Government Spending Shocks in Open Economy VARs

Mario Forni*
Università di Modena e Reggio Emilia, CEPR and RECent

Luca Gambetti†
Universitat Autonoma de Barcelona and Barcelona GSE

Abstract

We identify government spending news and surprise shocks using a novel identification based on the Survey of Professional Forecasters. News shocks lead, through an increase of the interest rate, to a real appreciation of US dollar and a worsening of the trade balance. The opposite is found for the standard surprise shock which raises government spending on impact: the currency depreciates and net exports improve. We reconcile the two conflicting results showing the different timing of the spending reversals associated with the two shocks. The effects of the news shock on government spending are much more persistent and the reversal occurs much later.

JEL classification: C32, E32, E62.

Keywords: structural VARs, government spending, fiscal policy, forecast revisions, government spending news, survey of professional forecasters, crowding-out, fiscal foresight.

*Contact: Dipartimento di Economia Politica, via Berengario 51, 41100, Modena, Italy. Tel. +39 0592056851; e-mail: mario.forni@unimore.it

†Financial support from the Spanish Ministry of Science and Innovation through grant ECO2009-09847 and the Barcelona Graduate School Research Network is gratefully acknowledged. Contact: Office B3.174, Departament d'Economia i Historia Economica, Edifici B, Universitat Autonoma de Barcelona, Bellaterra 08193, Barcelona, Spain. Tel: (+34) 935811289; e-mail: luca.gambetti@uab.cat

1 Introduction

While there is still a large disagreement among economists about the effects of government spending shocks on consumption, empirical VAR evidence strongly supports, at least with US data, the view that increases in government spending lead to a depreciation of the real domestic currency (see Kim and Roubini, 2008, Corsetti and Muller, 2006, Monacelli and Perotti, 2007, Ravn, Schmitt-Grohe and Uribe, 2007, and Enders, Muller and Scholl, 2011).[1][2] The result stands in sharp contrast with standard theory, which predicts that fiscal policy expansions appreciate the real exchange rate through an increase of domestic interest rates. Actually, the finding has sparked an important research effort to reconcile the theory with the empirical evidence. Ravn, Schmitt-Grohe and Uribe, 2007, show that, with deep habits, the increase in aggregate demand triggered by government spending leads to a reduction of the domestic markup, which in turn makes the domestic economy less expensive, i.e. the real exchange rate depreciates. Corsetti, Meier and Muller, 2011, argue that, if there are "spending reversals" so that the private sector expects spending cuts in the future, the real long term interest rate may, fall leading to a real depreciation of the exchange rate as well as an improvement of the external balance.

A common feature of the empirical works cited above is that they largely abstract from "fiscal anticipation" or "fiscal foresight", focusing exclusively on the effects of standard unanticipated or "surprise" shocks. A few recent works, however, have convincingly argued that, because of the existence of legislative and implementation lags, fiscal policy actions are, to some extent, anticipated. That is agents receive signals about future changes in taxes and government spending before these changes take actually place (see e.g. Yang, 2007, Leeper, Walker and Yang, 2013, Mertens and Ravn, 2010).

Fiscal anticipation entails two difficulties for VAR analysis. First, identification schemes implying a large impact on government spending, like the standard scheme of Blanchard and Perotti, 2002, cannot capture anticipated shocks. Second, as shown by Leeper, Walker and Yang, 2013, the underlying MA representation of the variables considered in the VAR could be non-fundamental. Evidence of non-fundamentalness is provided by Ramey, 2011, which shows that government spending shocks estimated with a standard closed economy VAR are predicted by the forecast of government spending from the Survey of Profes-

[1]Blanchard and Perotti, 2002, Fatas and Mihov, 2001, Gali, Lopez Salido and Valles, 2007, Mountford and Uhlig, 2002, and Perotti, 2002, 2007, find that consumption increases. Ramey, 2011, Ramey and and Shapiro, 1998, Burnside, Eichenbaum, and Fisher, 2004, Cavallo, 2005, Edelberg, Eichenbaum, and Fisher, 1999, Eichenbaum and Fisher, 2005, find that consumption reduces. Kim and Roubini, 2008, find that the trade balance improves while Monacelli and Perotti, 2007, and Ravn, Schmidt-Grohe and Uribe, 2007, find that it worsens.

[2]Beetsma, Giuliodori and Klaassen, 2008, Beetsma, Giuliodori and Klaassen, 2008 and Benetrix and Lane, 2009 find that for European countries the real exchange rate appreciates.

sional Forecasters.[3] If the structural MA representation is non-fundamental, the estimated impulse-response functions can be dramatically different from the true ones. Hence, the puzzling open-economy effects of government spending shocks could be an artifact due to non-fundamentalness.

Summing up, the fiscal foresight literature raises several questions which are still open. Is it possible to document fiscal foresight with time series data? Are standard open economy VAR specifications affected by non-fundamentalness? How can we identify the foresight shocks? Do foresight shocks lead to a depreciation or appreciation of the domestic currency?

We address these questions by using the Survey of Professional Forecasters. We find that government spending is predicted much better than GDP and consumption over the 1-year horizon. This result provides strong empirical support for the fiscal foresight hypothesis. However, a large fraction of spending volatility is not anticipated, particularly in the short run. We rationalize this finding by assuming, as is usual in the "news shock" literature, that there are both anticipated and non-anticipated shocks. The former, the "news" or "foresight" shocks, have only delayed effects on spending but, on impact, affect agents' expectations. The latter, the "surprise" shocks, are unanticipated changes in spending and are conceptually identical to the spending shocks of the traditional VAR approach *à la* Blanchard and Perotti, 2002.

Using the fundamentalness test proposed in Forni and Gambetti, 2014, we find (somewhat surprisingly and contrary to the result obtained in Ramey, 2011, for a closed economy VAR specification) that, despite fiscal foresight, the standard open-economy VAR specification is not affected by non-fundamentalness. The explanation for the puzzling behavior of exchange rates must be sought elsewhere.

Then, we use SPF data to identify and estimate the news shock. Consistently with its definition, the shock (unlike the surprise shock) has spikes coinciding with episodes like the fall of the Berlin Wall (1989:IV), the War in Afghanistan (2001:IV), the I and II Gulf Wars (1990:III and 2003:I) and the approval of the fiscal stimulus package (2009:I). All these episodes are followed by substantial changes in government expenditures. The shock increases both consumption and output, the government spending multiplier being above one in the short run and essentially zero in the long-run. Most interestingly, the fiscal expansion generates a significant increase of the long-term interest rate, a significant appreciation of the dollar and a significant deterioration of the current account balance, in line with the predictions of the standard Mundell-Fleming model. On the contrary, in line with the result

[3] The solution to the problem of non-fundamentalness is to extend the econometrician information set. Several approaches have been proposed in the literature. Mertens and Ravn, 2010, use Blaschke factors, i.e. dynamic rotations of the reduced form VAR innovations. Forni and Gambetti, 2010, employ a structural factor model. Ellahie and Ricco, 2012, uses a large Bayesian VAR. Ramey, 2011, using the *Business Week* and other newspaper sources, constructs a variable containing exogenous episodes of government spending.

of the fundamentalness test, the surprise shock estimated with the enlarged VAR including survey data is almost identical to the one obtained with the standard specification and its effects are the same, i.e. the long-term interest rate reduces and the dollar depreciates.

Why are the effects of anticipated and unanticipated shocks so different? Expectations provide the answer. In the enlarged VAR, forecasts of future spending reduce significantly after a positive surprise shock (whereas they increase significantly after a positive foresight shock). This finding provides strong empirical support to the "spending reversal" argument of Corsetti *et al.*, 2011: after a surprise shock, agents revise their expectation of future spending downward, long-term interest rates reduce and the domestic currency depreciates.

The spending reversal also occurs after a news shock. Public spending starts growing after about one year, reaches a maximum after about four years, then declines and reduces significantly below its pre-shock level after about fifteen years. Indeed, all differences between the impulse response functions of the foresight and the surprise shocks reduce to a phase shift of four-five years. The effects of government spending shocks on the real exchange rate are related to the persistence of its effects on government spending: the further in the future is the reversal, the larger is the appreciation. This finding emphasizes the key role of future fiscal policy expectations in determining the interest rate and consequently the real price of the domestic currency.

The remainder of the paper is organized as follows. Section 2 documents fiscal foresight by using professional forecasts. Section 3 addresses the fundamentalness question. Section 4 discusses alternative identification strategies. Section 5 presents evidence about the news shock. Section 6 present evidence about the surprise shock. Section 7 provides new evidence about the spending-reversal hypothesis.

2 Is government spending anticipated?

By now, there is widespread agreement that government spending is anticipated to a large extent. However, to our knowledge, there is no empirical evidence documenting fiscal foresight with time series data. The aim of this section is to provide evidence about fiscal policy anticipation and to quantify fiscal foresight by using the Survey of Professional Forecasters (SPF henceforth) reported by the Federal Reserve Bank of Philadelphia.

As a first step we evaluate the forecasting accuracy of SPF as compared to simple standard time series models. This is an important exercise to gauge the informational content of the SPF forecasts.

In the SPF, the forecasts of the levels are subject to several changes of the base year during the sample period. Hence, following Ramey, 2011, and Perotti, 2011, we focus on the forecasts of the growth rates. Precisely, we use the annualized percent change of mean responses for the real federal government consumption expenditure and gross investment.

The Survey reports, for each quarter t, the forecasts $f_t(h)$ made at time t for periods $t+h$, $h=0,\ldots,4$. At time t, when the forecasts are made, the forecasters know (the first release) of government spending growth for time $t-1$. From the original data we derive the implied cumulated forecasts, i.e. the forecasts of government spending growth between t and $t+h$, call it $F_t(0,h)=\sum_{j=0}^{h} f_t(j)$. We evaluate the accuracy of $f(h)$ and $F(0,h)$, $h=0,\ldots,4$. The target is the government spending growth (mnemonic FEDGOV, see below for a complete description of the data) for the whole period 1981:III-2013:III (multiplied by 400 to get annualized percentage rates).

The times series models we use are: (a) the best univariate autoregressive model (order 4); (b) the 4-lag autoregression augmented with the first lag of real GDP growth and the first lag of the spread between 10-year government bonds yield and the federal funds rate. The initial date of the sample is 1960:I and the parameters are estimated with a rolling window of 82 quarters.[4] To make a fair comparison, we compute $f^a(h)$ and $f^b(h)$, $h=0,\ldots,4$, by using data up to time $t-1$.[5] Hence $f^a(h)$ and $f^b(h)$ are what are usually called the $h+1$-step-ahead forecasts. For $h>0$, the forecasts are obtained by direct projections (rather than the iterative method). The accuracy of the forecasts is measured by the mean square forecast error (MSFE), normalized by dividing by the variance of the target. This number is the fraction of unpredictable variance, which can be interpreted as measuring the degree of "foresight".

