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Does anticipation of government spending matter? The role of (non-)defense spending

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Abstract

We investigate the effects of government expenditure on private consumption when the private sector anticipates the fiscal shocks. In order to capture anticipation of fiscal policy, we develop a new method based on a structural vector autoregression (SVAR). By simulating data from a theoretical model featuring (imperfect) fiscal foresight, we demonstrate the ability of our new approach to correctly capture macroeconomic dynamics. We take advantage of the flexibility of our econometric approach and study those subcomponents of total government spending, which have different macroeconomic effects according to economic theory. Using post-WWII US data, we find that when taking into account anticipation, private consumption significantly decreases in response to a defense expenditure shock, whereas when considering shocks to non-defense spending, consumption increases significantly. A standard SVAR does not produce clear consumption responses, highlighting the importance of anticipation. Our results thus reconcile the different findings of the narrative and SVAR approaches to the study of fiscal policy effects.

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1 Introduction

The empirical literature on the effects of fiscal policy on the macroeconomy is inconclusive. It can broadly be divided into two strands according to the identification approach. On the one hand, fiscal policy events are identified with the narrative approach employing dummy variables that indicate large increases in government expenditure related to wars.[1] These foreign policy events are assumed to be exogenous to the state of the economy and can therefore be used to identify the effects of fiscal policy. This line of research typically finds that in response to such a shock to government spending, GDP increases whereas private consumption and real wages fall (Ramey and Shapiro 1998, Edelberg, Eichenbaum, and Fisher 1999, Burnside, Eichenbaum, and Fisher 2004). On the other hand, structural vector autoregressions (SVARs) usually achieve identification by assuming that government spending is predetermined within the quarter and government revenue does not respond to macroeconomic developments in the same quarter except for exogenous automatic stabilizers (Blanchard and Perotti 2002). This strand of the literature finds that private consumption, similar to GDP, usually increases after a shock to government spending. Those results have been confirmed and extended in the papers by Perotti (2005, 2008), for example.[2]

These contrasting empirical findings have important implications for our view of the macroeconomy. Standard macroeconomic models focusing on fiscal policy such as the neoclassical model of Baxter and King (1993) but also most New-Keynesian variants (for example, Linnemann and Schabert (2003)) have an unambiguous prediction concerning the response of private consumption to a shock to government spending. Whereas output is expected to increase in response to such a shock, consumption should fall. The central reason for the latter dynamic response in those models is that government expenditure (financed by lump-sum taxes) constitute a withdrawal of resources from the economy, which in turn do not substitute or complement private consumption nor

[1] The narrative approach goes back to Romer and Romer (1989) in the area of monetary policy. A recent paper by Romer and Romer (2009) employs the narrative approach for tax changes.

[2] More empirical evidence with respect to European countries is provided by Biau and Girard (2005) for France, Giordano, Momigliano, Neri, and Perotti (2007) for Italy, de Castro and de Cos (2008) for Spain, and Tenhofen, Wolff, and Heppke-Falk (2010) for Germany. A different identification procedure was proposed by Fatás and Mihov (2001) and Mountford and Uhlig (2009), who also document a positive consumption response.

contribute to productivity. The resulting adverse wealth effect drives the negative consumption response. In contrast, Galí, López-Salido, and Vallés (2007) construct a New-Keynesian model with a positive consumption response, in order to reconcile current business cycle models with the empirical findings of the SVAR literature. Galí, López-Salido, and Vallés (2007) make clear, however, that many very special conditions have to be fulfilled for the model to be able to generate a positive response of private consumption. In particular, sticky prices and "rule-of-thumb" consumers drive the result.[3] Empirical findings therefore shape our modeling and understanding of the economy. Unfortunately, however, the different methods employed do not yield consistent results.

In an important contribution, Ramey (2009) aims at explaining the difference between the results of the two empirical approaches. She argues that VAR techniques miss the fact, that major changes in government spending, such as expenditure related to wars, are usually anticipated. Within a standard model, it is easy to show, that missing the point of anticipation will result in a positive response of consumption to a shock to government spending, as consumption following the initial drop increases with investment. In support of her hypothesis that shocks are indeed anticipated, Ramey (2009) documents that the war dummy shocks Granger-cause the VAR shocks, but not vice versa.

These problems fit into the more general discussion on when it is possible to relate the innovations recovered by a VAR to the shocks of a particular economic model. Early contributions in this regard are Hansen and Sargent (1980, 1991), Townsend (1983), Quah (1990), and Lippi and Reichlin (1993, 1994), with a recent reminder of these problems to the profession in Fernández-Villaverde, Rubio-Ramírez, Sargent, and Watson (2007). An application of these insights to fiscal policy anticipation, in particular concerning tax changes, with a thorough discussion of the related issues can be found in Leeper, Walker, and Yang (2009). This literature centers on the fundamental problem that in certain setups the information sets of the private agents and the econometrician are misaligned. In the case of fiscal policy anticipation, this means that private agents in addition to the variables observed by the econometrician know about the fiscal policy shocks occurring in future periods

[3] An earlier contribution featuring a positive consumption response is Devereux, Head, and Lapham (1996), for instance. In this paper, consumption only increases if returns to specialization are sufficiently high.

and act immediately on this information. The econometrician, on the other hand, only observing variables up to the current period, does not possess this information. On a more technical note, (fiscal) foresight in a generic dynamic stochastic general equilibrium (DSGE) model may introduce a non-invertible moving-average (MA) component into the equilibrium process. In this case, the stochastic process does not possess a representation in current and past endogenous variables. As a result, standard tools based on VARs, like impulse response functions or variance decompositions, can yield incorrect inferences.

