesky decomposition.

The method is described as follows. Coming back to our equation (1), we focus on $u_t = [u_t^g \; u_t^t \; u_t^y]$' the vector of reduced-form residuals (with nonzero cross correlations).

$$X_t = (1 - F(z_{t-1}))\mathbf{\Pi}_E(L)X_{t-1} + F(z_{t-1})\mathbf{\Pi}_R(L)X_{t-1} + \mathbf{\Pi}_Z(L)z_{t-1} + u_t \quad (6)$$

The residuals of government spending and revenues can be seen as a linear combination of 3 types of shocks, a response of type "automatic stabilizers", that is to say the automatic response of net taxes and spending to GDP; systematic discretionary responses of fiscal policy to the evolution of GDP and finally, the structural, random discretionary fiscal policy shocks: $\epsilon_t = [e_t^g \; e_t^t \; e_t^y]$. Let the residuals be decomposed more precisely as:

$$u_t^g = b_1 u_t^y + b_2 e_t^t + e_t^g$$

$$u_t^t = a_1 u_t^y + a_2 e_t^g + e_t^t$$

$$u_t^y = c_1 u_t^t + c_2 u_t^g + e_t^y$$

In words, unexpected movements in taxes within a quarter are due to responses to unexpected movements in GDP, responses to structural shocks to spendings $a_2 e_t^g$ and structural shocks to taxes e_t^t. The third equation can be interpreted as the unexpected movements in output being explained by unexpected movements in taxes, spending and structural shocks e_t^y. The residuals u_t can be expressed as $M_1 u_t = M_2 \varepsilon_t$. The implementation scheme will therefore be driven by the matrices M_1 and M_2 for which we will estimate the coefficients, and fix the diagonal elements to 1 (normalization of ε_t).

Since the residuals from the VAR do not represent *per se* structural shocks, Blanchard and Perotti (2002) make some assumptions that we will follow:

(1) discretionary expenditures policy cannot respond within the same quarter to business cycle conditions (given the high frequency of our quarterly data, discretionary fiscal policy will be slow).

(2) the output elasticities of tax revenues (obtained from information about tax codes) are used to differentiate between unanticipated shocks to tax revenues and endogenous reactions of tax revenues to GDP fluctuations.

(3) the unexpected fiscal policy innovations are defined as the innovations in fiscal variables that are not predicted by the VAR.

(4) given our ordering, decisions related to government spending are made prior to decisions related to tax revenue.

The coefficients a_1 and b_1 are estimated using institutional information – they represent the automatic effect of economic activity on spending and taxes, and discretionary adjustment made to fiscal policy in response to unexpected events within the same quarter. Given that we use quarterly data, we can eliminate the automatic feedback from economic activity to government spending and set b_1=0. The elasticity of net taxes with respect to output is :

$$a_1 = \sum \eta_{Ti,Bi} \eta_{Bi,Y} \frac{Ti}{T}$$

where the first term η_{T_i,B_i} represents the elasticity of taxes of type i to their tax base B and the second, $\eta_{B_i,Y}$ the elasticity of the tax base with respect to GDP. T stands for net taxes. The elasticities are obtained from historical tax data, and are computed by the BEA and OECD, which yields a value of $a_1 = 1$ yearly for France[5], 2.08 for the United States, 1 for Germany[6] and 1 for Italy. The same elasticities are used for the two regimes, which can be arguable. On the one hand, we could compute separate elasticities to take into account potential differences in automatic stabilizers within each regime. On the other hand, with a unique elasticity for both regimes, the different impulse responses between the regimes will therefore only be driven by different estimated parameters, and not elasticities. Subsequently, we construct the cyclically adjusted

[5]We follow the OECD estimates. Ilzetzki (2011) find a final output elasticity in the same range (0.85).

[6]This is the value chosen by Baum and Koester (2011) in a similar study. However, the literature presents diverging values of a_1 , ranging from 0.5 to 1.5.

reduced-form tax and spending residuals $u_t^t* = u_t^t - a_1 u_t^y$ and $u_t^g* = u_t^g$ since we set b_1=0. Now u_t^t* and u_t^g* can be used as instruments to estimate c_1 and c_2 by regressing u_t^y on u_t^g* and u_t^t*. We are left with a_2 and b_2 to estimate. We assume that spending decisions come first, therefore implying $b_2 = 0$, which, in turn, allows us to estimate a_2 by regressing u_t^t* on u_t^g*.

One could prefer the narrative to the conventional approach insofar as identifying discretionary changes in fiscal policy using cyclically-adjusted fiscal data is likely to bias our analysis toward expansionary austerity. This has been criticized in the literature, on the basis that the change in cyclically-adjusted primary balance includes non-policy factors that are correlated with other developments in the economy (e.g a boom in the stock market improves capital gains, hence improving the balance, and which is also likely to raise consumption and investment). The correlation between the change in the balance and the error term is therefore likely to be positive, creating an upward bias in the estimate of the effect of fiscal policy. Another criticism found in the literature is that VARs cannot account for the anticipations of changes in government spendings by forward-looking agents, due to legislative and implementation lags (the so-called "fiscal foresight" problem). Fiscal foresight could provoke a misalignment of the econometricians and agents' information sets, thereby rendering meaningless our identification of the shocks. But there are of course some potential issues associated with the narrative approach as well (developed in more depth by Favero and Giavazzi (2012) and Perotti (2011)). A recent controversy (Ramey 2011, Perotti 2011) have highlighted that the results of Ramey (2011) obtained with her narrative series depend on the inclusion of particular observations. Perotti (2011) highlights that if the quarters 1950Q4 and 1951Q1 are excluded, her results are reversed. Similarly, the revenue multiplier as computed in Romer and Romer (2010) could be subject to an upward bias. Indeed, their historical approach records changes in fiscal policy when they occur. The changes in fiscal policy should be "exogenous" but they recognize that nothing guarantees that they should be unanticipated: "if countries sometimes postpone fiscal consolidation until the economy recovers, then the consolidation exercise will be associated with good economic outcome (...). If the country is committed to a deficit-reduction path and the economy falls into recession, it may implement additional fiscal consolidation measures, thus associating fiscal consolidation with unfavorable economic outcomes. (...) which ignores the role of anticipation effects highlighted by Ramey (2011)". While we obtained

a database of narrative fiscal shocks compiled by Devries, Guajardo and Leigh (2013) for our sample countries, the observations are too scarce to provide reliable results. Therefore, we follow the conventional approach, especially since a recent paper by Chahrour, Schmitt-Grohé and Uribe (2010) conclude that both approaches are valid, and we will try to account for anticipations.

3.3 Response analysis

In our impulse response functions, we consider regime switches so as not to over or under estimate the fiscal multipliers. We will consider two types of mulitpliers, the maximal and the cumulative. We define the cumulative multipliers as the ratio between the cumulated increase of GDP (from date 1 to t) and the cumulated increase in government spending (from date 1 to t as well) as AG (2012a) and choose empirically an horizon of 20 quarters:

$$\Upsilon = \frac{\sum_{i=1}^{20} \Delta Y_i}{\sum_{i=1}^{20} \Delta G_i}$$

We also consider the maximal multipler as defined by:

$$\Upsilon = max_{i=1,\ldots,20} \left\{ \frac{\Delta Y_i}{\Delta G_i} \right\}$$

Firstly, we construct impulse responses discarding the feedback from changes in our threshold variable z, so that once the system switches of regime, it stays possibly in the regime for a long time. The impulse response function depends only on the regime when the shock occurs. The construction of the impulse response is a two-step process: firstly, we derive the contemporaneous responses from the Cholesky decomposition of Ω_t with government spending ordered first in the vector of variables. Contemporaneous responses vary according to the business cycles since the variance-covariance matrix Ω_t varies with it. Secondly, we obtain the propagation of the responses of our variables over time using the estimated coefficients of the lag polynomials, such as Π_E and Π_R which we apply to the contemporaneous response. We obtain two sets of impulse response functions, one for each regime. This specification of impulse response is a useful benchmark, with relatively quick computation. On the other hand, it relies on the assumption that once hit by the shock, the economy remains in the same

state, assumption that needs to be relaxed if we want to use our model for some policy experiments.

Subsequently, as done by Koop et al (1996) we use the generalized impulse response functions that allow a regime to switch following a structural shock, that is to say the threshold variable can respond endogenously. The impulse response will therefore depend on the value of the threshold variable, the history of our vector of endogenous variables and the shock itself. We specify as follows:

$$GIR_h(z_t, v_t) = E(y_{t+h}|z_t, v_t) - E(y_{t+h}|z_t)$$

with z_t the state of the economy, v_t the shock and h the horizon of the response. y_{t+h} denotes the history of our endogenous variables between period t and t+h. As a consequence, our non-linear IRFs will depend on the initial value of the index z, which we determine, as well as the size of the government policy shock. Endogenizing regime switches therefore forces us to use Monte Carlo Markov Chain simulation methods, which increases considerably the computation time to get the average IRFs conditional on a particular history as well as the confidence interval.

4 Data

We select a sample of quarterly data, for several countries — France, Germany, Italy and the United States, with different range according to the availability of the data (1960:1-2012:2 for France, 1947:1-2012:2 for the United States, 1970:1-2012:2 for Germany and 1991:1-2012:2 for Italy). We present in this section the construction of our sample as well as some descriptive statistics relevant for the calibration of our model. Section 1 of the Annex contains all the tables and figures of the descriptive statistics as well as more details on data sources.

4.1 Switching series

We compute a 7-quarter symmetric moving average of the switching variable, the growth rate of real GDP. The GDP growth series is obtained from OECD's Statistics and Projections database for European Countries and from the BEA table for the United States. Other empirical studies use various variables, such as Baum and Koester (2011) who use the sign of the output gap, Fazzari *et al.* (2011) who use the capacity utilization. We prefer the growth rate of GDP to

other specifications since we think it better captures the state of the economy - the economy can be in better states when growing out of a negative output gap than declining in a boom.

4.2 Macroeconomic series

All the data, except the unemployment rate, interest rates, and the GDP deflator are taken in log.

4.2.1 Real government expenditures

The government spending series are defined as the sum of real public consumption expenditures and gross fixed capital formation (investment). We choose to concentrate on the general government expenditures (the equivalent in French of APU "Administrations Publiques"), which includes public central administration, local as well as social security administrations for the European Countries of our sample, and for the U.S. it regroups local, state and central administration. Hence, in our case, final consumption expenditures will simply be the final consumption expenditures of the APU (an aggregate of collective and individual expenditures) and gross fixed capital formation, namely P3S13 and P51 in national accounts (ESA95 definition). All variables are expressed in current prices, converted into real terms with the GDP deflator. For France, it is obtained from the INSEE macroeconomic database. [7] For the United States, the government expenditures are directly obtained from the Bureau of Economics Analysis database, table 3.1 (including federal, state and local government). For Italy and Germany, quarterly national data is directly obtained from their respective national account statistics database as well.

Some objections have been raised regarding the use of aggregate data (on total government expenditures), as the output multiplier depends on the kind of expenditures. Moreover, the definition of government consumption has changed over time for France[8]. Some authors prefer using defense expenditures as an indicator of government spending expenditures, such as Barro and Redlick (2009) or Ramey (2011) who constructs a new measure of defense news based on narrative evidence (periodicals, President speeches,...). However, these results are

[7] Indicators of final consumption and capital formation and their aggregation method is detailed in more depth in the chapter 3 of the INSEE quarterly national account methodology publication as well as the OECD national accounts database http://www.insee.fr/fr/publications-et-services/sommaire.asp?codesage=IMET126

[8] The definition changed after the introduction of SNA 1993 and is now broader.

driven by the context of the wars (WWII, Korean War,...), so we prefer the aforementioned definition.

Figures 1 to 4 in Annex display the evolution of the share of consumption and investment relative to total expenditures, table 5 presents their shares over total GDP, and tables 1 to 4 provide summary statistics of our fiscal policy variables. All in all, government spending represents less than one third of GDP. Moreover, we see that consumption expenditures on goods and services represent a greater share of total government spending than investment for France, stagnating around 85% while the share of investment decreases over time to reach around 12% in 2010 in France. The U.S. display similar statistics, albeit slightly lower, with the share of investment culminating around 35% at the beginning of our sample. Finally, for Germany, investment represented between 60 and 50% of total expenditures and consumption around 40% at the beginning of the sample, to lead to a fair split in 2012. The share of consumption over total expenditures is increasing over time in all countries.

4.2.2 Tax revenues

The fiscal revenues series are defined as net government tax receipts. We obtain them from each country public finance main aggregates on their national website, namely the fiscal revenues from central government are obtained as the sum of taxes for the three accounts, the primary account (tax on production and exports), secondary account (tax on income and wealth) and the capital account (capital gains tax), and finally the social contributions. For the European countries, we obtain directly net government tax receipts. For the United States, we construct it as total government receipts net of transfers to business and people (from NIPA table 3.9.5) as defined by AG (2012). It is worth noting that the definition of fiscal series have been subject of numerous discussions. Perotti (2004) defines public revenues as general government revenues excluding social security and net of transfers. While we follow that definition for the U.S., we prefer to keep social insurance and transfer payments as part of government expenditures and revenues for the European countries we chose, given that it accounts for more than 40% of Germany's general government revenues, as well as for a great share of overall public spending, as it is the case for France. We are in line with Deák and Lenarcic (2011) and Baum and Koester (2011) with that definition, to which they bring an additional argument: during the Great Depression, a large part of the German fiscal stimulus consisted in cuts in social

security contributions (deficit-financed). Given the social insurance structure in the U.S., we keep AG (2012a) definition for that country. We choose these definitions of fiscal variables to be consistent with the literature and primarily because they seem the most appropriate to study the macroeconomic effects of government spending in these countries given their particular characteristics.