Results are reported in Table 1. The professional forecasts perform better than time series models at all horizons. For $h=3,4$ the difference is significant according to the Diebold and Mariano test, for both cumulative and non-cumulative forecasts. The finding suggests that professional forecast data provide useful information for predicting government spending.

Next we compare the accuracy of the professional forecasts for FEDGOV growth with the accuracy of professional forecasts for GDP growth and consumption growth. Table 1 shows the results. An interesting finding emerges. Predictability of consumption and GDP decreases with the horizon whereas the predictability of government spending increases with the horizon. At horizon 4, for instance, the cumulative-forecast errors for real GDP and consumption are 0.71 and 0.77 respectively, as against 0.50 for FEDGOV. At short horizons, particularly the first quarter, the rankings are reversed: both GDP and consumption growth are predicted better than FEDGOV growth (0.52 and 0.64 respectively, as against 0.80 for FEDGOV).

Higher predictability of government spending relative to GDP at longer horizons supports the presence of fiscal anticipation. Nonetheless it must be noticed that even at a

[4] Keeping fixed the starting date of the sample used for estimation provides qualitatively similar results.

[5] Notice, however, that we do not use vintage data, so that the econometrician knows the last release of FEDGOV, whereas the professional forecasters know only the first release.

4-quarter horizon there is still a substantial fraction of variance which is not anticipated. A plausible interpretation is that future government spending over a one-year or two-year horizon is well anticipated, but the exact timing of expenditure across different quarters is highly unpredictable. In sum, our results are compatible with the existence of a sizable anticipated or "foresight" shock as well as a non-anticipated or "surprise" shock having large short-run effects. Anticipation might give rise, as mentioned in the Introduction, to a problem of nonfundamentalness. This will be the focus of the next section.

3 Fundamentalness in open economy VARs

Several papers have noticed that fiscal foresight can lead to non-fundamentalness of the structural MA representation of the variables included in the VAR (see Leeper *et al.*, 2013, for a thorough discussion). The problem arises from the fact that fiscal variables do not convey information about the current news shock because they react only with a delay. If the VAR information is deficient, then VAR results can be misleading. Well known monetary policy puzzles like the price puzzle and the exchange rate puzzle are due to informational deficiency and disappear when VAR information is properly amended (Bernanke *et al.*, 2005, Forni and Gambetti, 2010). This could in principle be the case also for the puzzling open-economy effects of government spending.

On the other hand, news is likely to affect immediately forward-looking variables like interest rates and exchange rates, given that these variables closely reflect agents' expectations. As a consequence non-fiscal variables included in the VAR can in principle provide enough information to reconstruct the relevant shocks. Hence fundamentalness, or sufficient information, is ultimately an empirical question. In previous literature fundamentalness has been tacitly assumed without testing because fundamentalness tests were not available. Ramey, 2011, is a noticeable exception, since the Granger-causality test used therein is essentially equivalent to a fundamentalness test.

We test for sufficient information by using the orthogonality test recently proposed by Forni and Gambetti, 2014. The test is based on a simple theoretical result: if any linear combination of the VAR residuals is correlated with the past of available information, the structural MA representation of the variables included in the VAR is non-fundamental and the VAR is misspecified, in the sense that it does not include enough information to reconstruct the structural shocks. The testing procedure is the following: first, estimate a VAR and identify the shocks of interest; second, regress such shocks on the past values of a set of variables reflecting agents' information and perform an F-test for the significance of the regression. We use as regressors both the principal components of a large macroeconomic data set and the professional forecasts.

The government spending shock is identified, following Blanchard and Perotti, 2002, as the first Cholesky shock in a VAR(4)[6] including, in that order, real federal government consumption expenditures and gross investment, real GDP, real personal consumption expenditures, the federal surplus divided by GDP, net exports of goods and services divided by GDP, the 10-Year Treasury Constant Maturity Rate and the real exchange rate (specification A).[7] The time span is 1981Q3-2013Q3.

Figure 1 shows the impulse response functions of the unit variance government spending shock, together with the 68% (dark gray) and the 90% (light gray) probability intervals.[8] The impulse response functions report the puzzle. There is a depreciation of the US dollar driven by a fall in interest rate which improves net export.

Using the estimated government spending shock we run the orthogonality test. For comparison, we also report the results for a simple three-variable specification including FEDGOV, GDP and CONS (specification B). We regress the estimated government spending shock on seven sets of regressors: the first five include the series reported by the Survey, from $f(0)$ to $f(4)$, taken one at a time. The sixth set (All) includes all of the series $f(h)$, $h = 0, \ldots, 4$. The seventh set includes the lags of a single series that we shall use in the sequel, i.e. the cumulated forecast $F(1, 4) = f(1) + \cdots + f(4)$.

Results are shown in Table 2. The table reports the p-values of the test for the seven sets of regressors (rows) and different numbers of lags (columns). The upper panel shows results for specification B; the lower panel for specification A. Orthogonality is clearly rejected for the shock estimated with the small VAR by many regressor-lag configurations. By contrast, fundamentalness is never rejected in the lower panel. Similar results (not shown here) are obtained when regressing the other six shocks of the Cholesky identification.[9]

The result is confirmed when the surprise shock is regressed onto the principal components of a large data set (this is the implementation suggested in Forni and Gambetti, 2014). The data set is the one of Forni *et al.*, 2014, to which we refer for more detailed information about the series and the data treatment. Table 3 shows that specification B is

[6] We estimated a Bayesian VAR with diffuse prior.

[7] Real federal government consumption expenditures and gross investment (chain-type quantity index, BEA code B823RA3), real GDP (BEA code A191RX1), real personal consumption expenditures (BEA code DPCERX1), the federal surplus divided by GDP (federal receipts, BEA code W018RC1, minus federal expenditures, BEA code W019RC1, over nominal GDP, BEA code A191RC1), net exports of goods and services (BEA code A019RC1) divided by GDP, the 10-Year Treasury Constant Maturity Rate (Board of Governors of the Federal Reserve System) and the real exchange rate (trade weighted U.S. dollar index, major currencies, Board of Governors of the Federal Reserve System). The interest rate (10YBOND) and the exchange rate index (RER) are quarterly averages of the original monthly series. Federal spending (FEDGOV), GDP and Consumption (CONS) are taken in log-levels (multiplied by 100 to express the impulse-response functions in percentage rates of variation) whereas the federal surplus over GDP (SUR) and net exports over GDP (NX) are taken in levels.

[8] The reported impulse response functions are the averages of the posterior distribution over 500 draws.

[9] We also performed the Granger causality test proposed in Forni and Gambetti, 2014, obtaining the same result.

deficient, whereas the seven-variable specification A is not.

We conclude that there is no evidence of non-fundamentalness for the open-economy VAR specification. Hence the exchange rate puzzle is not due to a lack of information.

4 Identifying government spending shocks

The evidence of Section 2 supports the existence of a sizable "news" shock as well as a non-anticipated or "surprise" shock. In this section we describe how to identify the two shocks. We begin by assuming the following model for spending growth g_t:

$$g_t = \phi(L)\varepsilon_t + \theta(L)\eta_t + \delta(L)\xi_t, \tag{1}$$

where $\phi(L) = \sum_{k=0}^{\infty} \phi_k L^k$, $\theta(L) = \sum_{k=0}^{\infty} \theta_k L^k$ and $\delta(L) = \sum_{k=0}^{\infty} \delta_k L^k$ are impulse response functions in the lag operator L, ε_t is the foresight shock, η_t is the surprise shock and ξ_t is a non-policy shock reflecting "endogeneity" of public spending, i.e. a possible automatic, non-discretionary reaction of spending to shocks affecting some target variable like GDP. The shock ξ_t may be a vector, in which case δ_k is a row vector. By definition of news shock, government spending will react with some delay $s > 0$ to ε_t, i.e. $\phi_k = 0$ for $k < s$. Moreover, following Blanchard and Perotti, 2002, we assume that the non-policy shocks have no contemporaneous effects on g_t, owing to some perception and/or implementation delay, i.e. $\delta_0 = 0$. By contrast, $\theta_0 \neq 0$ is the distinguishing feature of the "surprise" shock.

4.1 News shocks

We propose two strategies to identify the government spending news shock, ε_t, both based on the Survey of Professionals Forecasters. The main idea behind our identification strategies is that expectations of future spending convey information about the current shock. The first strategy uses expectations of future government spending. The second hinges on a news variable defined as the difference between the forecast of government spending growth, made at time t, for the following quarters reported by the Survey, and the forecast, for the same quarters, made at time $t-1$.

Let us begin by making explicit the assumptions about the informational flows of the Survey. Let $\mathcal{P}_t$ be the information set of the professional forecasters at time t and $E_t^{\mathcal{P}}$ be the expectation, conditional on $\mathcal{P}_t$. As observed above, the Survey reports, for each t, the forecast made at time t for $g_t, g_{t+1}, \ldots, g_{t+4}$. At time t, the forecasters know the (first release of) g_{t-1}. Contrary to the simplifying assumption commonly made in literature, the nowcast of g_t is very different from g_t, i.e. $E_t^{\mathcal{P}} g_t \neq g_t$. A simple way to rationalize this difference is to assume that agents observe η_t and ξ_t with a one-period delay, that is $E_t^{\mathcal{P}}\eta_t = E_t^{\mathcal{P}}\xi_t = 0$ and $E_t^{\mathcal{P}}\eta_{t-k} = \eta_{t-k}$, $E_t^{\mathcal{P}}\xi_{t-k} = \xi_{t-k}$ for $k > 0$. On the contrary, ε_t, being "anticipated", is observed at time t, i.e. $E_t^{\mathcal{P}}\varepsilon_{t-k} = \varepsilon_{t-k}$ for $k \geq 0$.

Now let us define $\mathcal{H}_t$ as the information set spanned by the present and past values of the shocks and let $E_t^{\mathcal{H}}$ be the expectation conditional on $\mathcal{H}_t$. This new set differs from $\mathcal{P}_t$ in that $E_t^{\mathcal{H}}\xi_t = \xi_t$, $E_t^{\mathcal{H}}\eta_t = \eta_t$. Below, the role of $\mathcal{H}_t$ for identification will be clear.