We contribute to the empirical literature on the effects of fiscal policy by explicitly modeling anticipation in an SVAR framework. Our new approach is designed to align the information sets of the econometrician and the private agents. Thereby we are able to avoid the problems encountered by standard VARs in settings featuring fiscal policy anticipation. In particular, we are able to exactly capture a situation, where private agents perfectly know fiscal shocks one period in advance. While our method is not general in the sense of being applicable in the presence of all possible (and in practice unknown) kinds of information flows, the findings of a simulation exercise support our approach. In particular, this exercise indicates that our methodology is robust to situations with a potentially different information structure. In order to document the validity of our method, we simulate data from a theoretical model with fiscal foresight, where we demonstrate that the equilibrium process features a non-invertible MA component by using methods recently developed by Fernández-Villaverde, Rubio-Ramírez, Sargent, and Watson (2007). Despite having both anticipated and unanticipated fiscal shocks in the model, so that private agents only have *imperfect* foresight, our new approach correctly captures the dynamics within a VAR framework, while a standard VAR does not deliver the negative consumption response of the theoretical model.

In a next step, we apply our new methodology to real life data to investigate the effects of anticipated fiscal policy on private *consumption*. As Ramey (2009) argues, fiscal policy anticipation could have dramatic consequences by changing the sign of the consumption response. Our findings indeed highlight the importance of taking into account fiscal foresight in empirical work. We show that it is crucial to distinguish those subcomponents of total government spending, which might have different effects on the macroeconomy. In this regard, we take advantage of the flexibility of our econometric approach. Motivated by economic theory and in line with previous studies, we consider government defense and non-defense expenditure.[4] This allows us to reconcile the results of the narrative and SVAR approaches mentioned above and qualify recent findings in the literature.

We find that when taking into account anticipation issues private consumption significantly *decreases* on impact and in subsequent periods in response to a shock to government defense expenditure, exactly in line with Ramey's (2009) findings using the narrative approach. When considering shocks to non-defense spending, on the other hand, consumption *increases* significantly on impact and in the following periods in our expectation augmented VAR. In contrast, the corresponding responses in a standard VAR à la Blanchard and Perotti (2002) are quite weak and mostly insignificant. This highlights the importance of taking into account anticipation issues and is in line with Ramey's (2009) general argument, that standard VAR techniques fail to allow for fiscal foresight thereby invalidating the structural analysis.

Furthermore, the responses reported for the expectation augmented VAR are in line with central predictions of standard macroeconomic models. In those settings, less productive defense expenditure lead to a decrease in consumption while other, potentially more productive expenditure have the opposite effect. If we do not separate different expenditure components but use total government spending, we do not obtain clear-cut results, as we lump together spending items with different macroeconomic effects. Our findings are robust to adding real GDP and/or a short-term interest rate to the specification as well as to changes in the exogenous elasticities needed to identify the SVAR.

The remainder of the paper is structured as follows. The next section develops the expectation augmented VAR, while Section 3 presents estimation results based on model-generated data. Section 4 presents the findings of the empirical investigation with a particular focus on government defense and non-defense expenditure. Section 5 checks robustness and, finally, the last section concludes.

[4]While Blanchard and Perotti (2002) have a short subsection where they distinguish defense and non-defense expenditure, they only consider the response of output and do not take into account anticipation issues. Perotti (2008) also distinguishes defense and non-defense spending shocks in one of his SVAR specifications. Again, he does not allow for fiscal policy anticipation, which is the main focus of our investigation, where we show the importance of taking into account those issues.

2 An expectation augmented VAR

In order to explicitly take into account perfectly anticipated fiscal policy, we develop a new empirical approach. It is based on the framework put forward by Blanchard and Perotti (2002), which constitutes a well established SVAR methodology focusing on fiscal policy. Their basic idea is to exploit fiscal policy decision lags to identify structural shocks. In particular, the authors argue that as governments cannot react in the short run, e.g. within the same quarter, to changes in the macroeconomic environment, reactions of fiscal policy to current developments only result from so-called "automatic" responses. However, apart from *decision lags*, policymaking is also characterized by *implementation lags*. After a decision on a spending increase or tax cut, for instance, has been made, it takes time for the public authorities to implement those measures. As a result, even though there has been no actual adjustment of the respective policy instrument yet, private agents already know that there will be a change in fiscal policy, i.e., they anticipate fiscal policy actions, and act immediately on this information. Not taking account of those implementation lags could invalidate the analysis due to the potential misalignment of the information sets of the private agents and the econometrician. Such a misalignment arises particularly in standard setups, where the econometrician uses data only up to the current period and neglects information on future fiscal shocks. Figure 1 summarizes graphically the aforementioned ideas by means of a timeline and illustrates, in particular, the concepts of decision and implementation lags.

Blanchard and Perotti (2002) address anticipation issues by including expectations of future fiscal policy variables in their model. In particular, they assume that agents perfectly know fiscal policy shocks one period in advance and are able to react to it. Thus, the aforementioned expectations are taken with respect to an information set which includes next period's fiscal shocks. Impulse responses to anticipated fiscal shock are derived by simulating the system under rational expectations. They only consider the response of output, however, which is weaker but still positive. In particular, they do not report consumption responses, where anticipation effects could result in a different sign of the response as argued by Ramey (2009). The weaker output effect, though, might be an indication of a negative consumption response.

To allow for anticipation by the private sector, we go beyond the standard SVAR of Blanchard and Perotti (2002) by explicitly modeling the pro-

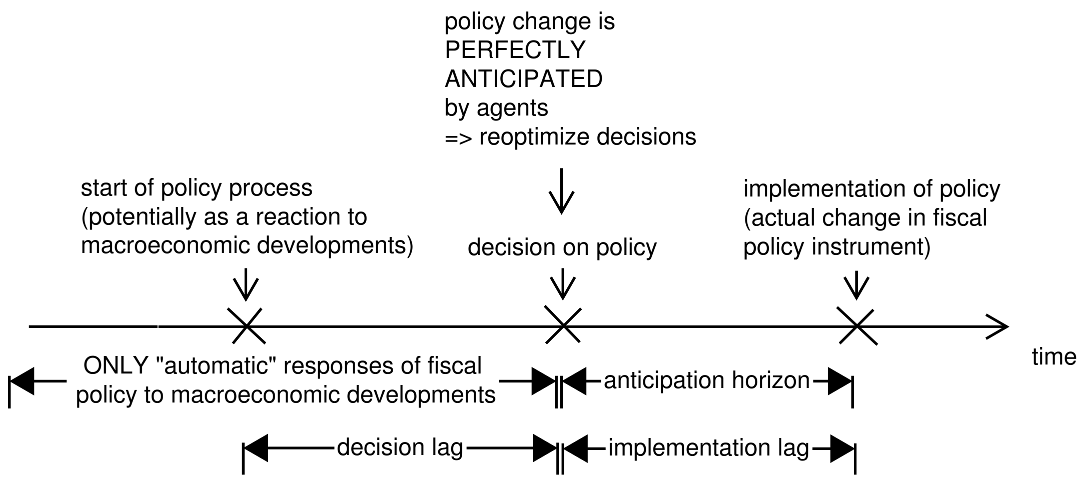

Figure 1: Sequence of events.

cess describing expectation formation within such a multivariate time series framework. Furthermore, a central contribution of this paper is to investigate the relevance of anticipation effects for the dynamic response of private consumption to fiscal policy shocks. We emphasize in particular the importance (of the nature) of the particular spending category under consideration, e.g. productive vs. unproductive public expenditure.