4.2.3 Additional variables

We condition on the stance of monetary policy through an indicator of inflation and the long-term interest rate. The GDP deflator chosen is the GDP implicit price deflator, Index 2005=100; the interest rates are obtained from the national accounts (French government guaranteed bond yield, 9-10 years interest rate for Germany, and the Federal Fund Rate for the United States). In addition, we document the response of the unemployment rate and other components of GDP such as real private consumption, and real private fixed investment, obtained from the Quarterly National Accounts. The unemployment rate is the civilian unemployment rate (number of unemployed as a percentage of the labor force for the population aged 16 and over). Private consumption is the private final consumption expenditures series of the BEA and OECD national account database, and we construct our investment series as private fixed investment. This regroups spending by private businesses, nonprofit institutions and households on fixed assets, and consists of both *residential* and *nonresidential* fixed investment. Our estimates are based on INSEE national account tables for France and datastream for Germany and Italy. For the U.S., we use gross domestic private investment which also includes changes in business inventories insofar as this series goes further back in time (compared to the fixed investment series which starts in 1995 only)[9].

4.3 Recession series

For European countries, the series are OECD-based recession indicators for each of our selected countries from Peak through the Trough, quarterly and not seasonally adjusted. The dummy variable takes the value 1 in recession and 0 in expansion. This time series is an interpretation of the OECD Composite Leading Indicator. The CLI system is based on the "growth cycle" approach – business cycles and turning points are identified through a deviation from the trend method. This series was obtained through the midpoint method, in which

[9]Chapter 6 of the NIPA handbook provides a thorough methodology to construct these estimates at http://www.bea.gov/national/pdf/NIPAhandbookch6.pdf

the recession is shown from the midpoint of the peak through the midpoint of the trough. We obtain a similar serie for the United States on Saint Louis Fred database, as computed by the National Bureau of Economic Research.

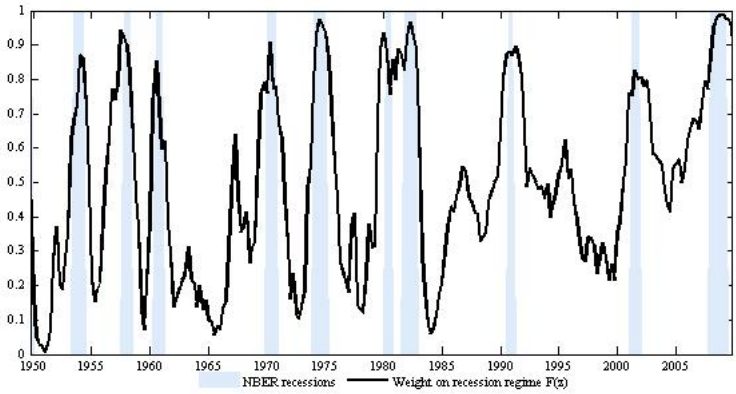
5 A self-defeating austerity?

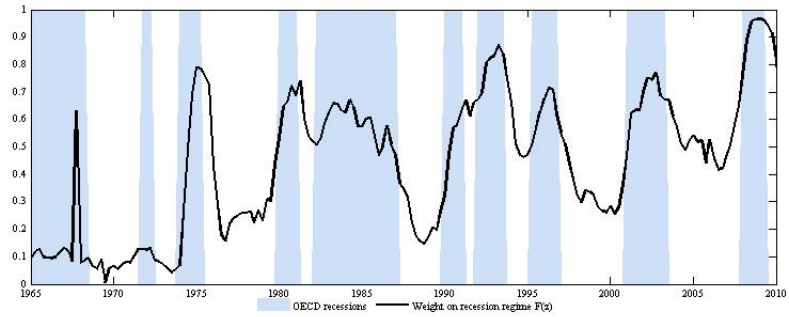
5.1 Spending policies

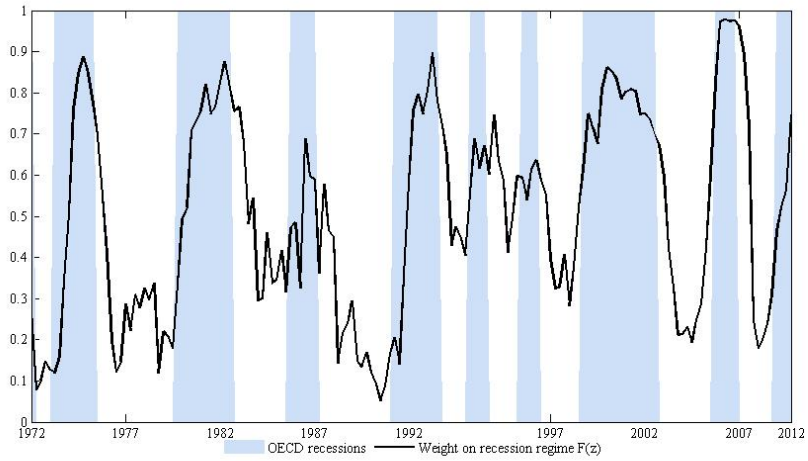
Firstly, we examine the behavior of output to a shock of government spendings. We choose to focus on the spending variable and not on government net receipts insofar as they are composed by different taxes which evolution can be led by changes in the marginal tax rates of the tax base. Moreover, tax shocks would be harder to identify in a time-varying set up, especially given the lack of availability of quarterly data on tax rates[10]. We present the basic aggregate results for our selected countries, based on our assumption that government expenditures shocks are unexpected. Figures 1 to 4 illustrate the probability of recessions induced by our specifications, and compare it with the actual recessions. The model seems to be replicating quite well the business cycles over our sample period, maybe with the exception of Italy, for which the probability of recession when a recession actually happened is 0.5 in our model.

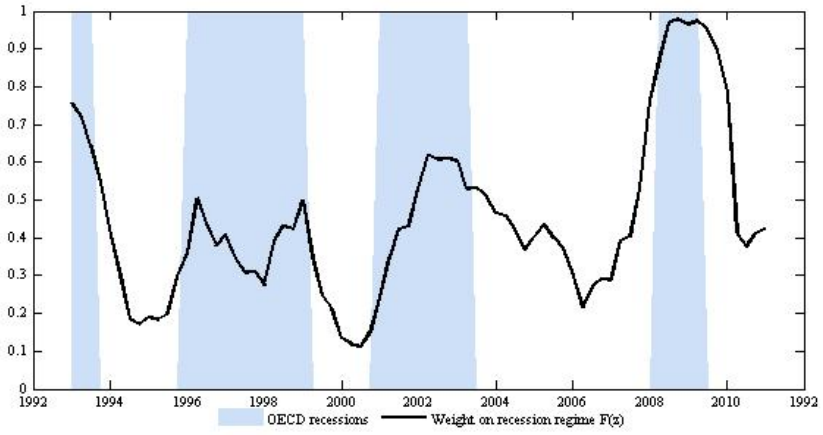
[10] Chahrour, Schmitt-Grohé and Uribe (2012) illustrate the challenges of the identification of tax shocks. They find that the SVAR and narrative approaches yield significantly different results. They use a DSGE model to evaluate whether these discrepancies are due to different transmission mechanisms rather than the identification scheme and they finally find that the models either identify different tax shocks or that these diverging results stem from small-sample uncertainty.

Figures 1-2-3-4: recessionary regimes a) United States, b) France, c) Germany, d) Italy









5.1.1 Spending shock, no feedback

We present the impulse responses of output to a government spending shock, in a given regime, discarding at first feedbacks from a change in our threshold variable z (i.e the economy can remain in the same state forever). To better highlight the robustness of our nonlinear model and its implications, we draw impulse responses with a 90% confidence interval (the grey band around the impulse responses), for a system in a recessionary and expansionary phases.

Our primary results appear in table 1, which highlights multipliers significantly different from 0 at 1% significance level. The results are also provided in more details in the subsequent figures (figures 5 to 7).

Business cycles seem to matter for the effects of fiscal poliy insofar as we find higher multipliers during periods of recession for the countries in our sample, with more contrast between the two regimes for the United States and France. The difference of multipliers between the two regimes is less wide for Germany, and we find inconclusive results for Italy, given the lack of convergence of our results for this country. Using different priors does not improve the results. Our data sample for Italy is much smaller and exhibits non-stationarity as well as no cointegration relationship, therefore the logarithm specification is not enough. One way to solve this issue might be to filter the data with an exponential filter and take the first difference, substracting an error correction term, but as mentioned in section 3.1.1, this is an arduous task to implement in our non-linear setting. In the remaining of the paper, we will therefore focus on France, Germany and the United States. The government spending shock increases immediately output in both regimes but the multiplier increases almost monotonically in recessions while it goes back slowly to 0 or less in expansions after the initial jump for the 3 countries.

For the United-States, our results are similar to AG(2012a) (figure 5): there is a multiplier effect in booms only in the short-run, approximating 0.5 initially, reaching 0 only after 2 quarters and converging to -1 in the long run. However, we find a point-estimate of the government expenditure multiplier equal to 0.5, raising rapidly to 1 after 3 quarters and reaching 2 at the horizon of 20 quarters in times of recessions. As for France, the impact multiplier (t=0) is slighlty smaller in recessions (0.2), but peaks after 3 quarters to reach around 1.5 and converges to this value in the long run (figure 6). In the medium and long terms, the multiplier in "low" regimes is clearly higher than during expansions, during which it exhibits a value around 0.5 converging to 0 after 10 quarters. The peak effect of fiscal consolidation on output is within the first year of the shock for France in recession, and much later for the United States. Comparing with Batini, Callegari and Melina (2012), we notice a difference in the magnitude of our multipliers but the asymmetry between the two states is the same. We also find a peak effect on output within the first year. Turning to Germany, as figure 7 suggests, fiscal multipliers still document a larger response of output in recessions, peaking at 1.3 after 8 quarters and converging to this value on

the long term, than in expansions (converging to 0.5). After an initial increase in output of around 0.7, the multiplier increases monotonically to reach below 1.5 in a low regime while it decreases to almost reach 0 in a high regime. Our results are in line with Baum and Koester (2011) who find higher multipliers in periods of negative output gap in Germany.

Thus, our estimates are in accordance with the literature, and seem to provide support for an heterogeneous effect of fiscal multipliers. We summarize the key findings as follows:

- In all countries, a fiscal expansion (increase in government spending) has a more pronounced effect on output if made during a downturn than during an upturn. The maximal multiplier is always positive, higher and significant in recessions. The 5-year cumulative multipliers in recessions are 10 times larger than in expansions with the United States, 7 times larger for France and 1.5 times for Germany.

- Furthermore, the multipliers document country-specific effects. The maximal multiplier during recessions is much larger in the U.S. than in the other countries in our sample, but the maximal size of the multipliers in expansions are rather homogenous across countries. Our findings are broadly in line with Batini, Callegari and Melina (2012) who find a similar pattern for the United States and the Euro Area.

- The horizon determines the multipliers: the multiplier is relatively small on impact but large after several quarters.

- These results yield some implications for the effectiveness of fiscal policy: for these 3 countries, we notice that the 1st year value of the multiplier is greater than 1 in periods of economic downturns, reaching 1.5 for France and the U.S. over the first four quarters. Some economists argue that the 1st year value of the multiplier conditions the success of consolidation (debt reduction). If implemented particularly in periods of recession, it translates into some practical guidelines for the timing of fiscal consolidation. For instance, a spending cut should be smooth rather than frontloaded so as not to induce or dampen a recession. This also means that fiscal policy is an efficient stabilizer in times of recessions, but less in times of expansion, suggesting the use of other instruments (monetary

policy or macroprudential policy) to curb credit booms for instance.

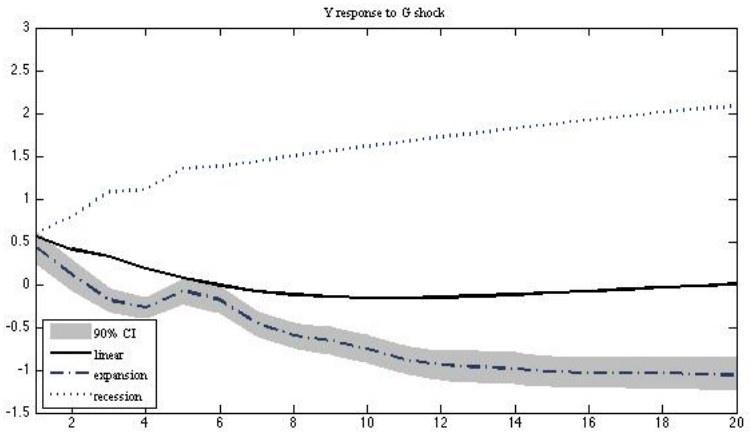
Such an asymmetric response of fiscal multipliers along the business cycles can be explained by the traditional Keynesian theory. From the supply side, if the economy does not fully employ available resources, because of low demand, the increase in government spendings will activate the use of these unused resources, thereby increasing output. From the demand side, financial frictions (as introduced by Woodford (2011)) could be another explanation. During recessions, financial intermediation might be more costly and less efficient, and a positive spending shock, by reducing the inefficiencies, generates a higher impact on output. Bilbiie, Meier and Müller (2008) support a similar hypothesis: the share of agents with limited asset participation - financially constrained agents - increases in times of crisis (households and firms face tighter credit constraints, as banks increase their risk premia on loans, such as the credit crunch during the Great Recession), which could modify the propagation mechanism of fiscal policy. Indeed, the increase in government spendings will increase their current disposable income, and this increase in revenue does not lead to a rise in precautionary savings, in anticipation of higher taxation in the future, therefore these consumers are more likely to increase their current consumption, reinforcing the effect of the positive spending shock. Finally, another potential effect causing this asymmetry is the non-linear monetary policy reaction, for instance an accommodative policy during periods of fiscal stress and recessions.