To better understand the role of expectations for identification, consider the following simplified version of (1)

$$g_t = \varepsilon_{t-s}.$$

The s-period ahead expectation is equal to the shock

$$E_t^{\mathcal{P}} g_{t+s} = \varepsilon_t$$

and so is the sum of the expectations up to H-period ahead as long as $s \leq H$,

$$\sum_{h=1}^{H} E_t^{\mathcal{P}} g_{t+h} = \varepsilon_t.$$

Notice however that the sum is a better measure than the single expectation in the case of an unknown s. In fact the h-period ahead expectation would miss the shock if $h \neq s$. Going back to equation (1) the h-step ahead expectation, under the above assumption, is

$$E_t^{\mathcal{P}} g_{t+h} = \sum_{j=0}^{\infty} \phi_{h+j}\varepsilon_{t-j} + \sum_{j=1}^{\infty} \theta_{h+j}\eta_{t-j} + \sum_{j=1}^{\infty} \delta_{h+j}\xi_{t-j}.$$

Summing the first H-period ahead expectation we obtain

$$e_t(1,H) = \sum_{h=1}^{H} E_t^{\mathcal{P}} g_{t+h} = \tilde{\phi}_0\varepsilon_t + \sum_{j=1}^{\infty} \tilde{\phi}_j\varepsilon_{t-j} + \sum_{j=1}^{\infty} \tilde{\theta}_j\eta_{t-j} + \sum_{j=1}^{\infty} \tilde{\delta}_j\xi_{t-j} \tag{2}$$

where $\tilde{\phi}_0 = \sum_{k=1}^{H} \phi_k = \sum_{k=s}^{H} \phi_k$, $\tilde{\phi}_j = \sum_{k=j+1}^{H+j} \phi_k$, $\tilde{\theta}_j = \sum_{k=j+1}^{H+j} \theta_k$, $\tilde{\delta}_j = \sum_{k=j+1}^{H+j} \delta_k$. Hence $e_t(1,H)$ contains the current news shock and the lags of all shocks. The news shock can be therefore identified as the residual of the projection of $e_t(1,H)$ onto $\mathcal{H}_{t-1}$. We call this "Identification #1" and we will discuss the details of the implementation below.

A second strategy hinges on a news variable defined as the difference between the forecast of government spending growth, made at time t, for the following quarters reported by the Survey, and the forecast, for the same quarters, made at time $t-1$. The revision of the h-step ahead forecast is

$$E_t^{\mathcal{P}} g_{t+h} - E_{t-1}^{\mathcal{P}} g_{t+h} = \phi_h\varepsilon_t + \theta_{h+1}\eta_{t-1} + \delta_{h+1}\xi_{t-1}. \tag{3}$$

Again, a single revision might miss the news shock if $h \neq s$. By contrast, summing the expectation revisions for $h = 1, \ldots, H$ we get

$$n_t(1,H) = e_t(1,H) - e_t(2,H+1) = \sum_{h=1}^{H} (E_t^{\mathcal{P}} g_{t+h} - E_{t-1}^{\mathcal{P}} g_{t+h}) \quad = \quad \tilde{\phi}_0\varepsilon_t + \tilde{\theta}_1\eta_{t-1} + \tilde{\delta}_1\xi_{t-1}.$$

The news variable conveys the new information that becomes available at time t: the current news shock, as before, and the first lag of the three shocks. As before, identification can be achieved by taking the residual of the projection of the news variable onto $\mathcal{H}_{t-1}$. We call this "Identification #2". Ricco (2013) proposes an interesting extension of our strategy based on disaggregated survey data.

The longest available horizon for the news variable in the SPF is 3 and for the expectation is 4. We estimate $e_t(1,4)$ with $F_t(1,4)$ and the news variable $n_t(1,3)$ as the difference $\tilde{n}_t(1,3) = F_t(1,3) - F_{t-1}(2,4)$. The two alternatives should in principle give the same result for the same horizon H. In practice, however, there may be some difference since the horizon used in the expectation is longer than that used in the news variable.

Identification is implemented as follows. Let z_t be a vector of variables spanning $\mathcal{H}_t$ and including either $\tilde{n}_t(1,3)$ or $F_t(1,4)$. Order the SPF variable in the q-th position and apply a Cholesky decomposition. The q-th shock is the news shock. Under the informational assumptions made before the SPF variable can in principle be ordered in whatever position, provided that the variables ordered before are not affected by the news shock ε_t on impact. For instance, the SPF variable can be ordered indifferently first or second after public expenditure, or even third after public expenditure and GDP, provided that GDP does not contain the current value of ε_t. However, if (contrary to our assumption) $\mathcal{P}_t$ contains some information about the current values of η_t and ξ_t, the SPF variable would contain the present values of η_t and ξ_t to some extent, so that ordering it third after government spending and GDP could be useful to "clean" the news shock from other shocks. Below we show results for the SPF variable ordered second, after public spending. We tried different orderings, more specifically $q = 1, 2, 3$, and found very similar results (not reported here).

4.2 Surprise shocks

Given the results of Section 3, we identify the surprise shock in just the same way as the spending shocks of the traditional VAR approach. Formally the shock is given by

$$g_t - E^{\mathcal{H}}_{t-1} g_t = \phi_0 \varepsilon_t + \theta_0 \eta_t + \delta_0 \xi_t = \theta_0 \eta_t. \tag{4}$$

In practice, we place government spending as the first variable in z_t and identify the surprise shock as the first one in the Cholesky decomposition. Even in the case of the surprise shock, under our assumptions, government spending could be ordered second after the SPF variable and the surprise shock could be defined as the second one in the Choleski decomposition, since conditioning on the present of the SPF variable, which does not contain η_t, is ineffective. As already observed, we tried this alternative ordering and found very similar results.

Notice that, given the informational assumptions about the Survey, the shock does not coincide with the projection of government spending onto the SPF information set (the variable used in Ramey, 2011) since

$$g_t - E^{\mathcal{P}}_{t-1} g_t = \theta_0 \eta_t + \theta_1 \eta_{t-1} + \delta_1 \xi_{t-1}. \tag{5}$$

Rather, the shock coincides with the nowcast error

$$g_t - E^{\mathcal{P}}_t g_t = \theta_0 \eta_t. \tag{6}$$

5 Evidence

We estimate two VAR(4) specifications including the seven variables used in Section 3 plus $F_t(1,4)$ (Specification #1) or $\tilde{n}_t(1,3)$ (Sepcification #2). Identification is obtained by imposing a Cholesky scheme with government spending ordered first, the expectations or the news variable ordered second, and the other variables in the same order of Section 3. The first Cholesky shock is the surprise shock and the second shock is the news shock.

5.1 News shocks

We start our analysis by studying the informational content of the news variable $\tilde{n}_t(1,3)$ used in Identification #2. Recall that the variable represents the new information that becomes available to the professional about future spending. Positive (negative) values mean that agents revise their expectations about future spending upward (downward). The top panel of Figure 2 plots the variable. The variable displays positive spikes in coincidence of three war episodes: the Gulf War (1990:III), the War in Afghanistan (2001:IV), and the Iraq War (2003:I). As documented in literature, these episodes are associated with sizable increases in military spending.[10] A negative spike is observed in correspondence to the fall of the Berlin Wall (1989:IV). This is in line with Ramey, 2011, which estimates a spending cut of about 507.6 billions of dollars in 1989 associated with end of the Cold War. Moreover the series displays large variations in coincidence of legislative acts like the Obama's fiscal stimulus package (2009:I) or the Strategic Defense Initiative (1983:I). The evidence reinforces the result of Section 2, pointing out that the news variable actually contains valuable information related to changes in government spending.

The mid and bottom panels of Figure 2 plot the two news shocks obtained under Identification #1 and Identification #2 respectively. Despite some minor differences, the two shocks are very similar, the correlation being 0.8. There is still a striking correspondence between peaks and troughs of the shocks and the political episodes associated with the vertical lines. Moreover, for the shock obtained in Identification #1, the matching is perhaps even stronger: in particular, the fiscal stimulus of the Bush administration in 2008 is now

[10] According to Ramey, 2011, in the three episodes government spending increased in the following quarters by about 112.1, 296.3 and 123.8 billions of dollars respectively.

visible. Finally, it should be noted that the news-based shock is not identical to $\tilde{n}_t(1,3)$ itself but very similar, the correlation being 0.81. All the shocks are orthogonal to the lags of the SPF forecasts as well as the lags of the principal components of Tables 3.[11]

5.2 The effects of news shocks

Figure 3 plots the impulse response functions of the news shock obtained in Identification #1. The estimated effect on spending is small in the first three quarters in accordance with the idea of anticipation and becomes large and significant at lag 4. The maximal effect is reached after about three-four years. After four years, spending declines gradually toward zero. Notice that federal surplus (fifth panel) moves specularly. Notice also that, consistently with the effect on spending, the expectation of future spending growth, reported in the upper-left panel, decreases gradually after the positive impact, and becomes negative after four years.

GDP is almost unaffected on impact. The positive effect after one year is barely significant. We computed the government spending multiplier as the effect on log GDP at various lags, divided by the maximal effect on log spending, divided by the average share of government spending over GDP. After an impact of 0.4, it reaches a maximum of about 1.3 after one year, is nearly 1 after 6 quarters, and reaches 0 after about two years. Hence federal spending crowds out private spending in the medium-run. The effect on consumption is positive and significant on impact, is almost flat for about 6 quarters and declines thereafter, reaching zero in about four years.

The real exchange rate appreciates significantly and, consistently, the trade balance significantly worsens. The results can be explained by the response of the long-term interest rate which rises immediately and significantly. The results are in line with the standard theory and in contrast with what is found in literature.

Table 4, upper panel, shows the variance decomposition at different horizons. The fraction of the forecast error variance of government spending explained by the news shock is relatively large. At the 6-year horizon the foresight shock explains almost 30% of total variance. The estimated effects on GDP and consumption are modest in terms of variance decomposition, apart from the 10% of consumption volatility explained by the shock on impact. At the 2-year horizon, the shock accounts for 10 and 12% of the volatility of the 10-year bond and the exchange-rate variation, respectively.

Figure 4 shows the impulse response functions obtained with Identification #2. The response of government spending is again zero on impact, increases slowly, reaching the maximal level after about 3 years. Both consumption and output increase significantly in the short-run but in the long-run the effect is zero or even negative. The deficit to GDP

[11] Results are available upon request.

ratio does not change significantly, although the point estimate is positive in the short run, when output increases and spending is unchanged and then falls in the long run, when output is back to its pre-shock level and spending is significantly higher.

The effects on the real exchange rate, the trade balance and the interest rate net exports are similar to those obtained before, confirming the absence of the puzzle for the news shock.