We propose the following setup, based on a standard AB-model SVAR:

$$Y_t = C(L)Y_{t-1} + U_t \tag{1}$$

$$AU_t = BV_t, \tag{2}$$

where $Y_t = [c_t \;\; g_t \;\; r_t \;\; \widehat{g}_{t+1} \;\; \widehat{r}_{t+1}]'$ is the vector of endogenous variables, U_t is the vector of reduced form residuals, and $V_t = [v_t^c \;\; v_t^g \;\; v_t^r \;\; v_{t+1}^g \;\; v_{t+1}^r]'$ is the vector of structural shocks to be identified. Here c_t denotes real private consumption, g_t is real government expenditure, r_t denotes real government revenue, and v_t^i is the respective structural shock.

The important novelty relative to a standard (S)VAR is the presence of $\widehat{g}_{t+1}$ and $\widehat{r}_{t+1}$ in the preceding equations. These expressions, reflecting fiscal policy anticipation, denote the conditional expectation of the respective fiscal variable with respect to current and past endogenous variables as well as next period's fiscal shocks, i.e., $\widehat{g}_{t+1} = E(g_{t+1}|\Upsilon_t, v_{t+1}^g, v_{t+1}^r)$ and $\widehat{r}_{t+1} = E(r_{t+1}|\Upsilon_t, v_{t+1}^g, v_{t+1}^r)$, where $\Upsilon_t = [y_t, y_{t-1}, y_{t-2}, \ldots]$ and $y_t = [c_t \;\; g_t \;\; r_t]'$. Accordingly, agents in the economy form expectations about the course of future fiscal policy on the basis of all information available to them. Besides the current and past realizations of the variables in the system, the agents know about the fiscal shocks occurring next period. These fiscal shocks are known as fiscal policy actions require time to be implemented. Moreover, they are usually subject to a broad public discussion before their actual implementation making the information available to a very broad audience.

This particular and novel feature of our approach is designed to align the information sets of the private agents and the econometrician. The goal is to avoid the problems encountered by standard VARs, when confronted with data generated from a process featuring a non-invertible moving-average component due to fiscal foresight. Our setup is able to exactly capture a situation, where private agents have one-period perfect foresight with respect to fiscal shocks. Even though this is not a general approach applicable in the presence of all possible kinds of information flows, the findings of the subsequent simulation exercise support our new method. It indicates that the methodology is robust to situations with a potentially different information structure. Moreover, our method is easily applicable to different spending categories. Without much effort and in a readily reproducible way, we can go beyond defense spending, i.e., beyond the point for which studies using the narrative approach exist.

2.1 A simplified setting: the general idea of our approach

In order to describe the basic idea of our approach, we first consider a *simplified version* of the aforementioned model, in particular, a setup which does not exhibit lagged endogenous variables. This framework, however, easily generalizes to the standard case including lags, which is discussed subsequently. The system can be partitioned into two parts: first, one set of equations representing the basic structure of the economy, and second, the remaining equations modeling the process describing expectation formation.

More specifically, the basic framework of the economy in the simplified setup is given by the first three equations of the model, presented here in structural form:

$$
\begin{aligned}
c_t &= \gamma_1 \widehat{g}_{t+1} + \gamma_2 \widehat{r}_{t+1} + \alpha_g^c g_t + \alpha_r^c r_t + v_t^c && (3)\\
g_t &= \alpha_c^g c_t + v_t^g && (4)\\
r_t &= \alpha_c^r c_t + \beta_g^r v_t^g + v_t^r. && (5)
\end{aligned}
$$

In accordance with our idea of fiscal policy anticipation by the private sector and following Blanchard and Perotti (2002), the two expectation terms appear in the consumption equation. Furthermore, we have to assume a relative ordering of the fiscal variables. Here we act on the assumption that spending decisions come first, i.e., the structural revenue shock, v_t^r, does not enter the expenditure equation, whereas v_t^g enters the revenue equation.[5]

As indicated above, the remaining part of the model consists of equations modeling the process describing expectation formation, in the simple framework given by:

$$
\begin{aligned}
\widehat{g}_{t+1} &= E(g_{t+1}|\Upsilon_t, v_{t+1}^g, v_{t+1}^r) = \beta_g^{Eg} v_{t+1}^g + \beta_r^{Eg} v_{t+1}^r && (6)\\
\widehat{r}_{t+1} &= E(r_{t+1}|\Upsilon_t, v_{t+1}^g, v_{t+1}^r) = \beta_g^{Er} v_{t+1}^g + \beta_r^{Er} v_{t+1}^r. && (7)
\end{aligned}
$$

Even though a standard VAR also implicitly models expectation formation, here we have to augment the basic VAR equations with the expectation terms and expectational equations, since we have to deal with a special informational structure. In particular, not only variables indexed up to time t are part of the information set with respect to time t, but it also contains future variables, i.e., shocks indexed $t+1$. Accordingly, one-period anticipation of fiscal policy actions is reflected in the presence of v_{t+1}^g and v_{t+1}^r in the preceding equations.

Analogous expectation terms, however, do not appear in the fiscal equations and there are no separate expectational equations for the non-fiscal variables. That does not mean, that the public sector does not form (rational) expectations about future developments in the economy. It just reflects the fact, that the fiscal authority's information set with respect to the private sector only includes variables indexed up to the current period.[6] It is hard to think of a case

[5] Note that since the model is presented in structural form, the coefficients α_c^g, α_c^r, and β_g^r are elements of the A and B matrices, respectively.