Table 1: Spending multipliers

	Maximal multiplier	Cumulative multiplier
Government spending shock, no feedback		
United States		
linear	0.57 (0.19)	0.01 (0.25)
expansion	0.44 (0.11)	-0.95 (0.10)
recession	2.07 (0.24)	2.11 (0.21)
France		
linear	0.87 (0.30)	0.80 (0.22)
expansion	0.53 (0.16)	0.23 (0.15)
recession	1.38 (0.27)	1.56 (0.22)
Germany		
linear	1.24 (0.12)	1.29 (0.12)
expansion	0.72 (0.06)	0.84 (0.08)
recession	1.31 (0.13)	1.14 (0.12)

Note: standard errors are in parenthesis.

Figure 5: Effect of a spending shock on output for the United States with a 90% confidence interval a) expansion b) recession



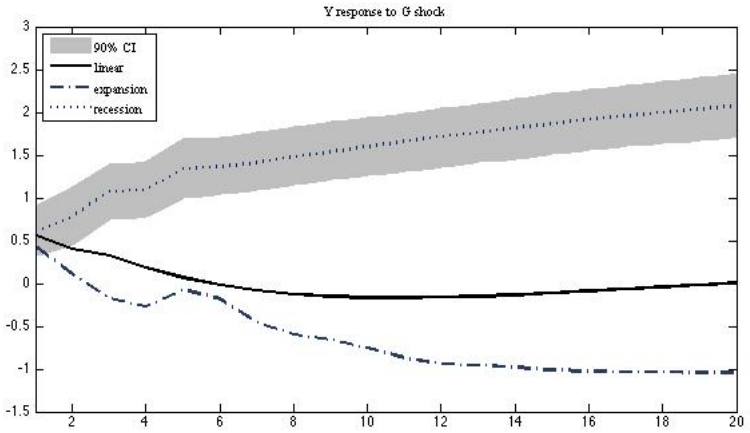


Figure 6: Effect of a spending shock on output for France, with a 90% confidence interval a) expansion b) recession

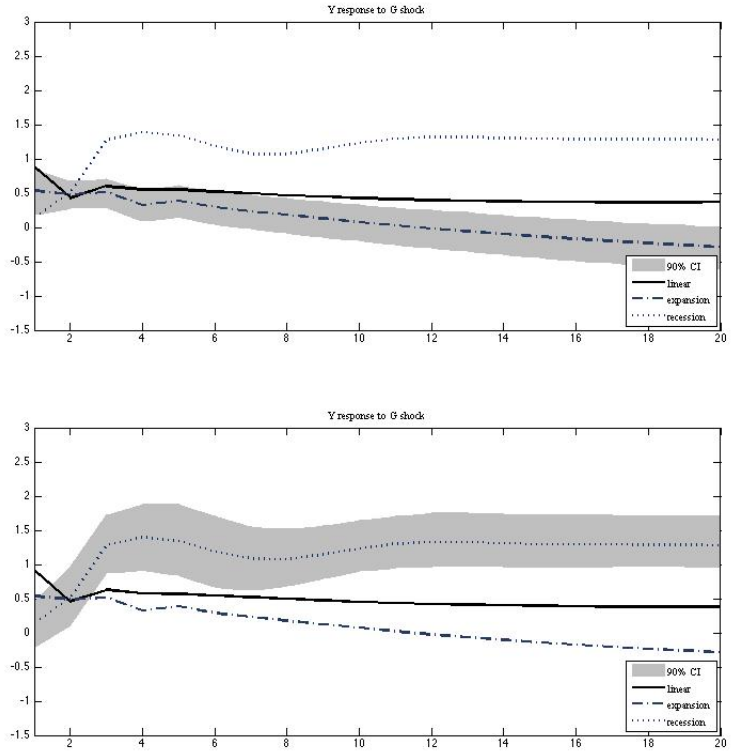
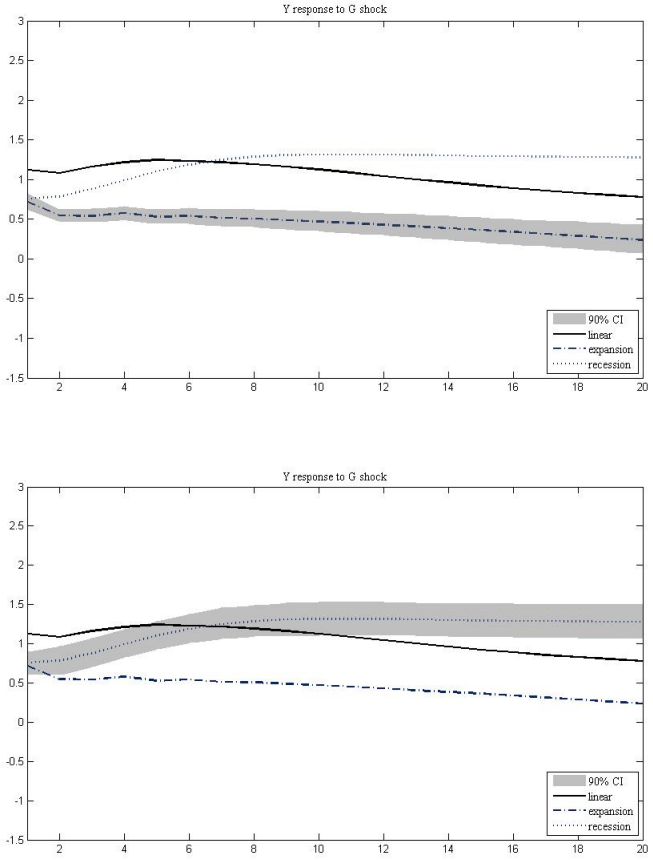


Figure 7: Effect of a spending shock on output for Germany, with a 90% confidence interval a) expansion b) recession



5.1.2 Historical multipliers in good and bad times

We now allow for a dynamic feedback on the variable z, once the shock have been implemented. Once we allow the economy to evolve from one state to another, the multiplier will depend on the history of the shock along with the state of the economy at the time of implementation of the spending shock. We retrace the value of the multipliers and present the results in figures 8 to 10. We highlight recessionary periods from NBER and OECD recession indicators to bring the attention to what would have been the value of the multipliers during these periods. All figures illustrate sizable cyclical variations of fiscal multipliers.

In the United States, during the period 1973-1975 the multipliers peaked at 1.5, as well as for the Great Recession of 2007-2009. We find historical multipliers within the same range for France for those two recessionary periods, however with a wider confidence interval, given that we have a smaller sample period for France. The multipliers are found to be smaller in Germany, except during the Great Recession, during which they reached up to 1.5 as well. Our results are in accordance with Fazzari *et al.* (2012), who, allowing for dynamic feedbacks, find an average multiplier peaking at 1.6 in the low states (recessions) and 0.8 in the high states.

Figure 8: Historical multipliers for the United States

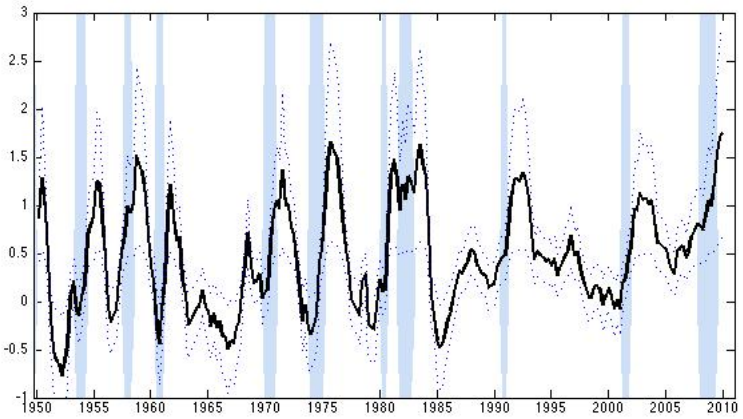


Figure 9: Historical multipliers for France

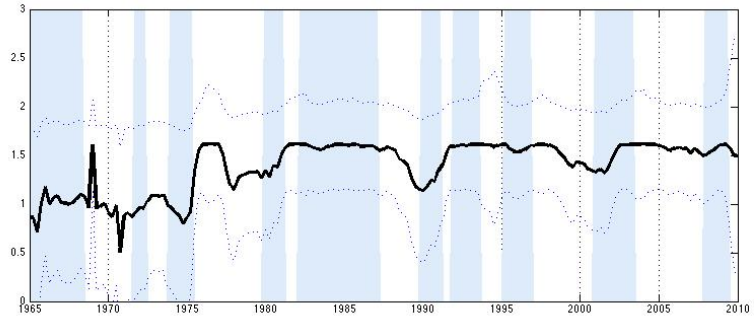
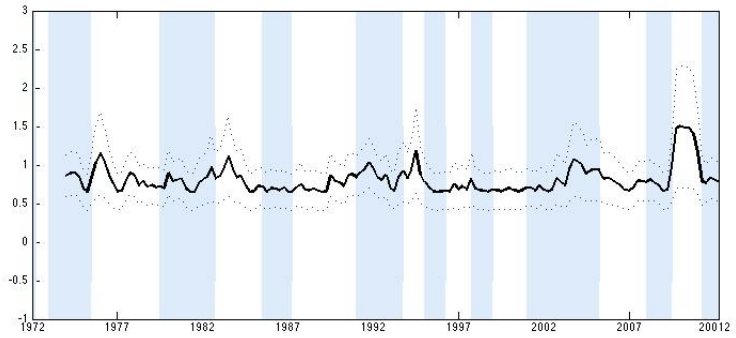


Figure 10: Historical multipliers for Germany



5.2 Decomposition: investment vs consumption expenditures

We subsequently try to assess the role of demand shocks, with shocks being based on specific spending positions. To do so, we distinguish government expenditures into government investment (P51 in ESA95 accounting terms) from other government expenditures in goods and services (P3S13). We only decompose the multiplier according to a consumption or investment shock, and not according to specific expenditures, such as defense or non-defense expenditures as it is common in the literature for the U.S. insofar as the breakdown of government expenditures by function is only available since 1995 for France, and between 1995-2010, defense spending only represented 6% of total government expenditure. Investment represents on average 14% of total government expenditures, this share decreasing over time (figure 1 in Annex). For the U.S., this share is approximately 22% over our sample (1947-2012), from 17% in the 1950's to 20% in the early 2000's. Figures 1 to 3 in Annex present the evolution of the share of investment in total government expenditures over time. The share becomes roughly stable over time, contrarily to France. The share is higher for Germany, averaging 50% over our sample period.

In order to distinguish between the two kinds of expenditures, we extend our VAR to 4 variables. We order consumption expenditures first and government investment in second position, and keep the same variables as before for the computation of consumption and investment multipliers. The identification procedure still relies on a Cholesky decomposition, from our reduced-form

shocks. Figures 11 to 13 display the responses of output to both investment and consumption shocks for the U.S., France and Germany. Detailing firstly the U.S. case, we notice that the impact multiplier following an investment shock increases output in both regimes (almost by 2 in recession, by 0.2 in expansion). This is not the case for a consumption shock insofar as the impact multiplier is 0 in expansionary regimes. The output effect of fiscal policy seems to be higher for an investment shock than a consumption shock on the long term, with multipliers averaging 1.5 and 0.5 after 20 quarters for respectively our regimes of recessions and expansions. The impact multiplier of consumption expenditures shocks is around 1 for recessionary states, higher than expansions (starting at 0), but decreases rapidly after 2 quarters to reach below 0 after 2 years. The results for Germany (figure 12) display higher multipliers in recessions for a consumption shock than an investment shock. In the case of the consumption shock, the multiplier converges to 1.4 in recession, compared to 1.2 if the shock is through the investment channel. Our findings for France mimic those of the U.S. (figure 13): the consumption multiplier in a recesionnary regime is initially higher than in expansion, and higher than the investment multiplier in the short-run. It peaks after 3 quarters to almost 4 to decrease progressively over the subsequent quarters, in turn to reach a value slightly above 0.5. However, the long term investment multiplier quickly rises to reach 4 on the long-run but is lower in recession than in expansion in the short-run.

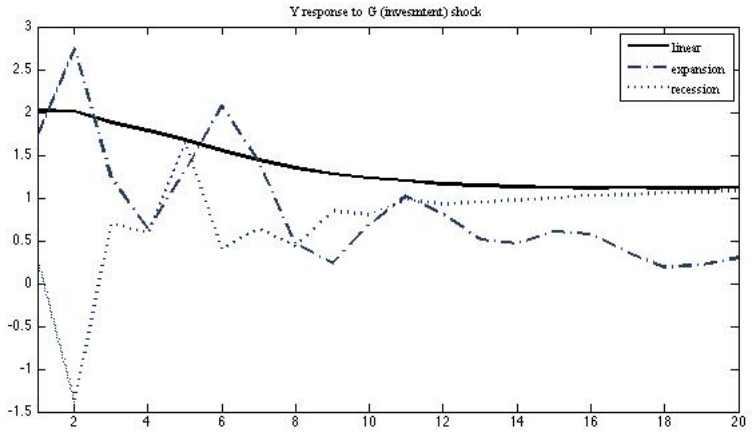
All in all, we notice a much stronger dependence on the regime of consumption spending multipliers for Germany and the U.S.. Regarding investment multipliers, the differences between regimes primarily lays in the timing of the response rather than the size insofar as for investment shocks, multipliers are lower in recessions than expansions in the short run but much higher in the long run in recessions. We draw several key policy implications from our analysis:

- When breaking down government spending into consumption and investment, the effect of consumption spending is found to be much larger in recession than expansion in the short term. If a stimulus needs to be implemented during a recession to raise output in the short term, it should be composed of consumption expenditures to have a greater impact. If consolidation needs to be implemented, it would be less harmful to GDP if done in upturns.