Table 4, central panel, shows the variance decomposition at different horizons. The fraction of the forecast error variance of government spending explained by the anticipated shock is much smaller than that obtained with Identification #1 even in the long run: only about 11% at the 6-year horizon. Reducing the maximal forecasting horizon seems to be detrimental in terms of variance decomposition, in accordance with the finding of Figure 3 that government spending has a large reaction at lag 4. The estimated effect on GDP is not large, reaching a maximum of 13% at the 1-year horizon. At the 2-year horizon, the shock explains about 17% of the volatility of the 10-year bond interest rate and about 14% of the exchange-rate variation.

5.3 Surprise shocks

Figure 5 displays the three surprise shocks obtained with Specification A (top panel), Specification #1 (mid panel), and Specification #2 (bottom panel).

A few remarks are in order. First, the three shocks are almost identical, the correlations being around 0.95. This confirms the fact that the shock is already well identified with Specification A, in line with the fundamentalness test performed in Section 3. Second, the surprise shock seems to be poorly connected with historical events, since there are no large peaks or troughs in correspondence of the vertical lines. This behavior is consistent with our definition of news and surprise shock. In fact, while the former reflects changes in expectations often related to identifiable political events, the latter mainly reflects the deviations of realized spending from such expectations and therefore there is no reason to expect a correspondence either in the timing or in the sign.

5.4 The effects of surprise shocks

Figure 6 plots the impulse response functions of the surprise shock estimated with Identification #1. We do not report the results for Identification #2 since they are almost identical. The impulse response functions are very similar to those of Figure 1. Again these results are mutually consistent and in line with the findings of Section 3.

The effect on government spending is large on impact, then declines gradually, and takes on negative values after about five years. At long-run horizons the effect is negative. Hence, there is "spending reversal" (Corsetti *et al.*, 2011). Symmetrically, federal surplus reduces on impact and in the short-run, but increases in the long-run. In terms of variance decomposition (Table 4) the effect of the unanticipated shock is very large in the short run but is smaller than that of the foresight shock at the 6-year horizon (about 20%).

GDP reacts positively and significantly on impact; after 2 periods, the effect becomes negative, albeit not significant. The effect on consumption is zero on impact and negative in the short-medium run; however, it is quantitatively modest and not significant. The variance decomposition of Table 4 confirms that the effects on GDP and consumption are very small, but for the contemporaneous effect on GDP, which explains about 10% of GDP volatility.

As a robustness check we have identified the surprise shock as in Ramey, 2011, using both the expectation revision $g_t - E_{t-1}g_t$ and the nowcast error $g_t - E_t^{\mathcal{P}} g_t$. These variables are ordered first in the VAR and the shock is the first Cholesky shock. The estimated shock and the impulse response functions, not shown but available upon request, are similar to the ones discussed above.

6 Spending reversal

Why are the impulse response functions of news and surprise shocks so different? The upper-left panel of Figure 6 sheds some light on this question. Unlike the foresight shock, after a surprise shock expectations of future spending growth reduce significantly.[12] This finding provides confirmation for the thesis put forward in Corsetti *et al.*, 2011. Unexpected spending increases are reabsorbed by spending reversals. Hence agents revise their expectation of future spending downward. This has the effect of reducing the long-run interest rates, which in turn produces a real depreciation of the exchange rate and a consequent improvement of the trade balance. By contrast, when political events induce agents to revise upwards their expectation of future spending, interest rates go up and the domestic currency appreciates.

The response of consumption however is at odds with that theory. There consumption increases because there are spending reversals. Our evidence on the contrary shows that the effect on consumption is higher the more persistent the increase in spending. So public spending boosts private consumption. An informal interpretation of the result is that the downward revision of expected spending might worsen expected general economic conditions and therefore depress current consumption.

But does spending reversal hold true also for the foresight shock? To answer this question we show in Figure 7 the impulse response functions of both the foresight shock (upper panel) and the surprise shock (lower panel) on FEDGOV over the unusually long horizon of 20 years. The result is striking. For both shocks, the impulse response functions have the

[12]The fraction of the forecast variance explained by the shock reaches about 15% in the long run (see Table 4).

shape of a long-run sine wave with a period of about 20 years. Positive effects are followed by significantly negative effects, with a distance of about ten years between the turning points. The two functions, which look inconsistent in the range 0-20 quarters, now appear similar, albeit out of phase by about five years.

Indeed, a closer look to Figures 5 and 6 reveals that all differences reduce to a phase shift. Figure 8 reports, on the left column, the response functions of $F(1,4)$, FEDGOV, SUR and RER to the foresight shock, taken from lag 20 onward, and, on the right column, the corresponding response functions for the surprise shock. The i.r.f. in the left column are much smoother because of an obvious estimation effect, but, apart for this, the general shape and the quantitative effects are similar. The same result holds for the variables not shown in Figure 7.[13] The effects of the unanticipated shock mirror those of the anticipated shock with a 5-year delay. The finding emphasizes the role of the degree of persistence of the effects produced by the government spending shock on government spending. When the shock has persistent effects on spending and the reversal occurs only very far in the future the real exchange rate appreciates and the trade balance worsens through an increase in the long term interest rate. On the contrary when the reversal occurs relatively quickly the long term interest rate falls and the currency depreciates.

7 Conclusions

We draw several conclusions. First, data support the presence of fiscal anticipation, government spending being much more predictable than other macroeconomic aggregates. Second, anticipation does not give rise to a problem of non-fundamentalness in standard open-economy VARs. This means that the typical government spending shock identified with a standard Cholesky decomposition is reliable and the evidence suggests that the real exchange rate depreciates. On the contrary, the news shock identified with the approach proposed in this paper leads, through an increase of the interest rate, to an appreciation of the real exchange rate and a worsening of the trade balance. We reconcile the two results showing that the differences reduce to a phase shift: the more delayed is the spending reversal the more the exchange rate appreciates. The finding stresses the key role played by agents' expectations about future spending.

[13] The only exception is the initial jump of GDP following the unanticipated shock, which is missing for the foresight shock, since there is no jump in federal spending at lag 20.

References

[1] Beetsma R. and M. Giuliodori (2011). The Effects of Government Purchases Shocks: Review and Estimates for the EU. The Economic Journal 121:F4-F32.

[2] Beetsma, R., Giuliodori, M. and Klaassen, F. (2008). The effects of public spending shocks on trade balances and budget deficits in the EU, Journal of the European Economic Association, vol. 6(2), pp. 41423

[3] Benetrix, A.S. and Lane, P.R. (2010). Fiscal shocks and the real exchange rate, mimeo, IIIS, Trinity College Dublin.

[4] Blanchard, O.J. and R. Perotti (2002). An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output. The Quarterly Journal of Economics: 1329-1368.

[5] Burnside, C., M. Eichenbaum, and J. D. Fisher (2004). Fiscal Shocks and Their Consequences. Journal of Economic Theory 115, 89-117.

[6] Canova, F. and E. Pappa (2007). Price Differentials in Monetary Unions: The Role of Fiscal Shocks. The Economic Journal 117, 713-737.

[7] Cavallo, M. (2005). Government Employment Expenditure and the Effects of Fiscal Policy Shocks. Federal Reserve Bank of Chicago Working Paper 2005-16.

[8] Clark, T. E., and M. W. McCracken (2005). Evaluating Direct Multistep Forecasts, Econometric Reviews 24, 369-404.

[9] Corsetti, G. and G. Muller (2006). Twin deficits: squaring theory, evidence and common sense, Economic Policy 48:597-638.

[10] Corsetti, G., A. Meier and G. Muller (2011). Fiscal stimulus with spending reversals. Mimeo EUI.

[11] Corsetti, G. K. Kuester, and G. Muller (2011). Floats, pegs and the transmission of fiscal policy. CEPR Discussion Papers 8180, C.E.P.R. Discussion Papers

[12] Dai, Q., and T. Philippon (2005). Fiscal Policy and the Term Structure of Interest Rates. NBER Working Paper No. 11574.

[13] Dornbusch, R. (1976). Expectations and exchange rates dynamics, Journal of Political Economy 84:1161-1176.

[14] Edelberg, W., M. Eichenbaum, and J. D. Fisher (1999). Understanding the Effects of a Shock to Government Purchases. Review of Economic Dynamics 2 (1), 166-206.

[15] Eichenbaum, M. and J. D. Fisher (2005). Fiscal Policy in the Aftermath of 9/11. *Journal of Money, Credit and Banking 37* (1), 1-22.

[16] Ellahie A., and G. Ricco (2012). Government Spending Reloaded: Fundamentalness and Heterogeneity in Fiscal SVARs. Mimeo London Business School.

[17] Elmendorf, D.W. (1993) Actual Budget Decit Expectations and Interest Rates. Harvard Institute of Economic Research.

[18] Enders, Z., G. Mller and A. Scholl (2011). How do fiscal and technology shocks affect real exchange rates?: New evidence for the United States. Journal of International Economics, 83(1):53-69.

[19] Erceg, C.J., L. Guerrieri and C. Gust. Expansionary Fiscal Shocks and the US Trade Deficit, International Finance 8(3):363-397.

[20] Evans, P. (1987) Interest Rates and Expected Future Budget Decits in the United States. Journal of Political Economy 95:34-58.

[21] Fatas, A. and I. Mihov (2001). The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence. CEPR Discussion Paper No. 2760.

[22] Fisher J.D.M. and R. Peters (2010). Using Stock Returns to Identify Government Spending Shocks. The Economic Journal 120, 414-436.

[23] Forni, M., L. Gambetti (2010). Fiscal Foresight and the Effects of Government Spending, CEPR Discussion Papers 7840.

[24] Forni, M., L. Gambetti (2014). Sufficient Information in Structural VARs. *Journal of Monetary Economics,* forthcoming.

[25] Gale, W.G,. and Orszag, P.R. (2003). The Economic Eects of Long-Term Fiscal Discipline. Tax Policy Center, Urban Institute and Brookings Institution.

[26] Gali, J., D. Lopez Salido, and J. Valles (2007). Understanding the Effects of Government Spending on Consumption. Journal of the European Economic Association 5, 227-270.

[27] Hansen, L.P., and T.J. Sargent (1991). Two problems in interpreting vector autoregressions. In Rational Expectations Econometrics, L.P. Hansen and T.J. Sargent, eds. Boulder: Westview, pp.77-119.

[28] Kim, S. and N. Roubini (2008). Twin deficit or twin divergence? Fiscal policy, current account, and real exchange rate in the U.S, Journal of International Economics, 74(2):362-383.

[29] Kollmann, R. (1998). U.S. trade balance dynamics: the role of fiscal policy and productivity shocks and of financial market linkages, Journal of International Money and Finance 17:637-669

[30] Laubach (2009) New Evidence on the Interest Rate Effects of Budget Deficits and Debt. Journal of the European Economic Association, 7(4):858-885.