[6] As the private sector, the government of course does know its own fiscal shocks next period and its effects on *current* non-fiscal variables. This is reflected in the system by equation (3) in combination with the fiscal equations.

of *aggregate* implementation lags for the private sector, which would give rise to the anticipation of future private sector actions by the government, analogous to the setting of fiscal foresight described in this paper. Consequently, we do not have to augment the fiscal equations by expectation terms and the system by corresponding expectational equations to accommodate such a setup.

Ultimately, we are interested in deriving impulse response functions with respect to perfectly anticipated fiscal policy shocks. Consequently, we have to obtain the corresponding MA-representation of the model. Concerning consumption, which is the main variable of interest, such a representation in this simplified setup results when using equations (4) - (7) in equation (3) and solving for c_t:

$$\begin{aligned} c_t &= \frac{1}{1-\alpha_g^c\alpha_c^g-\alpha_r^c\alpha_c^r}\Big[(\gamma_1\beta_g^{Eg}+\gamma_2\beta_g^{Er})v_{t+1}^g+(\gamma_1\beta_r^{Eg}+\gamma_2\beta_r^{Er})v_{t+1}^r \\ &\quad +(\alpha_g^c+\alpha_r^c\beta_g^r)v_t^g+\alpha_r^c v_t^r+v_t^c\Big]. \end{aligned} \tag{8}$$

Consequently, concerning government expenditure for example, the dynamic response of consumption results as

$$\frac{\partial c_t}{\partial v_{t+1}^g} = \frac{\gamma_1\beta_g^{Eg}+\gamma_2\beta_g^{Er}}{1-\alpha_g^c\alpha_c^g-\alpha_r^c\alpha_c^r} \tag{9}$$

$$\frac{\partial c_{t+1}}{\partial v_{t+1}^g} = \frac{\alpha_g^c+\alpha_r^c\beta_g^r}{1-\alpha_g^c\alpha_c^g-\alpha_r^c\alpha_c^r} \tag{10}$$

$$\frac{\partial c_{t+s}}{\partial v_{t+1}^g} = 0 \quad \forall s\geq 2. \tag{11}$$

Note, that this is the response to *next period's* fiscal shock, which is, however, perfectly anticipated today. In particular, consumption at time t moves in response to the fiscal shock of period $t+1$.[7]

We would like to emphasize the rationale of our expectational equations (6) and (7). The purpose of those equations is to describe how model-consistent expectations with respect to future fiscal variables are formed. In this respect, we are not interested in the structural relations between the different variables

[7] Due to the absence of lagged endogenous variables in this simplified setting, the dynamic response is zero for c_{t+s}, $\forall s\geq 2$. In the general framework, of course, this is typically not the case as indicated in the impulse responses presented below.

and thus the structural coefficients, but rather in the expectation of the respective fiscal variable in the sense of an optimal forecast based on the structure of the economy and all information available to the agent at the respective point in time.

Due to the linear structure of the economy, we consider linear projections as forecasts, which are the (reduced form) conditional expectation in this kind of setting. Consequently, since the conditional expectation leads to the forecast with the smallest mean squared error, linear projections produce optimal forecasts in this sense in such an environment. What remains to be specified are the relevant variables on which to project. In this respect, we consider all information available to the agent, which at time t comprises Υ_t, v^g_{t+1}, and v^r_{t+1}.[8] In particular, both future fiscal shocks are relevant variables to produce a forecast for *both* government expenditure and revenue despite the relative ordering assumption of the structural equations. To see why, lead the structural equations (4) and (5) by one period and take expectations:

$$\widehat{g}_{t+1} = \alpha^g_c \widehat{c}_{t+1} + v^g_{t+1} \tag{12}$$

$$\widehat{r}_{t+1} = \alpha^r_c \widehat{c}_{t+1} + \beta^r_g v^g_{t+1} + v^r_{t+1}. \tag{13}$$

The only variable not known to the agent in period t is next period's private consumption. Consequently, leading equations (3) to (5) by one period, combination, and taking expectations with respect to the information available at time t, i.e., Υ_t, v^g_{t+1}, and v^r_{t+1}, results in the following expression for expected consumption:

$$\widehat{c}_{t+1} = \frac{1}{1-\alpha^c_g\alpha^g_c - \alpha^c_r\alpha^r_c}\left[\gamma_1 \widehat{\widehat{g}}_{t+2} + \gamma_2 \widehat{\widehat{r}}_{t+2} + (\alpha^c_g + \alpha^c_r\beta^r_g)v^g_{t+1} + \alpha^c_r v^r_{t+1}\right], \tag{14}$$

where $\widehat{\widehat{g}}_{t+2} = E(g_{t+2}|\Upsilon_t, v^g_{t+1}, v^r_{t+1})$, $\widehat{\widehat{r}}_{t+2} = E(r_{t+2}|\Upsilon_t, v^g_{t+1}, v^r_{t+1})$, and note that v^c_{t+1} is not known at time t. In order to infer expected future consumption *both* expected future government expenditure and expected future government revenue are relevant. Those, in turn, depend - among other things - on future fiscal shocks as indicated by equations (12) and (13). Consequently, expected future consumption is governed by both next period's fiscal shocks. This, in turn, implies that those shocks will be relevant when forming expectations *both* with respect to government expenditure and government revenue, so that

[8] In this simplified setup, due to the absence of lagged endogenous variables, Υ_t is not relevant for expectation formation. In the general case, however, Υ_t does play a role.

the ordering concerning the shocks in equations (4) and (5) will not hold in the expectational equations. Intuitively, the two fiscal shocks are useful for estimating future private consumption, which in turn is relevant for forecasting the fiscal variables.