- The response of output to investment shocks relative to consumption is larger, more persistent in the long term and especially in recessions (for the U.S. and France). This suggests an importance of the composition of government spending: during recessions, stimuli are centered around investment, which could explain the large output response. Strategies involving investment should be aimed at increasing output in the long term. Cutting investment would be less harmful than cutting consumption in the short term, but not in the long term. On the contrary, the response of output to investment shocks is found to be lower relative to consumption shocks for Germany, thereby implying the need of country-specific strategies in terms of fiscal consolidation or stimulus.

However, we could go further by decomposing the effect by sub-category, for instance decomposing into the types of goods and services, such as real government wage expenditures, which account for a significant part of spendings, and would be useful for compositional purpose of fiscal packages. Our results still represent averages over different categories of investment and consumption expenditures.

Figure 11: Decomposition of the effects of government expenditures for the United States, a) investment, b) consumption



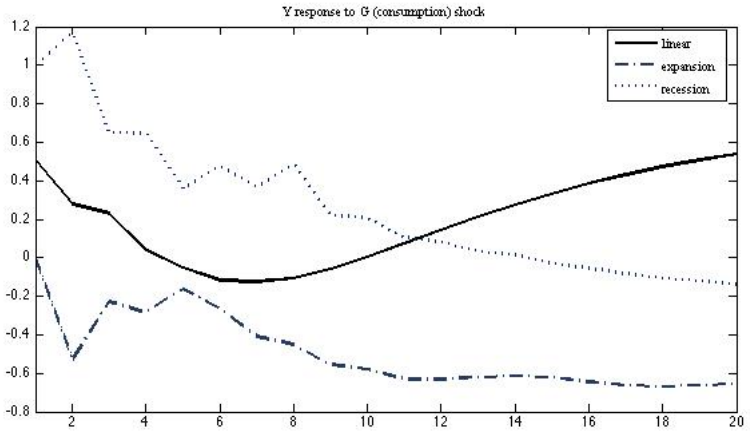


Figure 12: Decomposition of the effects of government expenditures for Germany, a) investment, b) consumption

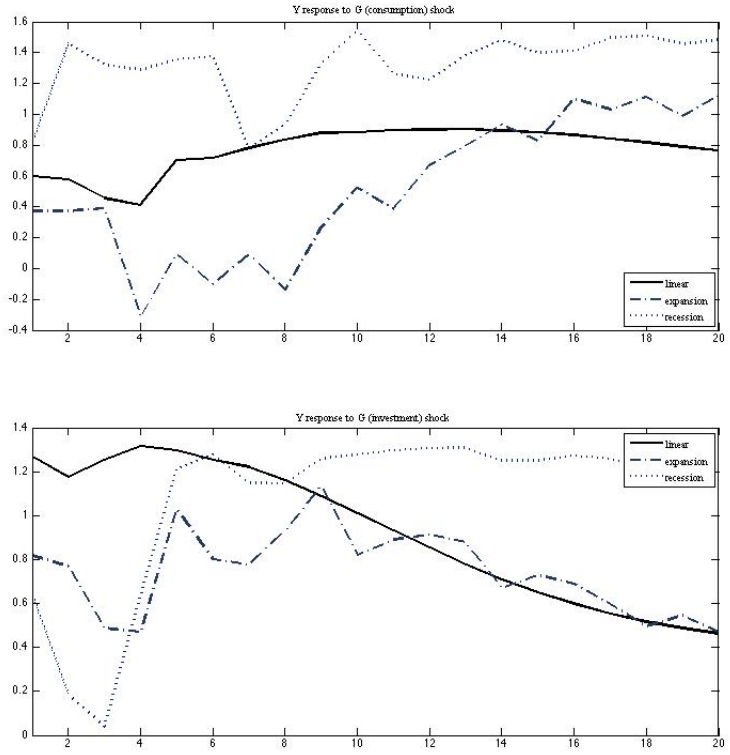
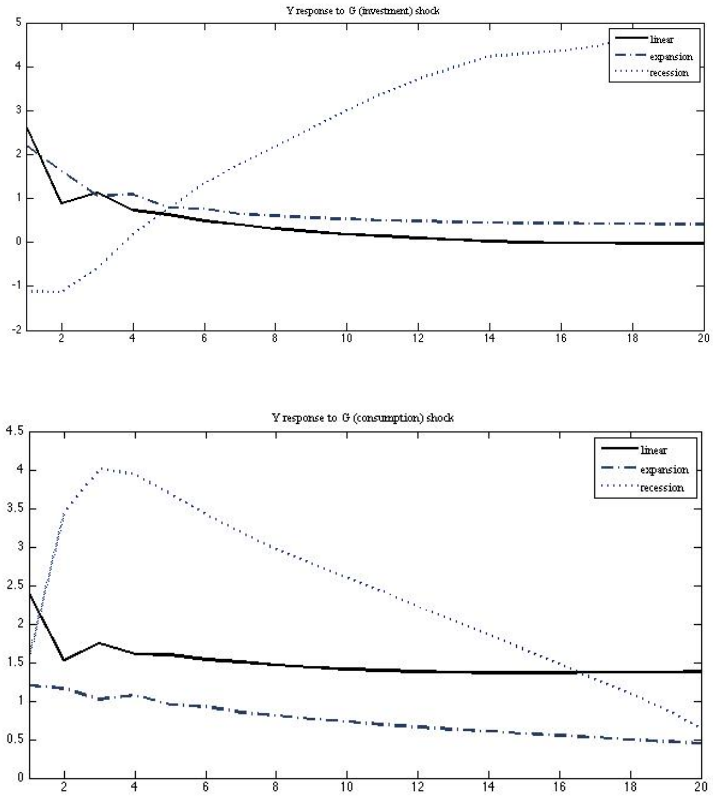


Figure 13: Decomposition of the effects of government expenditures for France a) investment, b) consumption



6 Further Specifications

6.1 Stance of Monetary Policy

As in Batini, Callegari and Melina (2012), we introduce the long-term interest rate and the GDP deflator to condition on monetary policy and take into account the feedback of inflation. The interest of adding a fourth variable in our vector of endogenous variables is twofold. Firstly, a study by the IMF (2010) exposes the pertinence of the coordination of monetary policy with fiscal policy : interest rates cut supports output during periods of fiscal consolidation, as a way for Central banks to oppress the contractionary pressures, lessening the impact on consumption and investment. The importance of the stance of the monetary

policy in determining fiscal multipliers was also emphasized in Woodford (2011). Secondly, this is one way of dealing with anticipation effects as these variables are forward-looking. Ramey (2011) deals with anticipations by including in a SVAR an additional variable, the news variable, obtained from the Survey of Professional Forecasts and ordering it first. Similarly, AG (2012a) use real-time data forecasts to control the prediction of fiscal variables and differentiate policy innovations from their predictable component, hence obtaining exogenous policy shocks. Unfortunately, real data forecasts on government spending is only available for the United States, the Survey of Professional Forecasters from the European Central Bank providing only forecasts of GDP and inflation, hence these forward-looking variables are our best available proxy.

Adding a price index (GDP deflator) in our vector of endogenous variables to capture the stance of monetary policy does not change the direction of our results. The results are summarized in table 2 but figures 5 to 10 in Annex present the IRFs in more details. On the contrary, it seems to strengthen our findings insofar as when we control for inflation, the multiplier during downturns is still significantly higher than during periods of economic strength, as in our previous specification (section 5.1). For the United States, we find a maximum multiplier of 2.22 in economic downturns (the multiplier in both regimes is initally 0.5 but increases to 2.2 in recessions after 10 quarters, and decreases in upturns), a cumulative multiplier of 3.27, and respectively 0.6 and 0.55 in booms. Our results are slightly higher than in the previous specification, where it was culminating at 2.14. The results for Germany and France are analogous: when adding inflation, both maximal and cumulative multipliers are still higher in recessions, as in the baseline specification. We find a maximal multiplier of 3.27 for France (1.38 in recession for the previous specification), and 2.08 (compared to 1.31 previously) for Germany. While multipliers are initially about the same value at t=0, in recessions, output increases by up to 2 in Germany, and from 1 to 3 in France, while in expansions, for both countries, the multiplier becomes gradually close to 0.

Adding the interest rate[11] in our model is another way to partially capture the effects of monetary policy and check for differences in results that could stem

[11] The interest rate is added as the fourth variable. Considering the five variables (adding both inflation and interest rates) as usually done in the literature in linear VAR could be an extension of our research. We did not compute a 5-variable STVAR for facing excessive computational time.

from monetary conditions. We use long-term interest rates, precisely Treasury Bills (Federal Fund Rate for the United States, 9-10 years government bond yield for Germany and French Government Guaranteed bond yield). Multipliers exhibit the same magnitude as in our baseline specification, especially maximal multipliers, which are comparable. The impulse responses as presented in Annex also exhibit similar magnitudes and patterns as when we add GDP deflator.

Table 2: Multipliers, conditionning on the stance of monetary policy

	maximal	cumulative	maximal	cumulative	maximal	cumulative
	United States		*France*		*Germany*	
Conditioning on inflation (chain-type index / GDP deflator)						
linear	0.74 (0.24)	0.79 (0.263)	0.88 (0.19)	1.39 (0.21)	1.10 (0.09)	1.09 (0.09)
expansion	0.60 (0.098)	0.55 (0.11)	0.39 (0.17)	1.48 (0.20)	0.76 (0.06)	0.63 (0.055)
recession	2.22 (0.27)	3.27 (0.25)	3.27 (0.21)	2.99 (0.16)	2.08 (0.27)	1.37 (0.17)
Conditioning on the interest rate						
linear	1.69 (0.127)	1.78 (0.30)	1.02 (0.15)	0.89 (0.18)	1.08 (0.13)	1.19 (0.10)
expansion	1.20 (0.12)	0.62 (0.11)	0.87 (0.25)	0.54 (0.16)	0.70 (0.17)	0.84 (0.08)
recession	1.32 (0.22)	1.90 (0.16)	1.98 (0.14)	2.03 (0.34)	1.82 (0.46)	1.22 (0.13)

Note: standard errors are in parenthesis
For France, we restrict the sample when we condition on the interest rate to 1969:1-2012:2. The results seem to exhibit subsample unstability.

After comparing both specifications, monetary policy does not seem to cushion the "business cycle effect" of fiscal multipliers. By integrating inflation or the interest rate in our vector of exogenous variables, we introduced a proxy for monetary policy and indirectly measured the possibility of a counter-cyclical monetary policy. Our results seem to vouch for the existence of such countercyclical policies (lower multipliers in expansions, that could possibly be linked with higher interest rates and targeted inflation; higher multipliers in recession potentially because of lower interest rates). Therefore, it might be interesting to document in a future extension of our study the reaction of interest rates and inflations to provide more rigourous conclusions about some *policy mix* by the Central Banks, that is to say the use of countercyclical monetary policy to accompany the fiscal policy and magnify the effect of shocks. As table 5 suggests, inflation seems to increase slightly following a positive fiscal shock, and more in recessions. The Keynesian theory predicts a maximal multiplier effect when

coupling fiscal and monetary policies - the more accommodative the monetary policy, the higher the multiplier effect, as confirmed by Woodford (2011). Indeed, when accounting for monetary policy, such as the zero lower bond or a model featuring a Taylor rule, the multipliers are found to be higher. The fiscal expansion (e.g positive shock in government spending) rises aggregate demand, hence the price level, which puts upward pressure on the nominal interest rate. An increase in the interest rate could have an adverse effect on private demand, leading to a crowding out of private investment and consumption, thus creating a smaller multiplier effect. A positive fiscal stimulus would be more efficient if an expansionary monetary policy (e.g a drop in the interest rates in recession to boost demand) accompanies an increase in public spending, insofar as it results in a higher multiplier. Hence, studying the response of short-term, long-term interest rates and other monetary instruments could sheld more light on the interaction between monetary and fiscal policy.

Table 5: Example of response of inflation

maximal response of inflation (percentage point)	
	Germany
linear	0.017 (8e-06)
expansion	0.056 (2e-05)
recession	0.11(5e-05)

Note: standard errors are in parenthesis

6.2 Effect on other macroeconomic variables

We illustrate the effects on other variables such as unemployment and most importantly, real private consumption and private investment. There exists empirical literature already documenting this, so our results are not *per se* innovative but useful to examine the sources of the asymmetry and the effects of shocks on labor market variables. When estimating the effect of government spending on output components and the other variables aforementioned, we substitute these new variables for output in our vector of endogenous variables.

6.2.1 Unemployment rate

According to conventional wisdom, a stimulus effort to spur aggregate demand should increase job creation, and decrease the unemployment rate. Figure 11 (Annex) presents the results for Germany. The impact response at t=0 in both regimes is initially 0. Then, in both the "high" setting and the "low" regime,

the unemployment rate decreases following the spending shock in the subsequent quarters (for about 2 quarters) to reach 0 again. This effect is approximately the same in both regimes, but the magnitude of the response is small. Figure 12 displays our findings for France, which present more contrasts: unemployment initially rises in periods of anemic growth, following a spending shock (at t=0 by 0.2%). Only after 3 quarters does the response goes back to 0 to fluctuate around that value. The unemployment rate also rises for several quarters before going back to 0 if the shock occured in upturns. Yet, as the significance interval suggest, there is no significant difference between our three regimes in the long term. The impulse response of the unemployment rate for the U.S. (figure 13) exhibits a similar pattern as France. In periods of low growth, unemployment will rise by around 0.3% for 3 quarters to then decrease. The multipliers are however found to be different between regimes. Overall, our results support Bruckner and Pappa (2010), who, using sign restrictions to identify fiscal shocks in a structural VAR, and its effects on labor markets variables, find that for many OECD countries, the unemployment rate significantly rises following a positive government spending shock, even though both employment and participation rates increase. While it is difficult to reconcile with existing theories, the authors mention two possible explanations: the presence of endogenous participation and workers heterogeneity. Altogether, endogenous participation, in presence of a fiscal shock, creates an aggrandizement of the pool of job seekers (labor demand increases, wages and employment too) because the expansionary shock leads to a better matching technology to vacancies. Outsiders (students, long-term unemployed) have a less efficient matching technology, provided that labor supply elasticity is sufficiently low, their unemployment rate increases, more than the fall in insiders unemployment, pushing total unemployment rate upward. While they find an increase of unemployment for the U.S which turns negative only after 10 quarters, their results are unstable with the subsample chosen. The response is negative up to 1990s and positive for the period 1990s and onwards.