[31] Leeper, E.M., Walker, T.B. and S.S. Yang (2008). Fiscal Foresight: Analytics and Econometrics, NBER Working Paper No. 14028.

[32] Leeper, E.M., A. W. Richter, and T. B. Walker. 2012. Quantitative Effects of Fiscal Foresight. American Economic Journal: Economic Policy 4(2): 11544.

[33] Leeper, E.M., Walker, T.B. and S.S. Yang (2008). Fiscal Foresight: Analytics and Econometrics, NBER Working Paper No. 14028.

[34] Lippi, M. and L. Reichlin (1993). The Dynamic Effects of Aggregate Demand and Supply Disturbances: Comment, American Economic Review 83, 644-652.

[35] Mertens, K. and M. Ravn (2010). Measuring the Impact of Fiscal Policy in the Face of Anticipation: a Structural VAR Approach. The Economic Journal, 120:544.

[36] Monacelli, T. and R. Perotti, Fiscal Policy, the Trade Balance and the Real Exchange Rate: Implications for International Risk Sharing. Working Paper, IGIER (2006).

[37] Mountford, A. and H. Uhlig (2002). What Are the Effects of Fiscal Policy Shocks. CEPR Discussion Paper No. 3380.

[38] Mussa, M. L. (1984). The Theory of Exchange Rate Determination. in Bilson J. F. O. and and Marston, R.C. *Exchange Rate Theory and Practice* NBER Books, National Bureau of Economic Research.

[39] Obstfeld, M. and K. Rogoff (1995). Exchange rate dynamics redux. Journal of Political Economy 103:624-660.

[40] Perotti, R. (2002). Estimating the Effects of Fiscal Policy in OECD Countries. CEPR Discussion Paper No. 3380.

[41] Perotti, R. (2007). In Search of the Transmission Mechanism of Fiscal Policy. NBER Macroeconomics Annual.

[42] Perotti, R. (2011). Fiscal Policy and Expectations: An Empirical Investigation. Mimeo Bocconi University.

[43] Plosser, C. (1987). Fiscal policy and the term structure. Journal of Monetary Economics, 20(2):343-367

[44] Ramey, V.A. (2009). Identifying Government Spending Shocks: It's All in the Timing, NBER Working Papers no. 15464.

[45] Ramey, V.A. and M. Shapiro (1998). Costly Capital Reallocation and the Effects of Government Spending. Carnegie Rochester Conference on Public Policy 48, 145-194.

[46] Ravn, M., Schmitt-Grohe, S. and M. Uribe (2007). Explaining the Effects of Government Spending Shocks on Consumption and the Real Exchange Rate. NBER Working Papers 13328.

[47] Ricco, G. (2013). A New Identification of Fiscal Shocks Based On The Information Flow. Mimeo LBS.

[48] Yang, S.S. (2008). Quantifying tax effects under policy foresight. Journal of Monetary Economics, 52(8):1557-1568.

Tables

Method	Horizon: quarters ahead 0	1	2	3	4
	non-cumulated forecasts				
AR(4)	0.92	0.96	0.94	0.99	1.05
ARX(4,1)	0.94	0.96	0.92	0.98	1.03
SPF FEDGOV growth	0.80*	0.83**	0.84	0.84***	0.85***
SPF GDP growth	0.52	0.77	0.88	0.89	0.91
SPF CONS growth	0.64	0.82	0.90	1.00	0.99
	cumulated forecasts				
AR(4)	0.92	0.80	0.75	0.77	0.83
ARX(4,1)	0.94	0.80	0.72	0.73	0.78
SPF FEDGOV growth	0.80*	0.68	0.62	0.54**	0.50***
SPF GDP growth	0.52	0.54	0.62	0.67	0.72
SPF CONS growth	0.64	0.65	0.68	0.73	0.77

Table 1. Accuracy of professional forecasts (SPF) and alternative forecasts obtained with standard time series methods. Accuracy is measured by the Mean Square Forecast Error, divided by the variance of the target variable. In the first three lines of each panel the target variable is federal government spending growth. In the last two lines of each panel the target is GDP growth and consumption growth, respectively. The alternative models are a simple autoregressive mode of order 4 (AR(4)) and an autoregressive model of order 4 augmented with the first lag of GDP growth and the spread between the 10-year bond interest rate and the federal funds rate (ARX(4,1)). The stars denote significance of the Diebold and Mariano test against the ARX(4,1): one star 10%; two stars 5%; three stars 1%.

Regressors	Number of lags 1 lag	2 lags	3 lags	4 lags
	3-variable VAR (specification B)			
$f(0)$	0.17	0.36	0.44	0.07
$f(1)$	0.00	0.00	0.00	0.01
$f(2)$	0.02	0.01	0.01	0.02
$f(3)$	0.37	0.39	0.01	0.02
$f(4)$	0.22	0.19	0.28	0.03
All	0.02	0.01	0.03	0.05
$F(1,4)$	0.02	0.08	0.12	0.08
	7-variable VAR (specification A)			
$f(0)$	0.53	0.77	0.93	0.46
$f(1)$	0.34	0.40	0.51	0.60
$f(2)$	0.43	0.62	0.76	0.84
$f(3)$	0.59	0.42	0.52	0.61
$f(4)$	0.71	0.60	0.56	0.61
All	0.71	0.60	0.56	0.61
$F(1,4)$	0.38	0.43	0.51	0.81

Table 2. Test of orthogonality: p-values of the F-test of the regression of the federal government spending shock estimated with the 7-variable VAR on seven sets of regressors. The first five include the series reported by the Survey, from $f(0)$ to $f(4)$, taken one at a time. The sixth set (All) includes all of the series $f(h)$, $h = 0, \ldots, 4$. The seventh set includes the sum $F(1,4) = f(1) + \cdots + f(4)$.

	Number of lags			
Regressors	1 lag	2 lags	3 lags	4 lags
	3-variable VAR (specification B)			
pc_1	0.68	0.84	0.92	0.97
pc_2	0.03	0.09	0.22	0.26
pc_3	0.57	0.37	0.58	0.63
pc_4	0.02	0.08	0.07	0.10
pc_5	0.13	0.18	0.34	0.36
$pc_1 - pc_5$	0.30	0.40	0.64	0.49
	7-variable VAR (specification A)			
pc_1	0.99	0.39	0.43	0.68
pc_2	0.24	0.15	0.20	0.25
pc_3	0.61	0.53	0.71	0.89
pc_4	0.12	0.25	0.15	0.07
pc_5	0.72	0.73	0.87	0.47
$pc_1 - pc_5$	0.72	0.72	0.89	0.81

Table 3. Test of orthogonality: p-values of the F-test of the regression of the federal government spending shock estimated with the 7-variable VAR on six sets of regressors. The first five include the largest five principal components of a macroeconomic data set (see Forni *et al.* 2014 for details), taken one at a time. The sixth set includes all of the largest five principal components.

Variables	Horizon: quarters after the shock				
	0	4	8	12	24
	News shock - Identification #1				
FEDGOV	0.0	3.0	10.8	21.6	29.6
$F(1,4)$	99.2	58.7	45.2	36.8	27.4
GDP	1.3	3.4	3.6	4.2	4.9
CONS	9.2	6.4	6.2	6.1	6.2
SUR	0.8	2.4	6.3	10.9	13.4
NX	0.8	8.5	10.9	13.4	13.7
10YBOND	3.8	13.9	12.6	11.3	10.6
RER	1.8	3.9	10.0	9.8	12.7
	News shock - Identification #2				
FEDGOV	0.00	2.04	4.15	6.69	10.83
GDP	2.88	10.63	9.80	9.22	7.57
CONS	6.44	8.49	10.56	10.76	8.07
SUR	1.59	2.83	3.46	3.95	5.90
NX	0.79	7.80	10.13	12.89	11.39
10YBOND	4.77	15.97	13.55	13.71	13.53
RER	2.13	9.53	15.70	14.14	13.58
	Surprise shock - Identification #2				
FEDGOV	0.8	3.4	4.9	7.9	14.2
$F(1,4)$	100.0	69.9	59.4	44.3	21.3
GDP	8.7	4.1	5.3	5.2	5.5
CONS	0.9	4.0	5.9	6.4	8.3
SUR	6.9	8.2	9.8	8.5	7.3
NX	0.8	2.8	4.5	5.3	11.3
10YBOND	0.8	3.9	4.0	3.9	4.7
RER	5.7	8.6	11.2	13.6	16.0

Table 4: Variance decomposition. Percentage of the forecast error variance explained by the news and surprise shocks at different horizons.