Moreover, in this simplified setting we can easily combine the last three equations and solve for $\widehat{g}_{t+1}$ and $\widehat{r}_{t+1}$, yielding:

$$\widehat{g}_{t+1} = \underbrace{\frac{1-\alpha_r^c\alpha_c^r+\alpha_c^g\alpha_r^c\beta_g^r}{1-\alpha_g^c\alpha_c^g-\alpha_r^c\alpha_c^r}}_{\beta_g^{Eg}} v_{t+1}^g + \underbrace{\frac{\alpha_c^g\alpha_r^c}{1-\alpha_g^c\alpha_c^g-\alpha_r^c\alpha_c^r}}_{\beta_r^{Eg}} v_{t+1}^r \tag{15}$$

$$\widehat{r}_{t+1} = \underbrace{\frac{\alpha_c^r\alpha_g^c+\beta_g^r-\alpha_g^c\alpha_c^g\beta_g^r}{1-\alpha_g^c\alpha_c^g-\alpha_r^c\alpha_c^r}}_{\beta_g^{Er}} v_{t+1}^g + \underbrace{\frac{1-\alpha_g^c\alpha_c^g}{1-\alpha_g^c\alpha_c^g-\alpha_r^c\alpha_c^r}}_{\beta_r^{Er}} v_{t+1}^r. \tag{16}$$

This demonstrates the consistency of the expectational equations with the equations describing the basic structure of the economy. In particular, the linear projection coefficients of equations (6) and (7) can be related to the structural coefficients of equations (3) to (5).

2.2 The general setting: estimating an expectation augmented VAR

After having discussed the basic idea of our approach in the simplified setting, we now turn to the *general case* and present our estimation procedure. Taking into account lagged endogenous variables, the basic structure of the economy is given by the following set of equations:

$$\begin{aligned} c_t &= C_{11}(L)c_{t-1}+\gamma_1\widehat{g}_{t+1}+\alpha_g^c g_t+C_{12}(L)g_{t-1}+\gamma_2\widehat{r}_{t+1} \\ &\quad +\alpha_r^c r_t+C_{13}(L)r_{t-1}+v_t^c \qquad (17) \\ g_t &= \alpha_{c1}^g c_t+\alpha_{c2}^g c_{t-1}+\widetilde{C}_{21}(L)c_{t-2}+C_{22}(L)g_{t-1}+C_{23}(L)r_{t-1}+v_t^g \qquad (18) \\ r_t &= \alpha_{c1}^r c_t+\alpha_{c2}^r c_{t-1}+\widetilde{C}_{31}(L)c_{t-2}+C_{32}(L)g_{t-1}+C_{33}(L)r_{t-1} \\ &\quad +\beta_g^r v_t^g+v_t^r, \qquad (19) \end{aligned}$$

where we pulled c_{t-1} out of the lagpolynomial, since we have to treat the corresponding coefficients separately due to the identification scheme of Blanchard and Perotti (2002).

The expectational equations in the general setup result as:

$$\begin{aligned}
\widehat{g}_{t+1} &= E(g_{t+1}|\Upsilon_t, v^g_{t+1}, v^r_{t+1}) \\
&= C_{41}(L)c_t + C_{42}(L)g_t + C_{43}(L)r_t + \beta^{Eg}_g v^g_{t+1} + \beta^{Eg}_r v^r_{t+1} \qquad (20) \\
\widehat{r}_{t+1} &= E(r_{t+1}|\Upsilon_t, v^g_{t+1}, v^r_{t+1}) \\
&= C_{51}(L)c_t + C_{52}(L)g_t + C_{53}(L)r_t + \beta^{Er}_g v^g_{t+1} + \beta^{Er}_r v^r_{t+1}. \qquad (21)
\end{aligned}$$

Estimation of this model basically proceeds in three steps.[9] First, we look at the fiscal equations (18) and (19). Here we start by exploiting the assumption concerning decision lags. In particular, in order to address endogeneity issues, we use exogenous consumption elasticities of government expenditure and revenue to compute adjusted real government direct expenditure and net revenue.[10] Furthermore, we not only have to assume that there is no fiscal policy discretionary response to consumption developments within the quarter but also no response to such developments in the previous quarter. This indicates a tradeoff inherent in our method. On the one hand, we are able to incorporate fiscal foresight in the benchmark fiscal VAR model of Blanchard and Perotti (2002), but on the other we are constrained by the assumptions on which this approach is based. In particular, the maximum anticipation horizon we can implement depends on the number of periods we are willing to assume that fiscal policy is not able to discretionarily respond to macroeconomic developments. This step leads to the following setup:

$$\begin{aligned}
g^A_t \equiv g_t - \alpha^g_{c1}c_t - \alpha^g_{c2}c_{t-1} &= \widetilde{C}_{21}(L)c_{t-2} + C_{22}(L)g_{t-1} + C_{23}(L)r_{t-1} + v^g_t \qquad (22) \\
r^A_t \equiv r_t - \alpha^r_{c1}c_t - \alpha^r_{c2}c_{t-1} &= \widetilde{C}_{31}(L)c_{t-2} + C_{32}(L)g_{t-1} + C_{33}(L)r_{t-1} \\
&\quad + \beta^r_g v^g_t + v^r_t. \qquad (23)
\end{aligned}$$

Subsequently, we recursively estimate the resulting equations by OLS to obtain the structural shocks to the respective fiscal variable, i.e., we first estimate

[9] Here our focus is on the aspect of anticipation. A more detailed description of the general estimation approach can be found in Blanchard and Perotti (2002) and Tenhofen, Wolff, and Heppke-Falk (2010).

[10] Blanchard and Perotti (2002) argue that fiscal policy decision making is a slow process, involving many agents in parliament, government, and civil society. As a result, reactions of fiscal policy to current developments only result from automatic responses. Those are defined by existing laws and regulations and can be taken into account by applying exogenous output or consumption elasticities. Adjusting government expenditure or revenue using these elasticities allows to obtain unbiased estimates of the structural coefficients and thus the structural fiscal policy shocks.

equation (22) and obtain v_t^g, and then use this shock series as an additional regressor to estimate equation (23).