6.2.2 Private components of output

The response of some of the private components of output, among which private consumption and private investment, could shed some light on the source of the asymmetric response of output to an expansionary spending shock. We want to verify the existence of crowding out effects on consumption or investment. Figures 22 to 24 display the fixed-regime response of private consumption

for Germany, France and the U.S..

We find no compelling evidence that higher government spendings crowd out private consumption, contrary to the predictions of neoclassical models. On the contrary, the response of consumption is persistent and exhibits a crowding-in effect like in Blanchard and Perroti (2002) and Mountford and Uhlig (2009), thereby validating the Keynesian theory. Indeed, following a government spending shock in Germany, consumption increases initially by 0.25, and the multiplier gradually increases to then level off close to 0.5 in a recession. The magnitude of the response for the U.S is within the same range, around 0.5. Indeed, after an initial increase close to 0 in both the expansion regime and the linear setting, there is a crowding out effect only for 2 quarters, quickly rising to reach 0.5 in the long run and in upturns; the crowding out effect however persists in recession regimes. Overall, our findings are in accordance with Blanchard and Perotti (2002) who decompose the effects of spending shocks into their effects on each component of GDP, but in a linear setting, as well as in line with Galí *et al.* (2007), in a New Keynesian model with sticky prices, based both on U.S. data. Multipliers have greater magnitudes for France. Indeed, from an impact multiplier (at t=0) close to 1 in both regimes, the multiplier on consumption decreases immediately during an upturn to level off to around 0 whereas it quickly increases during a period of economic weakness to reach the value of 3. Our estimates are within the same range as Galí *et al.* (2007), as they find an impact multiplier around 0.17 that rises to 0.95 afters 2 years. However, their results are based on a single regime. Our results clearly suggest a state-dependent response of consumption to a spending shock for France and Germany: the response is smaller, averaging 0.25 on the short-term, if the shock occurred in an economic boom period for Germany, compared to 0.5 in boom (at t=0) and respectively 1 and 1.5 for France. Given that private consumption constitutes 58% of GDP for both Germany and France, the asymmetry in output response possibly stems from consumption. Regarding the U.S., our confidence interval overlap in the short-term, implying no significant difference between regimes, at least in the short-term.

A possible explanation for government spending having a stronger positive effect on private consumption in recession, closely related to Galí *et al.* (2007) argument and those developed in section 5.1, is the countercyclical movements in the fraction of households that face binding income and liquidity constraints

(the so-called rule-of-thumb consumers). In a low economic activity, with severe labor market constraints, credit and liquidity constraints, and if interest rates remain low, the government spending shock relaxes these constraints. Indeed, if consumers behave in a non-Ricardian fashion, consumption will be function of current disposable income. Once their income increases, they spend that additional income and increase consumption. In a high growth state, with no constraints, households can inter-temporally smooth consumption, and choose between consumption and employment, hence a smaller effect of policies. As a consequence, an argument could be made in favor of targeted measures to support lower incomes, since it could lead to higher current spendings by those liquidity constrained households and businesses.

Another mechanism that would cause consumption to rise would be the passive monetary policy during recessions, as discussed in more depth in section 6.1. Indeed, following an increase in government purchases, and in presence of sticky prices, aggregate demand rises, as well as labor demand. If the labor supply is not too elastic, real wages increases (especially with sticky prices) and households work harder, substituting consumption for leisure (intra-temporal substitution). As government spending increase, the price level increases, so does the expected path of inflation. However, if monetary policy is accommodative, and does not increase the nominal interest rate, the real rate declines, implying a drop in returns to savings and a rise in current consumption (inter-temporal substitution).

Figure 22: Real private consumption response, Germany a) recession b) expansion

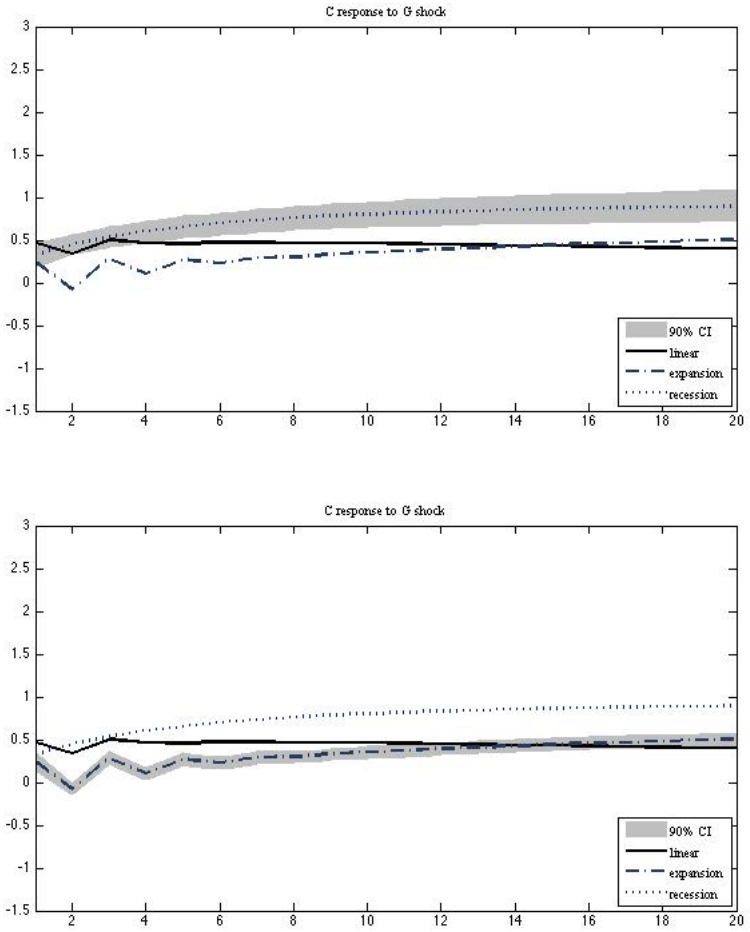


Figure 23: Real private consumption response, United States a) recession b) expansion

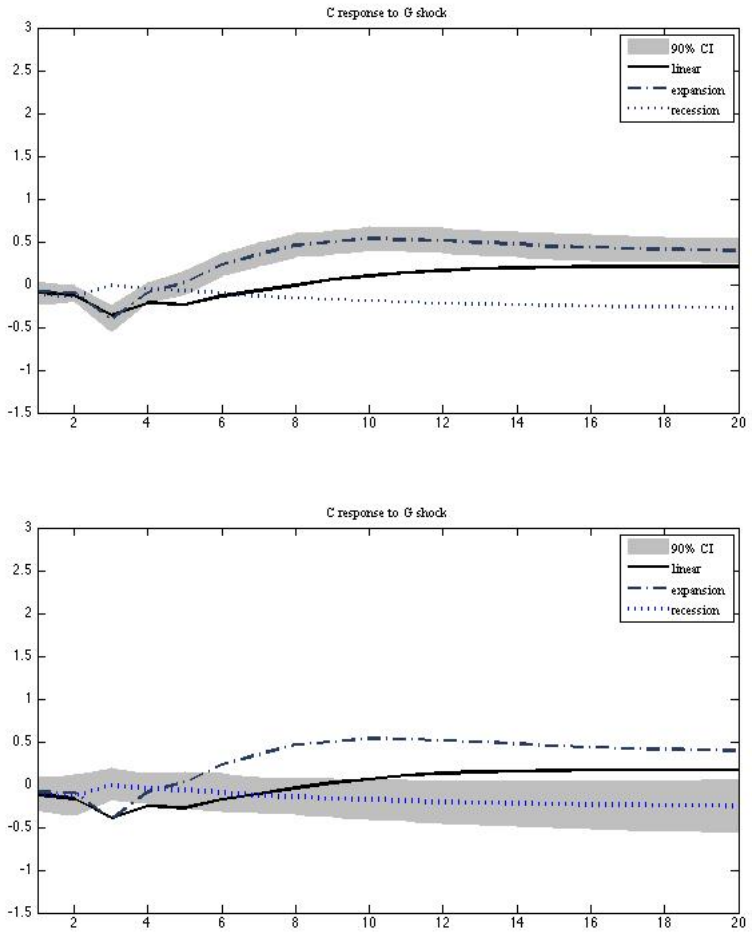
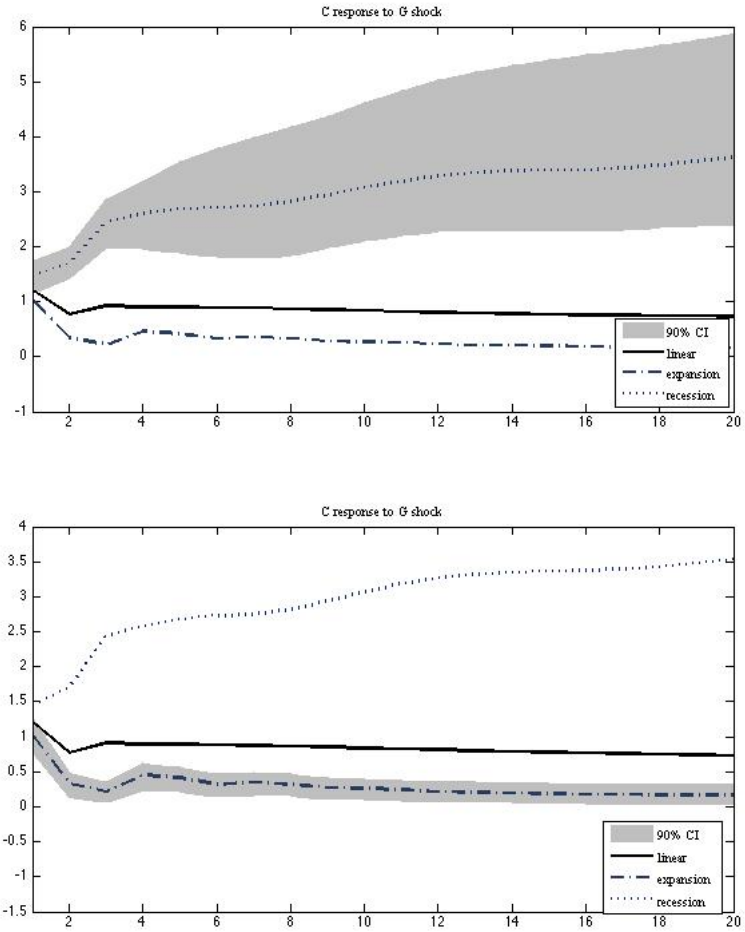


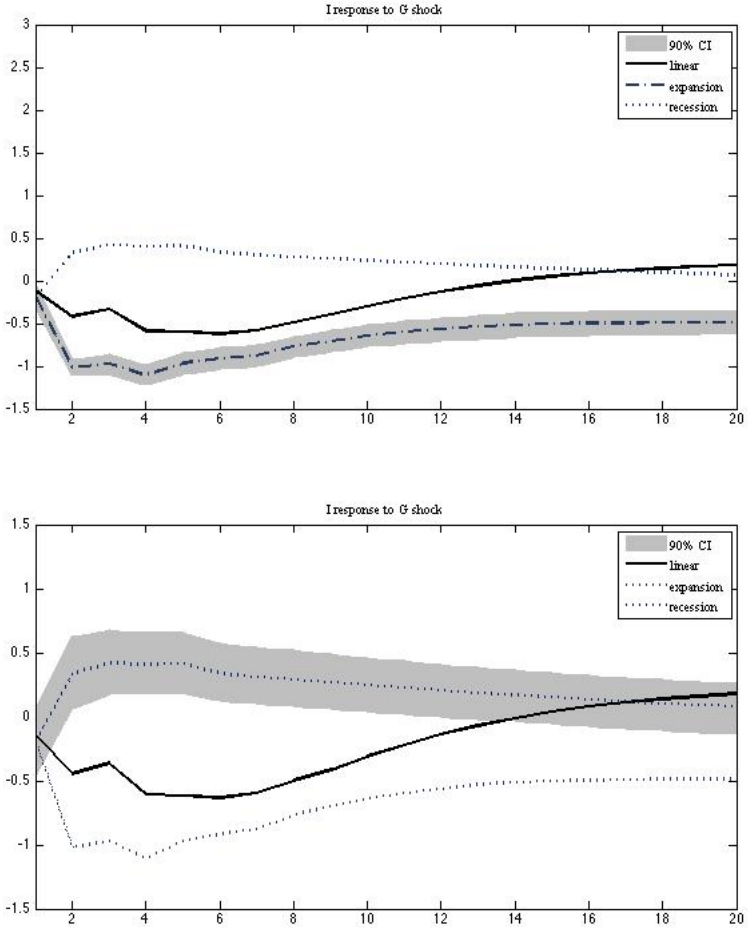
Figure 24: Real private consumption response, France a) recession b) expansion