Figures

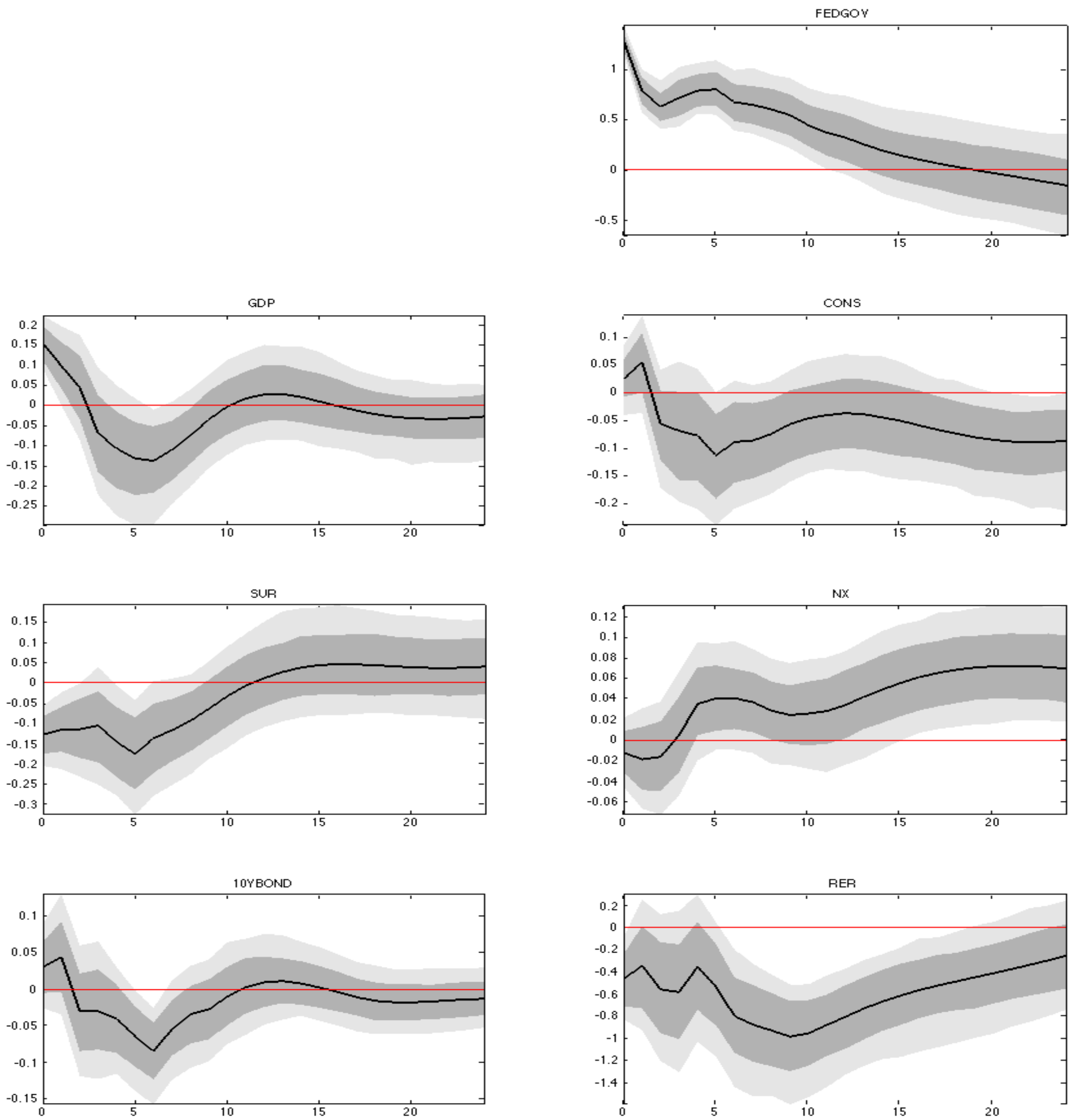

Figure 1: Impulse response functions to the government spending shock in a seven-variable bayesian VAR with diffuse prior including, in this order, real federal spending, real GDP, real consumption, federal surplus divided by GDP, net exports divided by GDP, the 10-year bond interest rate and the exchange rate. The shock is the first one of the Cholesky decomposition. Solid lines are point estimates (average across 500 draws), dark-gray area is the 68% confidence region; light-gray area is the 90% confidence region.

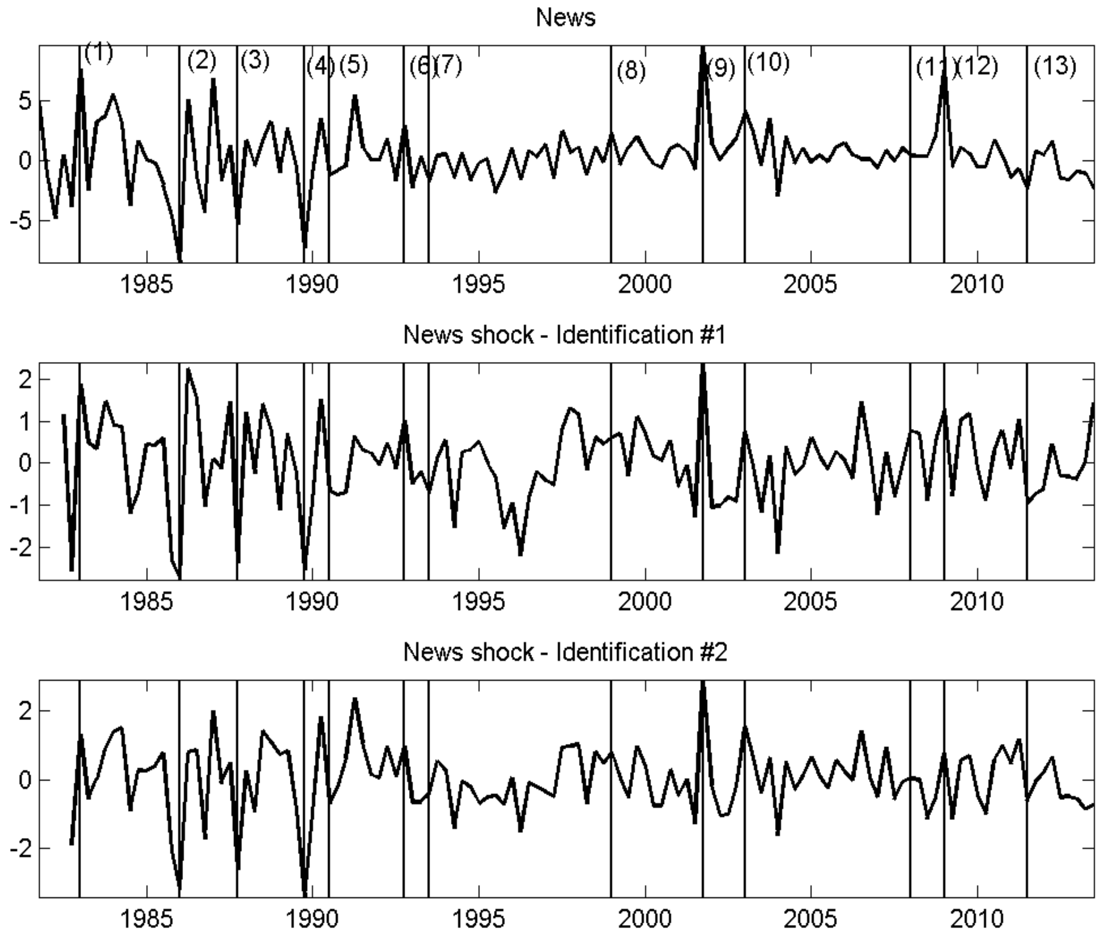

Figure 2: Top panel - spending news variable NEWS; mid panel - news shock under identification #1; bottom panel - news shock under identification #2. The vertical lines are associated with the following episodes:
(1) 1983Q1 - Strategic Defense Initiative;
(2) 1986Q1 - Emergency Deficit Control Act;
(3) 1987Q4 - Emergency Deficit Control Reaffirmation Act
(4) 1989Q4 - Berlin Wall fall;
(5) 1990Q3 - Gulf War;
(6) 1992Q4 - Clinton's election;
(7) 1993Q3 - Omnibus Budget Reconciliation Act;
(8) 1999Q1 - Kosovo War;
(9) 2001Q4 - War in Afghanistan;
(10) 2003Q1 - II Gulf War;
(11) 2008Q1 - 2008 Fiscal Stimulus;
(12) 2009Q1 - Obama Fiscal Stimulus;
(13) 2011Q3 - Budget Control Act of 2011.

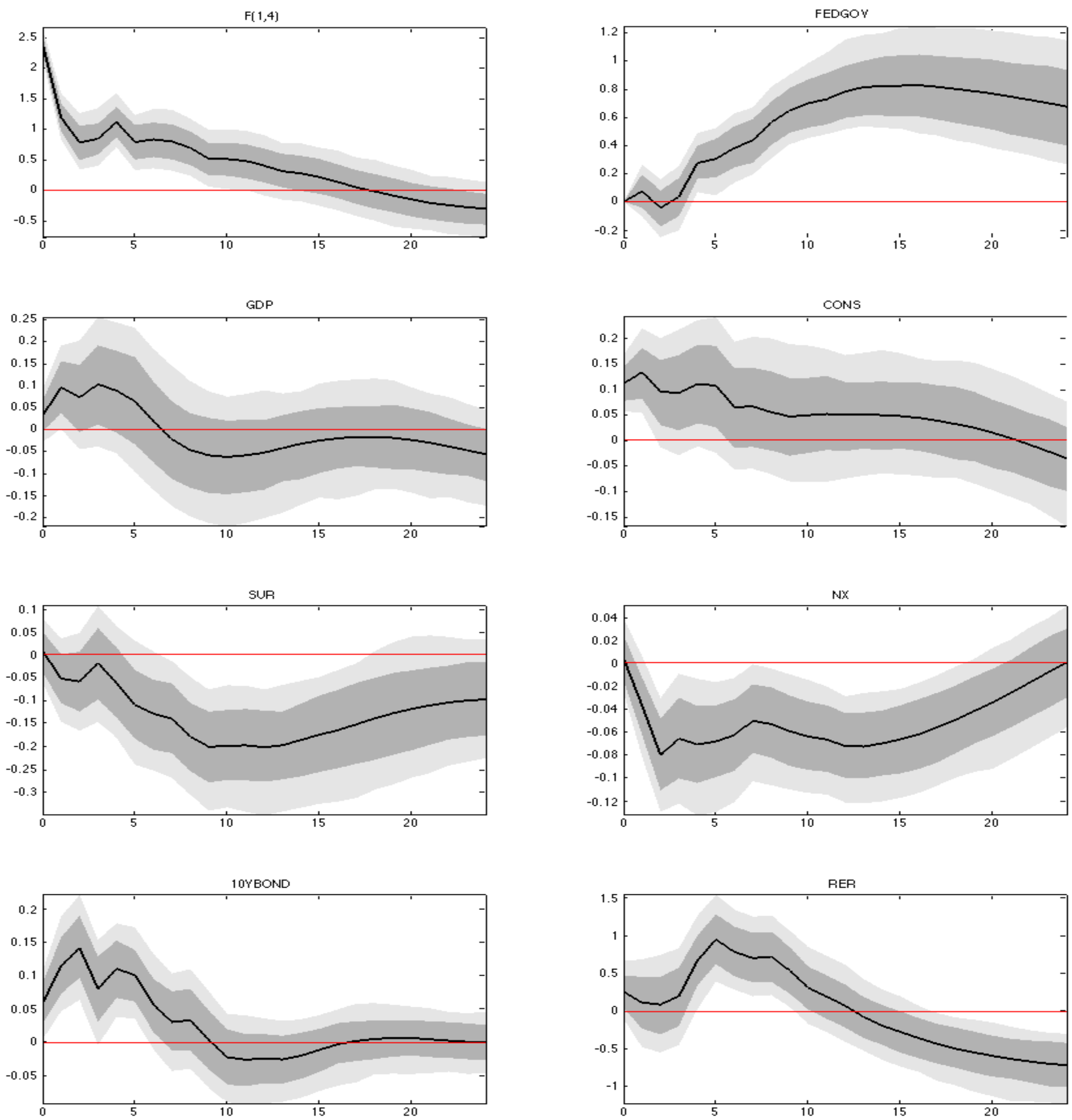

Figure 3: Impulse response functions to a foresight (anticipated) spending shock (Identification #1) with in a eight-variable Bayesian VAR with diffuse prior including, in this order, real federal spending, the cumulated professional forecast $F(1,4)$, real GDP, real consumption, federal surplus divided by GDP, net exports divided by GDP, the 10-year bond interest rate and the exchange rate; the shock is the second one of the Cholesky decomposition. Solid lines are point estimates (average across 500 draws), dark-gray area is the 68% confidence region; light-gray area is the 90% confidence region.