In the second step, we consider the equation modeling private consumption. We begin by rewriting equation (17) as follows:

$$\begin{aligned} c_t &= C_{11}(L)c_{t-1} + \gamma_1 g_{t+1} + \alpha_g^c g_t + C_{12}(L)g_{t-1} + \gamma_2 r_{t+1} \\ &\quad + \alpha_r^c r_t + C_{13}(L) r_{t-1} + v_t^{c'}, \end{aligned} \tag{24}$$

where

$$g_{t+1} = E(g_{t+1}|\Upsilon_t, v_{t+1}^g, v_{t+1}^r) + u_{t+1}^g \tag{25}$$

$$r_{t+1} = E(r_{t+1}|\Upsilon_t, v_{t+1}^g, v_{t+1}^r) + u_{t+1}^r, \tag{26}$$

and consequently $v_t^{c'} = v_t^c - \gamma_1 u_{t+1}^g - \gamma_2 u_{t+1}^r$. Subsequently, equation (24) is estimated by instrumental variables, in order to account for the correlation of the respective regressors and error term. Since both v_{t+1}^i and v_t^i $(i = g, r)$ are perfectly known at time t, they are uncorrelated with the expectational errors in $v_t^{c'}$. Furthermore, because they are also uncorrelated with v_t^c, we can use v_{t+1}^g, v_t^g, v_{t+1}^r, and v_t^r as instruments to estimate γ_1, α_g^c, γ_2, and α_r^c.

Finally, in the third step, we look at the equations modeling expectations. Since, as mentioned above, with respect to these two equations we are only interested in forecasting and not in estimation of the structural parameters, it is sufficient to just plug equations (20) and (21) into equations (25) and (26), respectively, and estimate these by OLS, as OLS provides a consistent estimate of the linear projection coefficient.[11]

Following this procedure, we obtain all coefficients necessary to compute the structural impulse response functions. In particular, it is possible to derive the dynamic response to a perfectly anticipated fiscal policy shock.

3 Application to simulated data

In order to illustrate the ability of our approach to capture fiscal policy anticipation, we apply this new empirical method to model-generated data. We consider a stylized theoretical model featuring fiscal foresight to assess whether

[11] See, for example, Hamilton (1994, p. 76).

our approach is able to address problems related to non-invertibility due to fiscal policy anticipation. In particular, we use a variation of the model of Ramey (2009), which is a standard neoclassical growth model, to simulate time series and subsequently use these artificial data to estimate both a standard VAR and our expectation augmented VAR to derive impulse response functions. A convenient feature of simulating data from a theoretical model is that we know the true impulse response function in this setup. Consequently, by comparing the estimated impulse responses to the theoretical one, we can check whether the two aforementioned VAR models are able to address anticipation effects.

Ramey (2009) presents a simple neoclassical growth model featuring government spending financed via nondistortionary taxes, where agents learn about changes in government expenditure before their actual realization. We take her setup as a starting point, but augment it with a few features to be able to apply Fernández-Villaverde, Rubio-Ramírez, Sargent, and Watson's (2007) invertibility condition.[12] As mentioned in the introduction, fiscal foresight in a generic DSGE model may lead to an equilibrium process with a non-invertible MA component, posing substantial problems for standard VAR analysis.[13] These problems can be illustrated as follows: in the case of non-invertibility, the stochastic process does not possess a (VAR) representation in current and *past* endogenous variables, as observed by the econometrician, where the resulting innovations are called fundamental. For each non-invertible process, however, there exists an invertible one, featuring the same mean and autocovariance-generating function. This implies that these processes cannot be distinguished based on the first two moments, so that Gaussian likelihood or least-squares procedures, for instance, run into an identification problem. As a result, it is standard in the VAR literature to disregard all non-invertible representations and focus solely on the corresponding invertible process. This means, however, that the econometrician is only able to recover the fundamental innovations corresponding to the invertible representation of the process, whereas the true economic shocks might correspond to the non-fundamental

[12] Our model is still relatively close to Ramey's (2009) original specification. In particular, in the two models the impulse responses which are at the center of our investigation, i.e., the ones with respect to a government spending shock, are quite similar.

[13] An MA process is called invertible, if all the roots of the corresponding characteristic equation are outside the unit circle.

innovations of a non-invertible process.[14] As a result, standard tools based on such VARs, like impulse response functions or variance decompositions, potentially yield incorrect inferences.

In order to detect whether non-invertibility is present in a given DSGE model, Fernández-Villaverde, Rubio-Ramírez, Sargent, and Watson (2007) derive a condition based on the state-space representation of the equilibrium process of an economic model:

$$x_{t+1} = Ax_t + Bw_{t+1} \tag{27}$$

$$y_{t+1} = Cx_t + Dw_{t+1}, \tag{28}$$

where x_t is a vector of (possibly unobserved) state variables, y_t is a vector of variables the econometrician observes, and w_t denotes the vector of economic shocks. If "the eigenvalues of $A - BD^{-1}C$ are strictly less than one in modulus,"[15] a standard VAR will be able to recover the true economic shocks, w_t. Note, however, to be able to apply this condition, the matrix D has to be nonsingular. In particular, the matrix must be square, i.e., the number of variables observed by the econometrician has to equal the number of economic shocks. For many models, this will not be the case, and this prerequisite is not met in Ramey's (2009) original setup. Consequently, we add investment-specific technology shocks and an error in forecasting government expenditure to the model, to obtain a nonsingular matrix D.[16] The latter feature is particularly interesting for this exercise. It allows to vary the relative importance of anticipated vs. unanticipated shocks to government expenditure. In particular, the model is able to represent a setting where foresight is not perfect.

With respect to the economic environment of the model, preferences and technology are specified as follows: the representative household maximizes

[14]Please note, that in this description, we use a relation between (non-)invertibility and (non-)fundamentalness which abstracts from the borderline case, when at least one root of the characteristic equation of the moving-average process is *on* the unit circle (and none inside). Then, the process is non-invertible but the innovations are said to be fundamental.

[15]CONDITION 1 in Fernández-Villaverde, Rubio-Ramírez, Sargent, and Watson (2007, p. 1022).