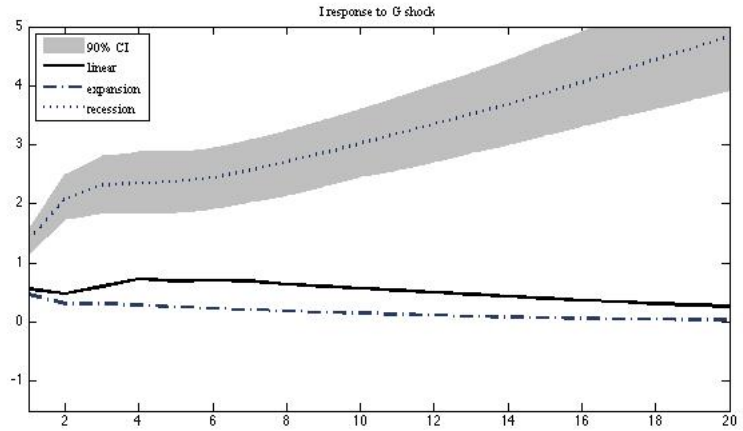
We now turn to the response of private investment to verify Blanchard and Perotti (2002) findings of an "investment puzzle". Figures 25 to 27 display the impulse responses of investment to a positive spending stimulus (table 6 sums up the results in Annex, section 3). In periods of economic weakness, our findings suggest no crowding-out of investment, in accordance with Fatás and Mihov (2001) and Perroti (2004). On the contrary, private investment increases up to 0.5 after 2 quarters for the United States before gradually declining to 0. In periods of economic strength, a positive spending shock exhibits some crowding out effect: on impact, investment decreases by -1 to reach -0.5 in the

long term. Regarding France, in both regimes, government spending shocks create rather a crowding-in of private investment, with an impact multiplier around 0.5 in expansions and greater than 1 in recessions. The multiplier, during a period of anemic growth, continues to rise in the long term. Both these results stem from the predictions of two theories. The responses in recession are in accordance with traditional Real Business Cycle models, according to which an increase in investment has a positive effect on employment, and if this effect is sufficiently persistent, this leads to a rise in expected return to capital, thereby triggering a rise in investment and creating an amplification effect, which we observe for the case of France. Bachman and Sims (2012) suggest an increase in private sector productivity, reflected later on in higher confidence (they refer to "pure sentiments effects", for instance news that provide signal effects on future productivity). In contrast, the crowding out in expansion is supported by the standard IS-LM theory which predicts that an increase in government consumption, if not accompanied by a rise in money supply, will tend to increase the interest rate and decrease investment. Finally, the response of private investment for Germany do not display any significant asymmetry, but rather a similar response for both regimes, 0.5 initially, rapidly declining to 0. Therefore, we might hypothesize that the asymmetry in the response of output stems partly more from consumption for Germany, and more from investment for the U.S.

Figure 25: Private fixed investment response
a) United States



b) France


Iresponse to G shock
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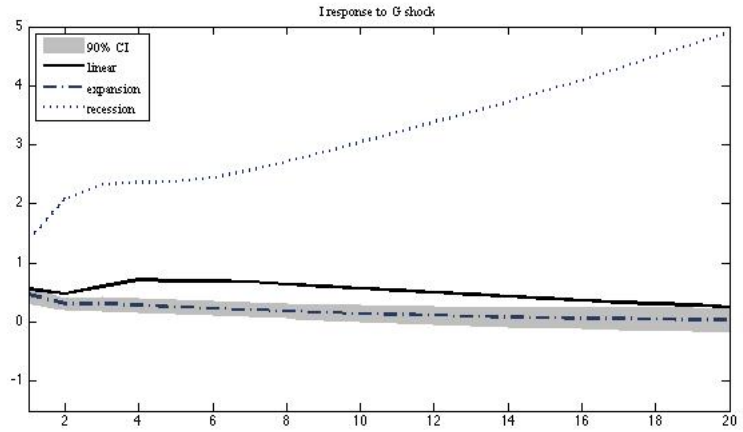
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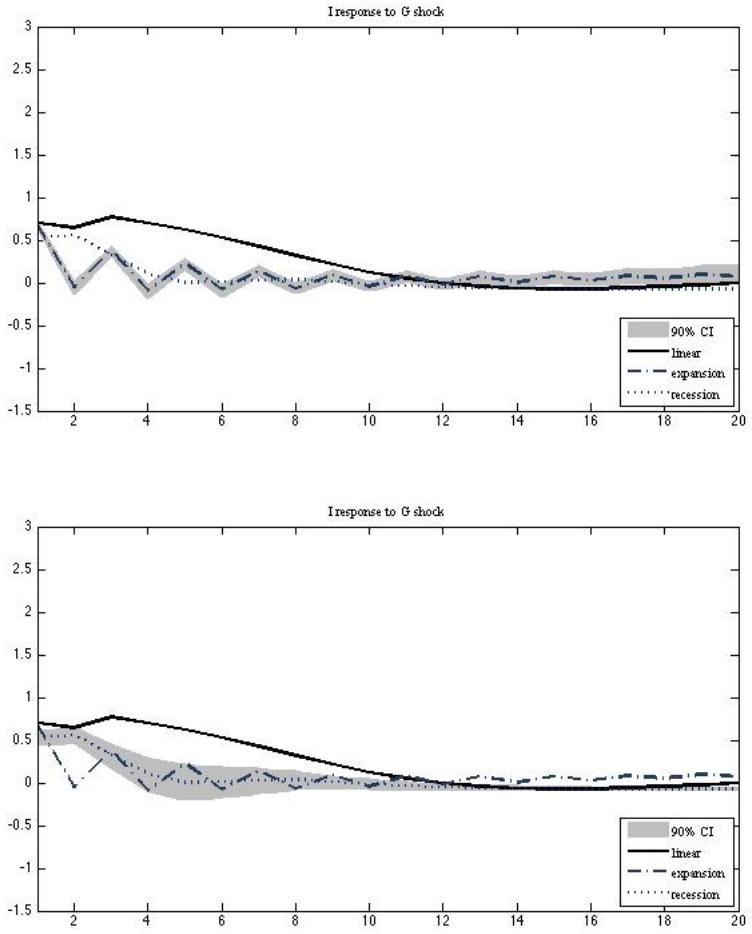
c) Germany



7 Conclusion

In this paper, we aimed at providing some empirical characterization of the effects of fiscal policy along the business cycles. We find that the magnitude of the multiplier depends on time- and country-specific characteristics. Our analysis provides evidence for higher multipliers during periods of output contractions and suggests that averages such as the ones found in the linear VAR empirical literature mask substantial differences that exist across economic regimes. This asymmetry persists when we condition on monetary policy and seems to

find its sources in the dependency of the response of both private consumption and investment on the business cycles. The components of public spendings are also found to have different, but still assymmetric effects on output. Given the tight fiscal discipline experienced by some member countries of the European Monetary Union, the asymmetry we find between regimes is relevant for its policy implications. These results advocate a more gradual approach than a front-loaded adjustment of fiscal policy so as not to prolong or induce recessions without actually translating into lower debt-to-GDP ratios, as well as targeted packages on specific categories of spendings to implement the cuts.

Notwithstanding, it has to be noted that time-variation could stem from other sources, and further research could be pursued by using a model allowing all parameters to vary in time. A TV-SVAR, more flexible than the non-linear transition model could be a useful tool, as used by Cogley and Sargent (2005). Indeed, all coefficients of the model, including the variance-covariance matrix coefficients, are allowed to vary, thereby allowing the shocks to depend over time, on top of the contemporaneous and lagged coefficients. Furthermore, other asymmetries of the response of output to a spending shock could arise from the size and sign of the shock, which we made abstraction of in the present paper and which could be explored in more depth.

Moreover, another possible extension would be to include other stages of the business cycle, by incorporating a third regime, for instance, thereby allowing us to differentiate between a dire and average recession. The dichotomy between regimes could also be based on a more general indicator, regrouping three interrelated possible situations: recessions and expansions, "good fiscal stance" and weak public finances (using for example the debt-to-GDP ratio or deficit-to-GDP ratio), as well as banking stress and normal times (using for instance the default rate). Such a global turmoil indicator would particularly be useful for the estimation of multipliers in several countries of the periphery of the Eurozone, which faced such situations.

Finally, as done by Favero and Giavazzi (2012), we will extend the database compiled by Devries *et al.* (2013) on narrative fiscal shocks and embed these narrative shocks in our non-linear VAR.

Annex

1 Data sources and descriptive statistics

1.1 Data sources

1.1.1 Basic variables

We provide the sources, and the codes of the data we used to construct our variable.

Country	Sample	Government expenditures	Government tax revenues	Source
France	1962:1-2012:2	FCE+ GFCF	NGTR	INSEE BDM
Germany	1972:1:2012:2		net total tax revenues	Deutsch Bank national account
Italy	1992:1-2012:2		net total tax revenues	National Institute of Statistics
United States	1947:1-2012:2		current receipts - GSB	NIPA tables 3.9.3; 3.1; 3.9.5

FCE: final consumption expenditures (in the case of the U.S social security spending are not included in consumption expenditures, contrarily to France and Germany) P3S13 in ESA95
GFCF: gross fixed capital formation (P51 in ESA95)
NGTR: net government tax receipts (net of transfers, including social security contributions)
GSB: government social benefits

1.1.2 Control variables

Country	Sample	price index	interest rate	Source
France	1962:1-2012:2	GDP deflator	FRG bond	OECD & datastream
Germany	1972:1:2012:2	GDP deflator	BDG bond	
U.S.	1949:1-2012:2	GDPCTPI	USFD fund*	BEA

BDG Bond: long term government bond yield- 9-10 years
FRG Bond: French Government guaranteed bond yield
USFD fund: US Federal Fund rate (monthly average)
* the data is only available starting from 1953:4

1.1.3 Other macroeconomic variables

Country	Sample	unemployment rate	real private consumption	private investment	Source
France	1960:1-2012:2	FRUN%TOTQ	FRAPFCEQDSMEI	private GFCF	OECD & Datastream
Germany	1970:1:2012:2	BDUN%TOTQ	DEUPFCEQDSMEI	private GFCF*	Datastream Deutsche Bundesbank
U.S	1947:1-2012:2	UNRATE	PCECC96	GPDIC96**	FRED database

GFCF: gross fixed capital formation
* the data is only available starting from 1991:1
** we use gross domestic private fixed investment (which accounts for changes in inventories, compared to Gross Fixed Capital Formation) as the GFCF series is only available starting in 1995 which reduces considerable the sample. Even though AG(2012a) use a data set provided

by some of their colleagues that reconstructed the missing data, there is a break in data which provided unreliable results.

1. 2 Descriptive statistics

Table 1: Descriptive statistics of the data (in real terms), United States

	z	**Y**	**G**	**T**	r	**GDP deflator**	**UR**	**private I**	**private C**
mean	0.784 (0.8)	6548	814	804.5	5.29	52.7	5.79	915	4379
max	2.49	13548	2737	2518	17.8	115	10.7	2266	9582
min	-0.63	1766	27.6	38.1	0.07	14.3	2.6	167	1131
st. dev.	0.50	3685	811	744.7	3.46	33.17	1.66	617	2632

Note: all values are in billions of dollars, except the unemployment rate, and the threshold variable z, which is the moving average of the growth rate of real GDP
We note in parenthesis the median of the threshold variable.
r: interest rate
UR: unemployment rate

Table 2: Descriptive statistics of the data (in real terms), France

	z	**Y**	**G**	**T**	r	**GDP deflator**	**UR**	**private I**	**private C**
mean	0.7 (0.55)	288.8	74.6	333.5	7,.9	60.7	8.1	49.4	121.9
max	2.35	454.5	125.7	845	17.5	112.5	10.8	83.1	292.9
min	-0.56	100.1	20.4	13.1	3.04	10.9	3	20.3	7.23
st. dev.	0.5	106.5	31.4	276.2	3.33	35	1.9	14.9	92.6

Note: all values are in billions of euros, except the unemployment rate, and the threshold variable z, which is the moving average of the growth rate of real GDP
We note in parenthesis the median of the threshold variable.

Table 3: Descriptive statistics of the data (in real terms), Germany

	z	**Y**	**G**	**T**	r	**GDP deflator**	**UR**	**private I**	**private C**
mean	0.497 (0.50)	445.7	180	318.2	6.4	78.8	7	93.2	218.8
max	1.48	618	230.8	572.6	10.68	107	11.9	108.31	379.5
min	-0.77	258.2	119.7	82.6	1.5	36.7	0.5	77.5	58.8
st. dev.	0.44	105.6	32.9	151	2.1	20.9	3.2	7.37	97.34

Note: all values are in billions of euros, except the unemployment rate, and the threshold variable z, which is the moving average of the growth rate of real GDP
We note in parenthesis the median of the threshold variable.

Table 4: Descriptive statistics of the data (in real terms), Italy

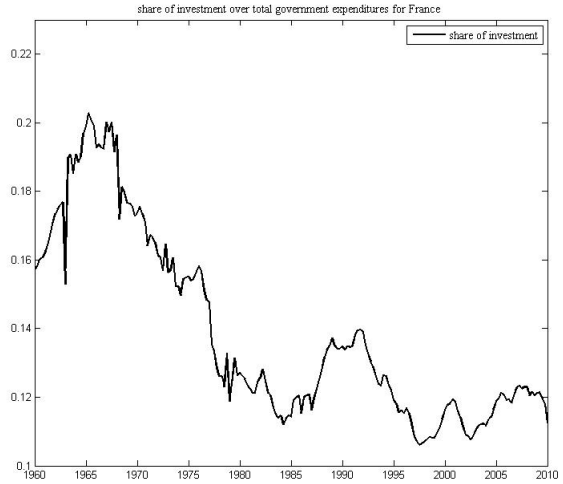
	z	**Y**	**G**	**T**	**GDP deflator**
mean	0.19	337	133.9	562	91.1
max	0.89	374.4	154.6	638	113.37
min	-1.07	294.8	113	423	64
st. dev.	0.43	246.6	13.01	56.09	14.7

Note: all values are in billions of euros, except the threshold variable z, which is the moving average of the growth rate of real GDP
We note in parenthesis the median of the threshold variable.