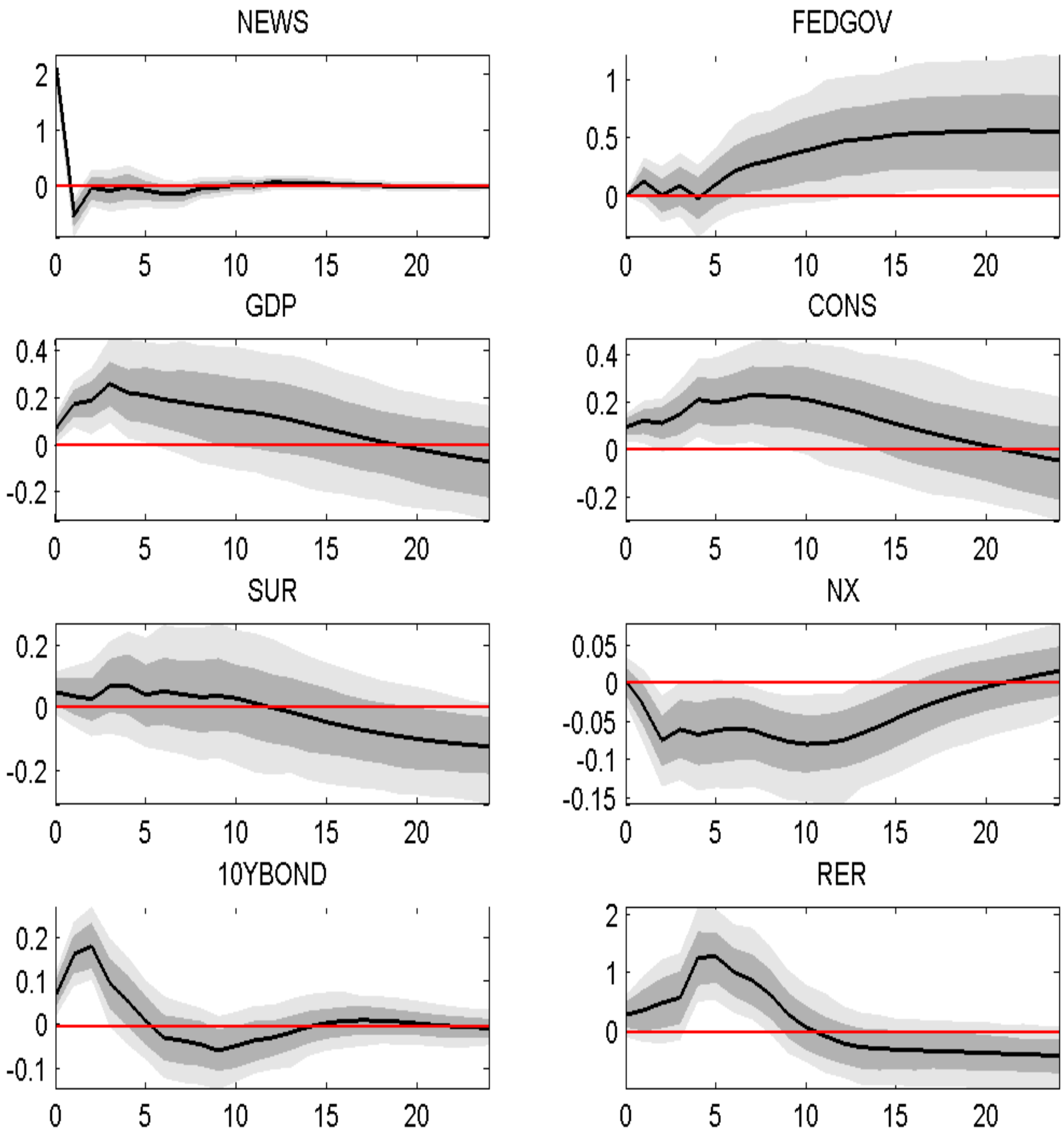

Figure 4: Impulse response functions to a foresight (anticipated) spending shock (Identification #2) in a eight-variable bayesian VAR with diffuse prior including, in this order, the news spending variable, real federal spending, real GDP, real consumption, federal surplus divided by GDP, net exports divided by GDP, the 10-year bond interest rate and the exchange rate. The shock is the first one of the Cholesky decomposition. Solid lines are point estimates (average across 500 draws), dark-gray area is the 68% confidence region; light-gray area is the 90% confidence region.

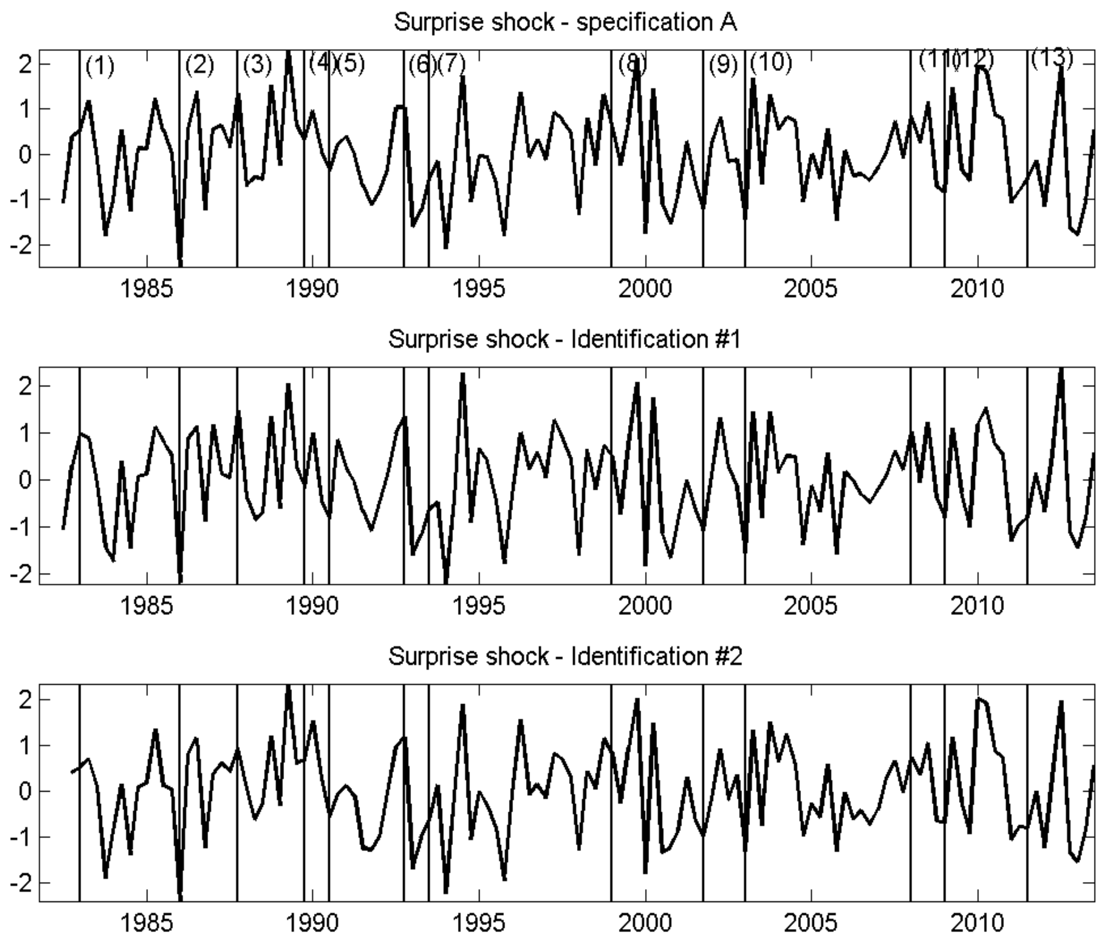

Figure 5: Top panel - surprise shock in specification A; mid panel - surprise shock under identification #1; bottom panel - surprise shock under identification #2. The vertical lines are associated with the following episodes:

(1) 1983Q1 - Strategic Defense Initiative;
(2) 1986Q1 - Emergency Deficit Control Act;
(3) 1987Q4 - Emergency Deficit Control Reaffirmation Act
(4) 1989Q4 - Berlin Wall fall;
(5) 1990Q3 - Gulf War;
(6) 1992Q4 - Clinton's election;
(7) 1993Q3 - Omnibus Budget Reconciliation Act;
(8) 1999Q1 - Kosovo War;
(9) 2001Q4 - War in Afghanistan;
(10) 2003Q1 - II Gulf War;
(11) 2008Q1 - 2008 Fiscal Stimulus;
(12) 2009Q1 - Obama Fiscal Stimulus;
(13) 2011Q3 - Budget Control Act of 2011.