[16]Going back to Greenwood, Hercowitz, and Huffman (1988), investment-specific technology shocks are considered to be a major source of economic growth as well as business cycle fluctuations. With respect to the former, see for example Greenwood, Hercowitz, and Krusell (1997), whereas the latter point is made, for instance, by Greenwood, Hercowitz, and Krusell (2000) and Fisher (2006).

$$U_0 = E_0 \left[\sum_{t=0}^{\infty} \beta^t \left(\log C_t + \psi_t \log L_t \right) \right], \tag{29}$$

where β is the household's discount factor, C_t is private consumption, and L_t denotes leisure. The production function of the representative firm is given by

$$Y_t = (Z_t N_t)^{1-\alpha} K_t^{\alpha}, \tag{30}$$

where Y_t is output, N_t denotes labor input, and K_t is the capital stock, which evolves according to

$$K_{t+1} = (1-\delta) K_t + X_t I_t. \tag{31}$$

In the latter equation, I_t denotes (gross) investment, X_t is the level of investment-specific technology, and δ is the rate of depreciation for capital.[17] The two resource constraints in this economy are given by

$$\begin{aligned} L_t + N_t &\leq 1 && (32) \\ C_t + I_t + G_t &\leq Y_t. && (33) \end{aligned}$$

The stochastic processes governing the shocks to technology, the marginal rate of substitution, and investment-specific technology are assumed to evolve according to

$$\begin{aligned} \log Z_t &= \rho_1 \log Z_{t-1} + e_t^z, \quad e_t^z \overset{iid}{\sim} (0, \sigma_{e^z}^2) && (34) \\ \log \psi_t &= \rho_2 \log \psi_{t-1} + e_t^{\psi}, \quad e_t^{\psi} \overset{iid}{\sim} (0, \sigma_{e^{\psi}}^2) && (35) \\ \log X_t &= \rho_3 \log X_{t-1} + e_t^x, \quad e_t^x \overset{iid}{\sim} (0, \sigma_{e^x}^2). && (36) \end{aligned}$$

Finally, the evolution of government spending, financed via non-distortionary taxes, is specified as follows:

$$\begin{aligned} \log G_t &= \log G_{t-j}^{F,j} + \log \mathcal{E}_t^G, \quad j > 0 && (37) \\ \log G_t^{F,j} &= d_1 \log G_{t-1}^{F,j} + d_2 \log G_{t-2}^{F,j} + d_3 \log G_{t-3}^{F,j} + e_t^{GF}, \quad e_t^{GF} \overset{iid}{\sim} (0, \sigma_{e^{GF}}^2) && (38) \\ \log \mathcal{E}_t^G &= d_1 \log \mathcal{E}_{t-1}^G + d_2 \log \mathcal{E}_{t-2}^G + d_3 \log \mathcal{E}_{t-3}^G + e_t^{\mathcal{E}G}, \quad e_t^{\mathcal{E}G} \overset{iid}{\sim} (0, \sigma_{e^{\mathcal{E}G}}^2), && (39) \end{aligned}$$

[17]This way of introducing investment-specific technological change follows Fisher (2006).

where G_t is *actual* government spending at time t, $G_t^{F,j}$ is the *j-period forecast* of government spending made at time t, and $\mathcal{E}_t^G$ is the error made in forecasting government expenditure. Alternatively and perhaps more intuitively, one can think of government expenditure as following an AR(3) process, where the error consists of an anticipated and an unanticipated part:

$$\log G_t = d_1 \log G_{t-1} + d_2 \log G_{t-2} + d_3 \log G_{t-3} + e_t^G \tag{40}$$

$$e_t^G = e_{t-j}^{GF} + e_t^{\mathcal{E}G}. \tag{41}$$

Combining such a specification with the forecasting relation (37) and the process for the forecast error (39) yields equation (38). The anticipated part of the error is known j periods in advance. Consequently, the preceding equations imply j-period *imperfect* foresight with respect to government expenditure shocks. In the following exercise, j is set to 1, corresponding to the specification in our empirical application in the next section.[18] This setup is quite convenient in the sense, that by varying the variances of the anticipated and unanticipated shock, e_t^{GF} and $e_t^{\mathcal{E}G}$, respectively, it is possible to vary the relative importance of the two shocks for government expenditure. As $\sigma^2_{e^{\mathcal{E}G}}$ tends to zero, we approach a case of j-period *perfect* foresight, whereas when $\sigma^2_{e^{GF}}$ goes to zero, fiscal foresight will vanish. Furthermore, Ramey (2009) introduces measurement error in the logarithm of output, governed by an AR(1) process with autocorrelation coefficient ρ_4 and variance $\sigma^2_{e^m}$.

With respect to the calibration of the model, the same parameters are chosen as in Ramey (2009), where one time period in the model corresponds to a quarter. The calibration of the stochastic process for investment-specific technology, which is not present in Ramey's (2009) original model, is taken from In and Yoon (2007). These authors estimate this process for quarterly data, following an approach introduced by Greenwood, Hercowitz, and Krusell (1997, 2000), where the latter use annual data. Furthermore, we distribute the variance of the government expenditure shock given by Ramey (2009) among the anticipated and unanticipated part. In our benchmark calibration, we choose the same value for the standard deviation of the forecast error with respect to

[18]This is an additional slight deviation from Ramey's (2009) original model, where she introduces two periods of foresight. Our estimation approach could also accommodate such a setting, but we want to be consistent with the informational assumptions employed in our subsequent empirical investigation.

Table 1: **Calibration**

Symbol	Value	Symbol	Value	Symbol	Value	Symbol	Value
β	0.99	ρ_2	0.95	$\sigma_{e^{\psi}}$	0.008	σ_{e^m}	0.005
α	0.33	ρ_3	0.95	σ_{e^x}	0.012	d_1	1.4
δ	0.023	ρ_4	0.95	$\sigma_{e^{GF}}$	0.0275	d_2	-0.18
ρ_1	0.95	σ_{e^Z}	0.01	$\sigma_{e^{\varepsilon G}}$	0.005	d_3	-0.25

government spending as for the standard deviation of the measurement error in output. All in all, the values chosen are standard and summarized in Table 1.