Table 5: Shares of government expenditures in GDP (whole sample)

	U.S	**France**	**Germany**	**Italy**
govt. spending	22	23.7	31.4	39
consumption	21.3	21.3	15.1	20
investment	3.7	3.4	16.3	19

Figure 1: Evolution of a) share of investment b) share of consumption on goods and services (in percentage points), France



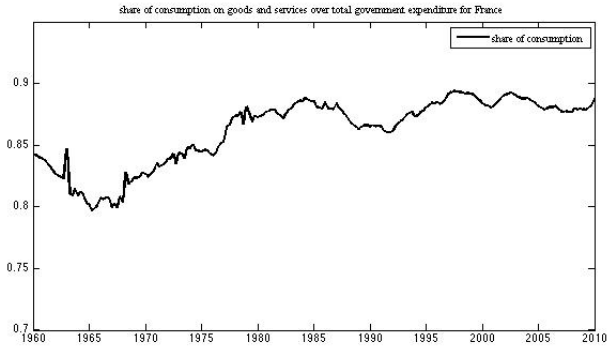


Figure 2: Evolution of a) share of investment b) share of consumption on goods and services (in percentage points), United States

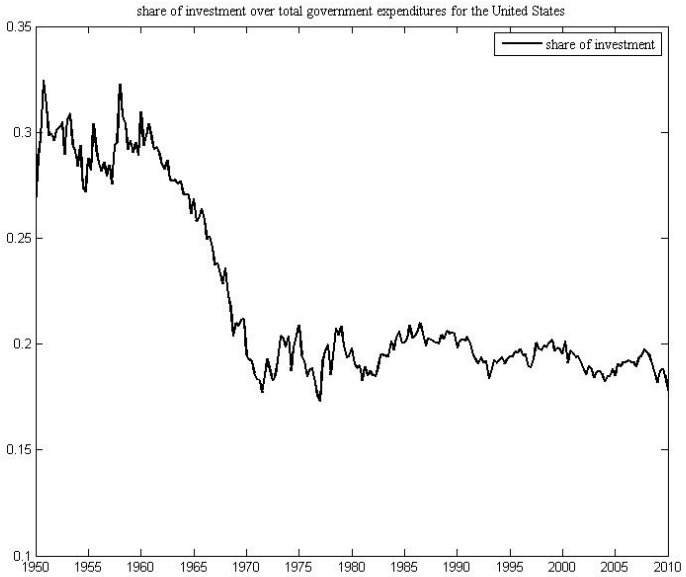


Figure 3: Evolution of a) share of investment b) share of consumption on goods and services (in percentage points), Germany

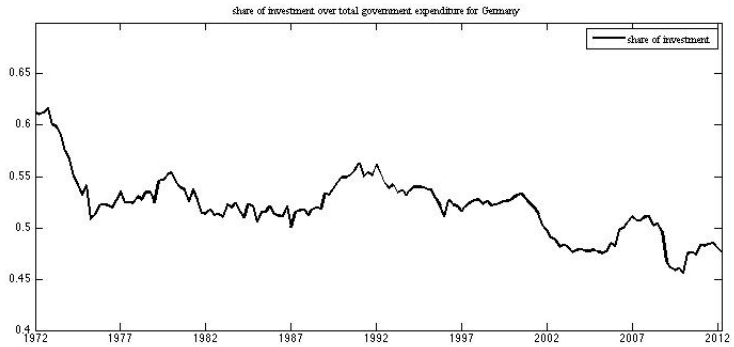


Figure 4: Evolution of a) share of investment b) share of consumption on goods and services (in percentage points), Italy

2 Estimation algorithm

The estimation procedure relies on maximum likelihood. The log-likelihood considered is :

$$logL = const - \frac{1}{2}\sum_{t=1}^{T} \log \mid \Omega_t \mid - \frac{1}{2}\sum_{t=1}^{T} u_t' \Omega_t^{-1} u_t$$

with u_t defined as in equation (2):

$$u_t = X_t - (1 - F(z_{t-1}))\Pi_E(L)X_{t-1} - F(z_{t-1})\Pi_R(L)X_{t-1}$$

and

$$\Omega_t = \Omega_E(1 - F(z_{t-1})) + \Omega_R F(z_{t-1})$$

Regarding the implementation, Auerbach and Gorodnichenko (2012a) provide more details of their estimation procedure in the appendix of their paper. As mentioned in the description of the method, Markov Chain Monte Carlo (MCMC) method is used to construct the confidence interval, given the non-linearity of the model and mainly because of the large number of parameters to be estimated in our parameter space. They chose the Hastings-Metropolis algorithm to implement the MCMC to determine the parameters and their posterior distributions.

We sum up briefly the in main steps of the MCMC algorithm:

i) begin at a location in the parameter space (i.e we draw firstly a vector of parameters, "candidates" for which we test the value)

ii) compute the likelihood at this point $\mathcal{L}_p$

iii) the jump function proposes a new location

iv) compute the new likelihood $\mathcal{L}_n$

v) the decider is the Hastings-Metropolis algorithm, which determines whether or not to accept the new location (i.e candidate), or to repeat the procedure until one is accepted.

In brief, this algorithm works the following way:

- compute the ratio of the likelihoods:

$$\alpha = \frac{\mathcal{L}_p}{\mathcal{L}_n}$$

- the acceptance criterium is:

$\alpha \geq 1$ always accept

$\alpha < 1$ accept with probability α

We use 100 000 draws for the estimates, and chose a burn-in period of 20 000 draws.

3 Further specifications

3.1 Stance of monetary policy

3.1.1 Inflation

Figure 5: Conditioning on inflation (price chain-type index), United States

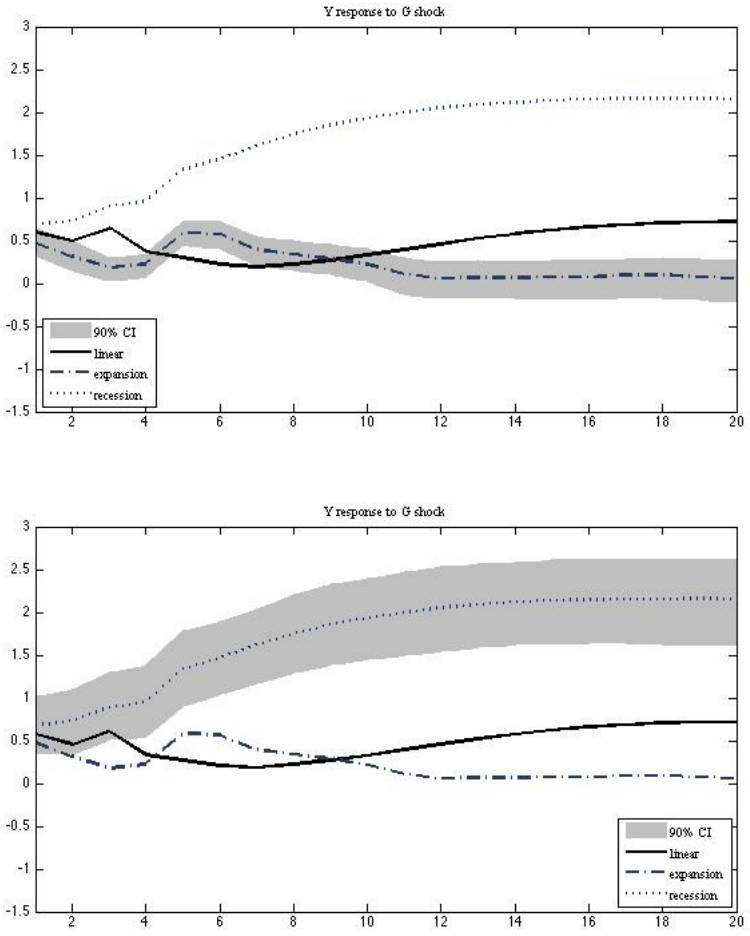


Figure 6: Conditioning on inflation (GDP deflator), Germany

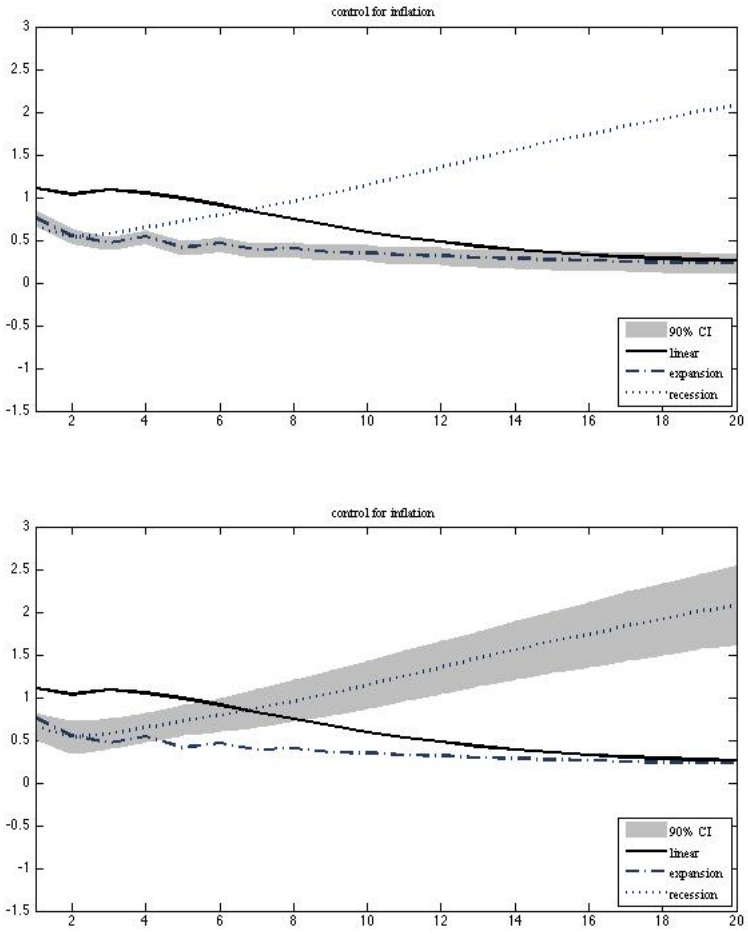
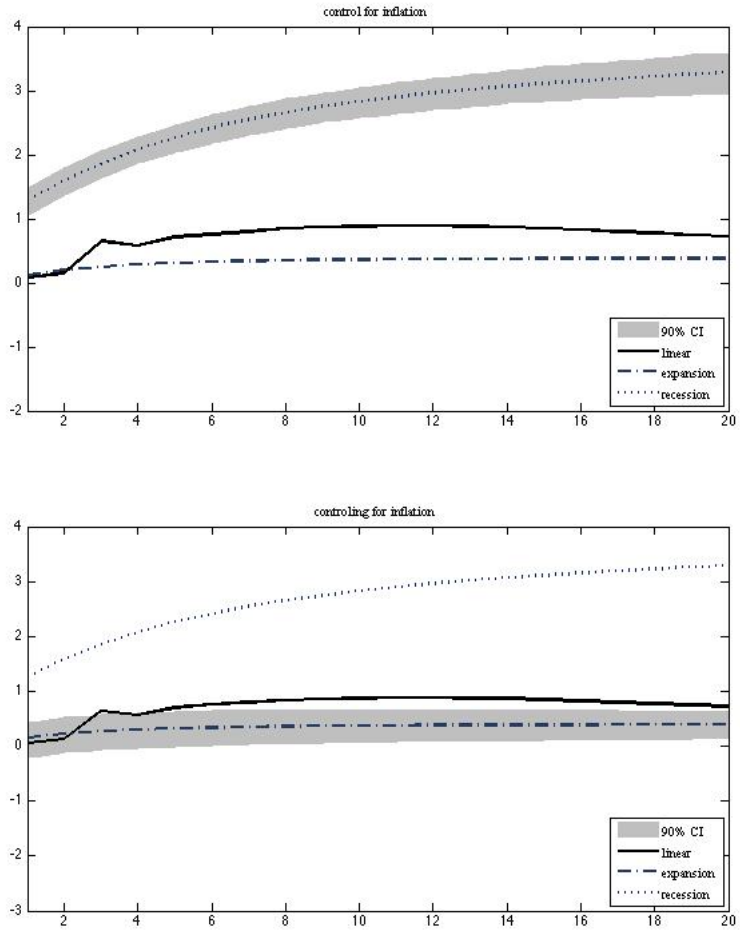