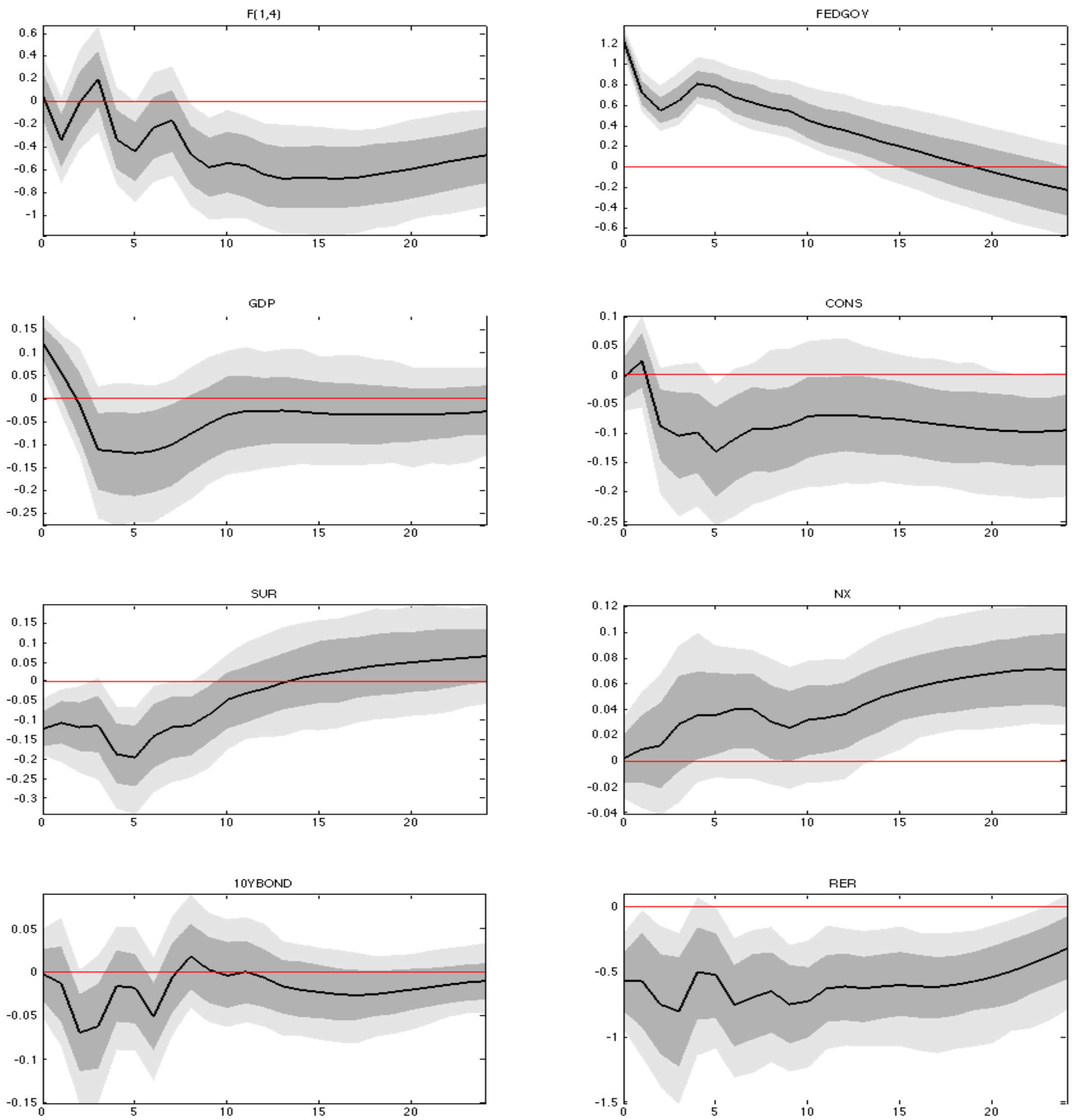

Figure 6: Impulse response functions to a surprise (unanticipated) spending shock (Identification #1) in a eight-variable bayesian VAR with diffuse prior including, in this order, real federal spending, the cumulated professional forecast $F(1,4)$, real GDP, real consumption, federal surplus divided by GDP, net exports divided by GDP, the 10-year bond interest rate and the exchange rate; the shock is the first one of the Cholesky decomposition. Solid lines are point estimates (average across 500 draws), dark-gray area is the 68% confidence region; light-gray area is the 90% confidence region.

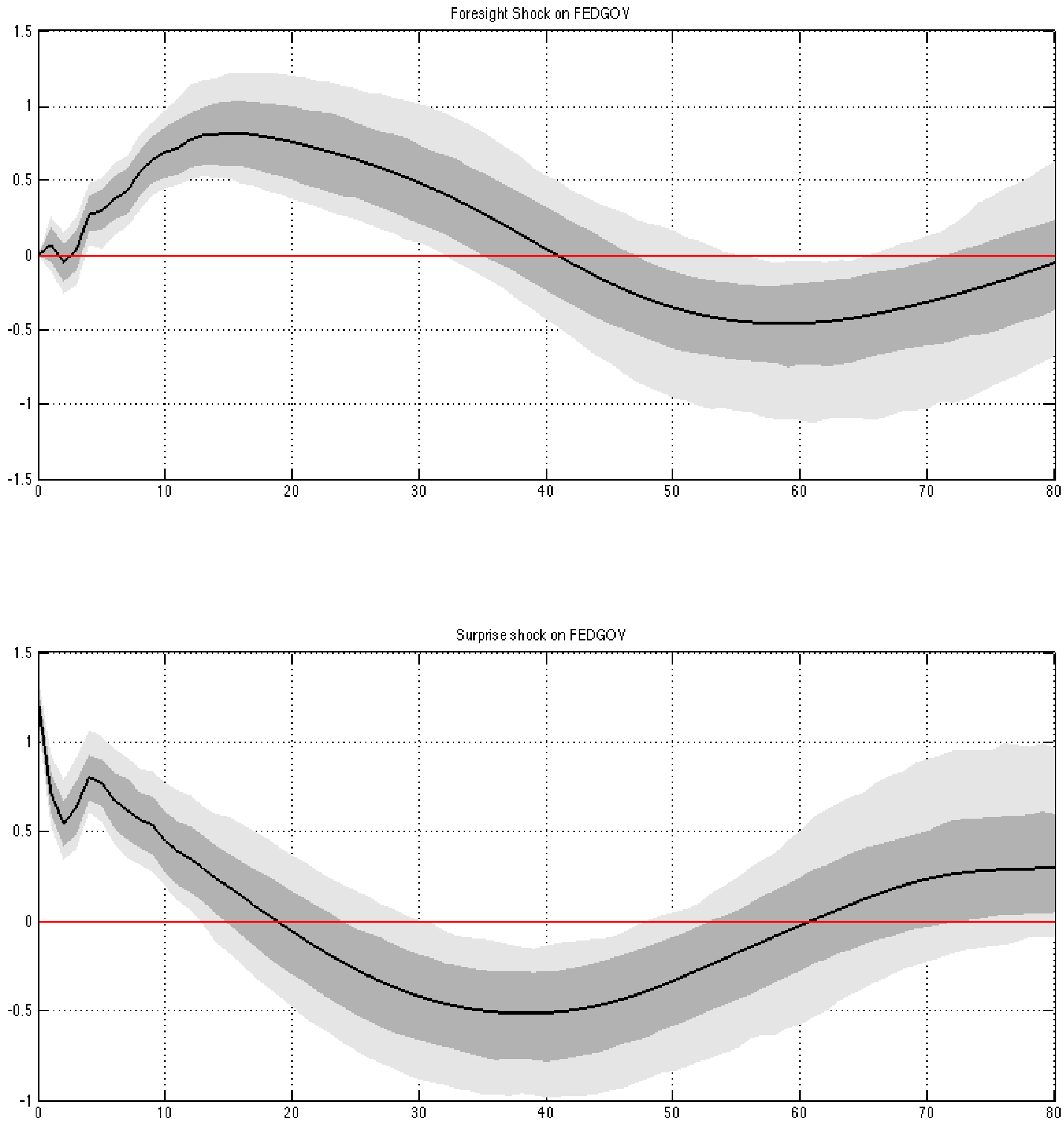

Figure 7: Impulse response functions to a foresight (upper panel) and a surprise (lower panel) spending shock (Identification #1) to real federal spending. The horizon of the horizontal axis is enlarged to 20 years. Solid lines are point estimates (average across 500 draws), dark-gray area is the 68% confidence region; light-gray area is the 90% confidence region.

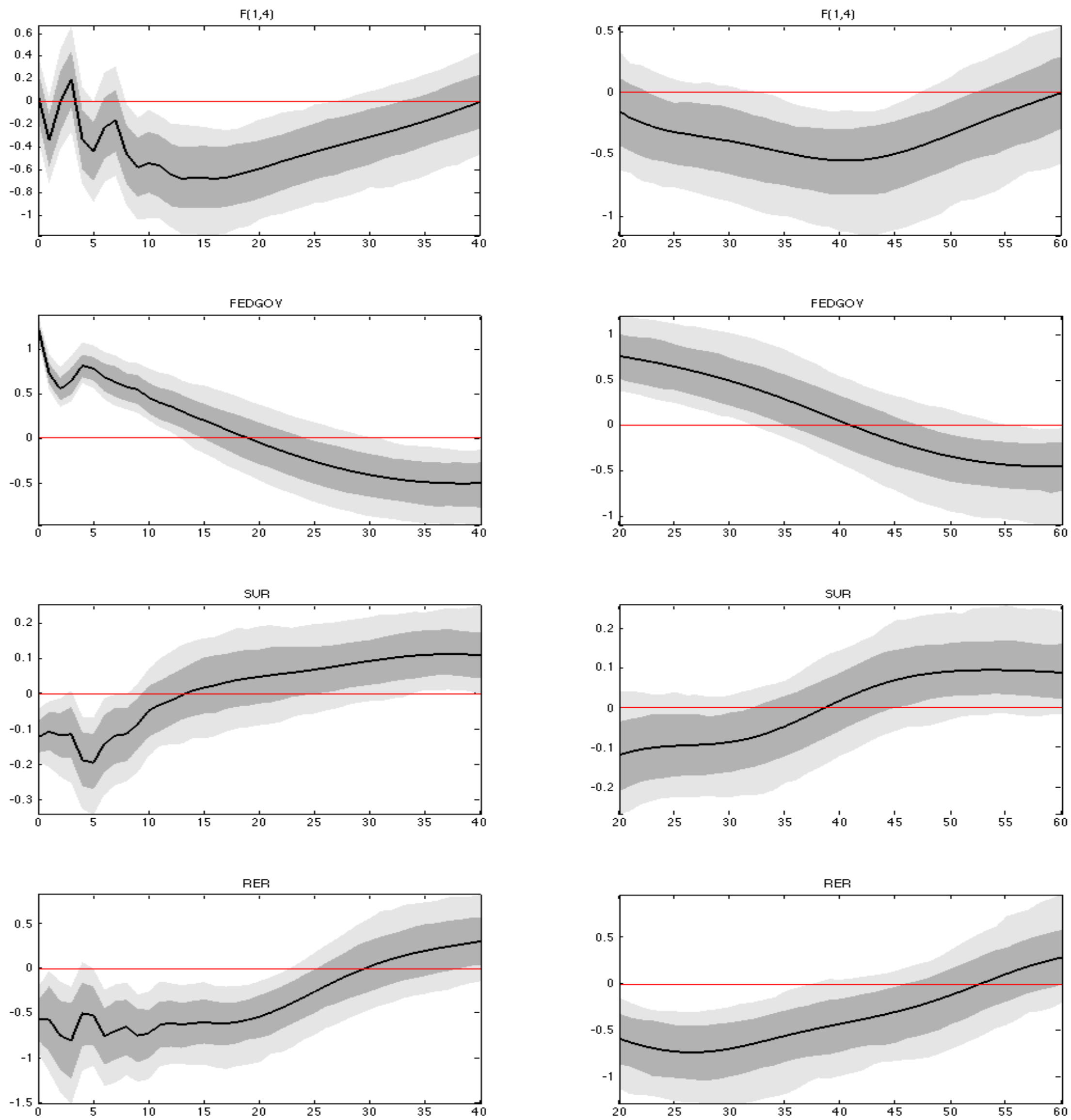

Figure 8: Impulse response functions to a foresight (right column) and a surprise (left column) spending shock (Identification #1) to selected variables. In the right column the impulse response functions are shifted ahead by 20 periods. Solid lines are point estimates (average across 500 draws), dark-gray area is the 68% confidence region; light-gray area is the 90% confidence region.