Figure 7: Conditioning on inflation (GDP deflator), France



3.1.2 Interest rate

Figure 8: Controls for long-term interest rate (Government T-Bills), Germany

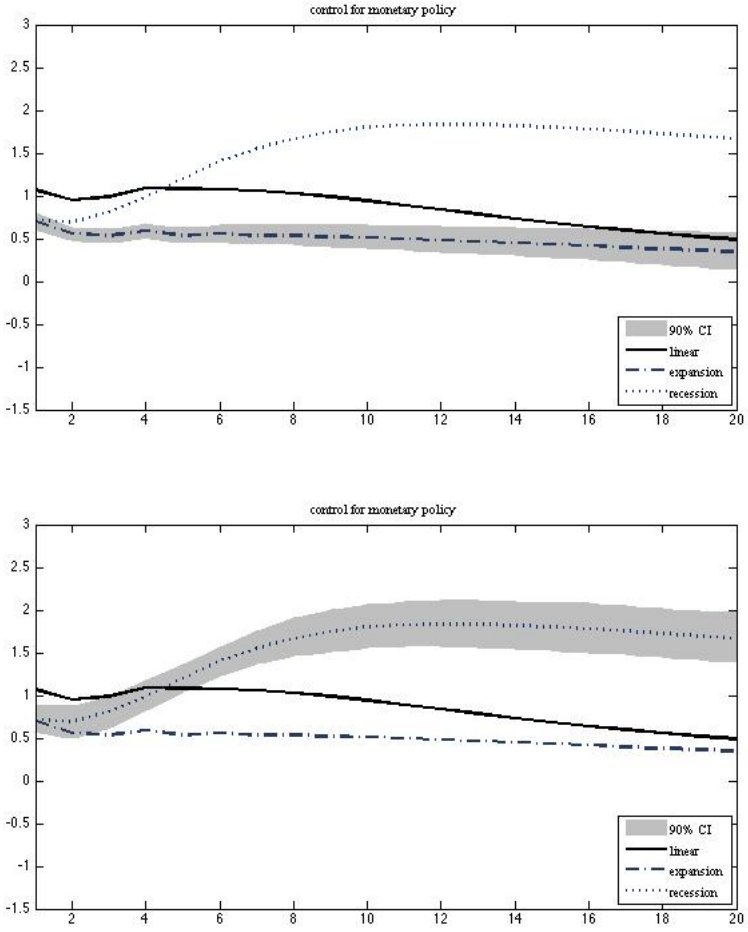


Figure 9: Controls for long-term interest rate (US Federal Fund Rate), United States

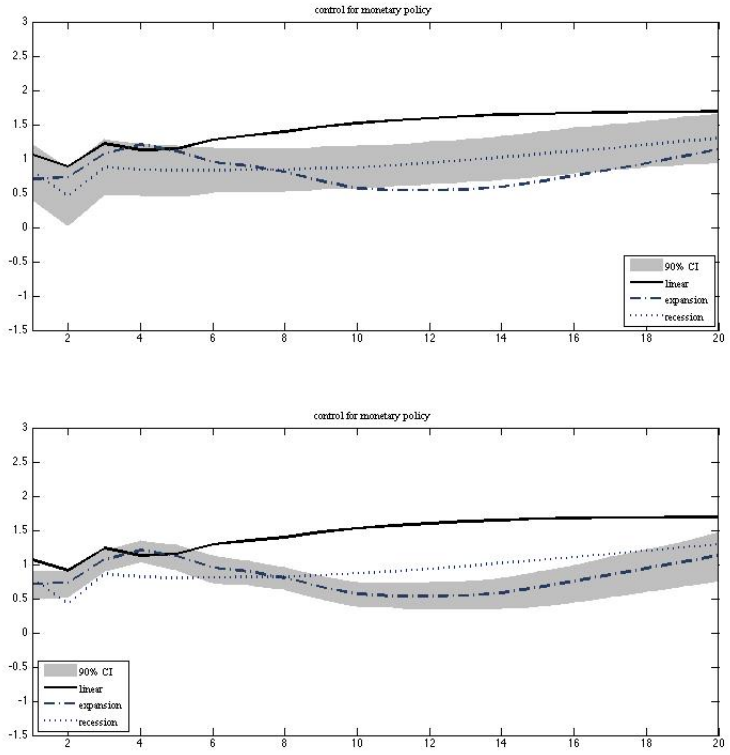
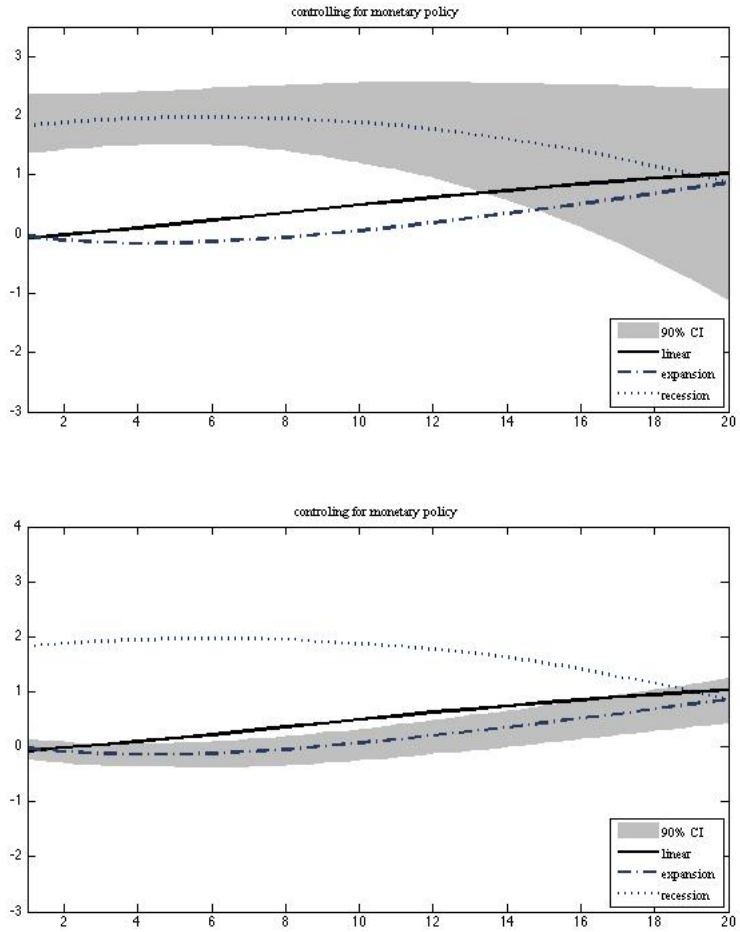


Figure 10: Controls for long-term interest rate (French Government Bond), France



3.2 Other macroeconomic variables

3.2.1 Unemployment rate

Figure 11: Response of unemployment, Germany (confidence intervals in grey)

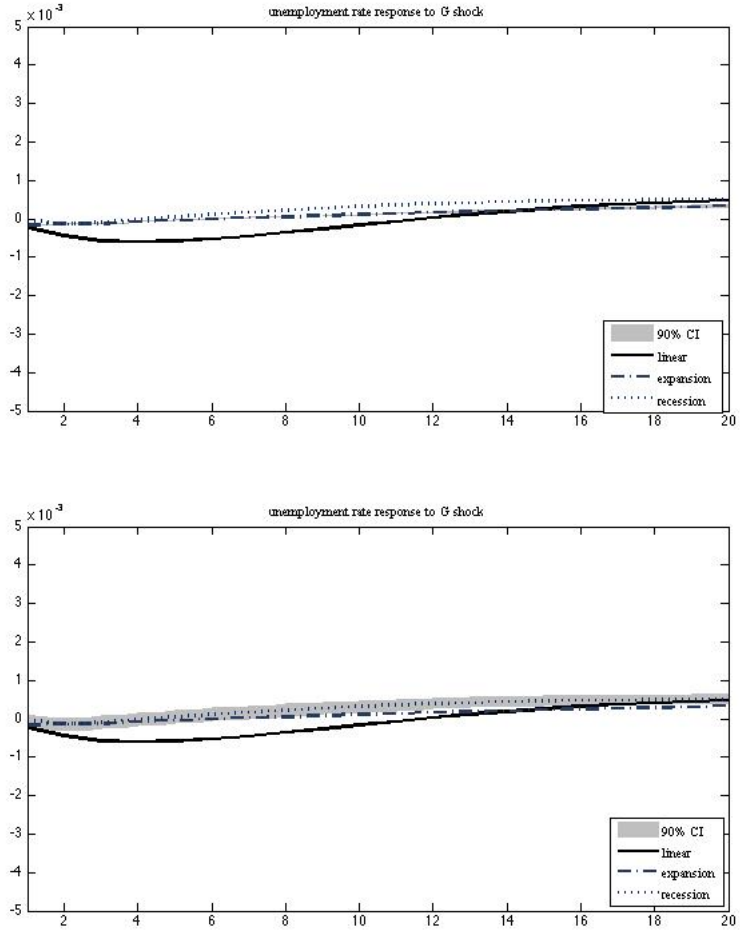


Figure 12: Response of unemployment, France

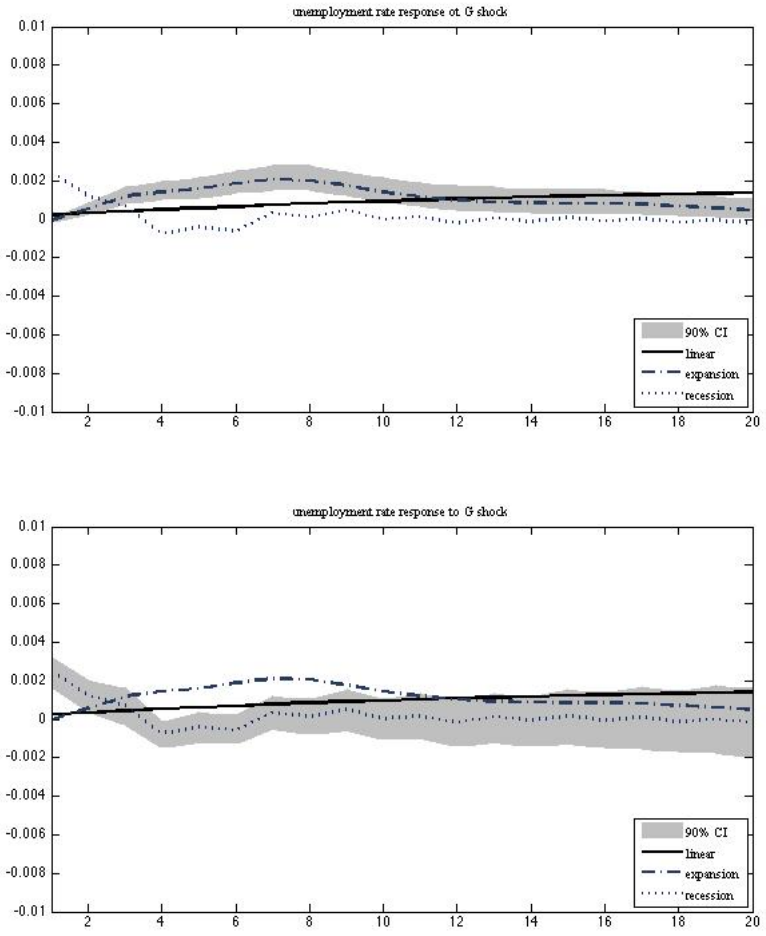
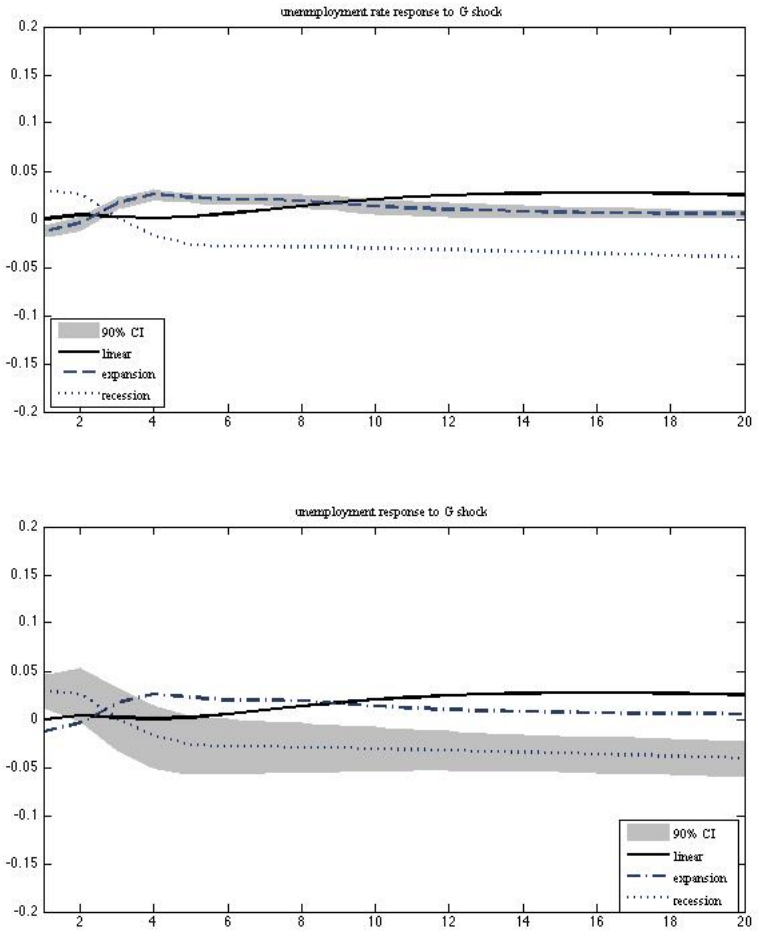


Figure 13: Response of unemployment rate, United States



3.2.2 Private consumption and invesmtent

Table 6: Maximal and cumulative multipliers for private components of output

	max	cum	max	cum	max	cum
	France		*U.S.*		*Germany*	
private consumption						
linear	1.2 (0.17)	1.13 (0.08)	0.17 (0.16)	0.005 (0.17)	0.504 (0.04)	0.59 (0.05)
expansion	1.02 (0.14)	0.69 (0.09)	0.5 (0.08)	0.44 (0.08)	0.503 (0.05)	0.59 (0.05)
recession	3.5 (1.1)	1.67 (0.7)	-0.01 (0.12)	-0.47 (0.15)	0.89 (0.12)	0.77 (0.09)
private investment						
linear	0.73 (0.17)	0.73 (0.13)	0.13 (0.09)	-0.29 (0.12)	0.77 (0.03)	0.56 (0.01)
expansion	0.48 (0.10)	0.29 (0.09)	-0.19 (0.09)	-1.39 (0.08)	0.66 (0.06)	0.24 (0.03)
recession	4.8 (0.6)	3.3 (0.36)	0.39 (0.14)	0.28 (0.13)	0.56 (0.03)	0.16 (0.04)

Note: standard errors are in parenthesis

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