Based on this calibration, we compute the eigenvalues of the matrix mentioned in Fernández-Villaverde, Rubio-Ramírez, Sargent, and Watson's (2007) invertibility condition. In this way we can check, whether the equilibrium process of the model just presented features a non-invertible moving-average component. Indeed, two eigenvalues are larger than one in modulus, implying that a standard VAR will not be able to recover the true economic shocks from current and past endogenous variables.[19] Even though we know, that the economic shocks cannot be *exactly* recovered from the observed current and past endogenous variables used in a VAR, it is still possible that (a subset of) those shocks can be reconstructed with relatively high accuracy. This point is made by Sims and Zha (2006) and demonstrated for a particular DSGE model. Since we are primarily interested in impulse response functions, in the following we check the actual severity of the invertibility problem introduced by fiscal foresight, by comparing the theoretical impulses responses to the estimated ones obtained from a standard VAR using Blanchard and Perotti's (2002) identification scheme. Furthermore, by computing the corresponding impulse responses using our expectation augmented VAR, we can examine whether our approach is able to align the information sets of the agents and econometrician and can cope with the more demanding informational setup introduced by anticipation of fiscal policy.

Taking the theoretical impulse responses as a reference point, we simulate time series of 100 observations from the setup described above and subsequently employ these artificial data in the estimation of a standard VAR and an expectation augmented VAR. Since our main focus is on the consumption response to an anticipated government spending shock, we concentrate on bi-

[19]For this model, the eigenvalues of the matrix $A - BD^{-1}C$ in modulus are as follows: 1.6245, 1.6245, 0.9977, 0.7442, 0.7442, 0, 0, 0, 0, 0, 0.

variate VARs in consumption and *actual* government expenditure while solely plotting the impulse response for consumption with respect to a shock to the latter variable. In the standard VAR, we use a Cholesky decomposition to identify the structural shocks, where government spending is ordered first. In this simplified setting, this amounts to the identification scheme of Blanchard and Perotti (2002), where the consumption elasticity of government spending is assumed to be zero contemporaneously. Concerning the expectation augmented VAR, we proceed as described in the previous section. In both cases, we include a constant and four lags of the endogenous variables in the estimation.[20]

The results are presented in Figure 2. Each graph plots the response of consumption to a one standard deviation anticipated or unanticipated shock to government expenditure over a horizon of 20 periods. In the theoretical model, the response to both of those shocks is qualitatively the same. Consequently, and since our main focus is on the issue of fiscal foresight, we just show the theoretical impulse response resulting from the model for the anticipated shock to government expenditure, displayed in the first graph of the figure. The remaining plots show the corresponding impulse response function for the standard and expectation augmented VAR, respectively. In addition, the latter two graphs also display 68% bootstrap confidence intervals.[21] The timeline is normalized in such a way, that period 0 corresponds to the point in time when there is the actual change in government spending, potentially coinciding with an unanticipated shock to government expenditure. The starting point, however, is period -1, when in the theoretical model, which governs the data generating process, the news about an increase in government expenditure arrives. This corresponds to the anticipated government spending shock.[22]

In the theoretical model, even though government spending does not move

[20]This follows the specification of Ramey (2009). In her paper, she performs a similar exercise, in order to stress the importance of timing in a VAR. In particular, she compares two recursively identified VARs, where in the first estimation she uses *actual* government expenditure, G_t, and in the second one the *forecast* of that variable, $G_t^{F,j}$.

[21]In this regard, we follow the literature on the effects of fiscal policy shocks. See, for example, Blanchard and Perotti (2002) or Ramey (2009).

[22]The remaining theoretical impulse responses corresponding to a government expenditure shock are presented in Figure A-1 in the appendix. Note in particular, that all variables except government spending, of course, move immediately when the news about the shock arrives.

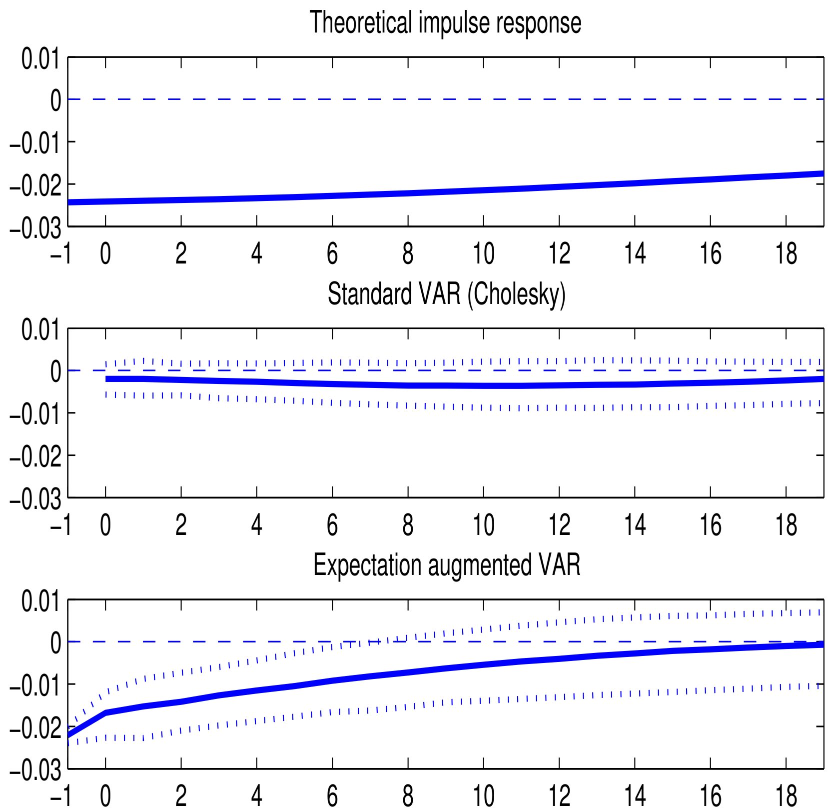

Figure 2: Theoretical and VAR impulse responses of consumption to a one standard deviation shock to government spending as well as 68% bootstrap confidence intervals.

until period 0, consumption reacts immediately upon arrival of the news, i.e., in period -1. Due to the negative wealth effect, consumption drops on impact followed by a slow increase. Such a response, however, does not result when estimating a standard VAR and employing the well-established identification approach of Blanchard and Perotti (2002). In particular note, that this conclusion is unaltered if instead an unanticipated government expenditure shock is considered, since the dynamic response in the theoretical model is qualitatively the same for both of those shocks.[23] The consumption response for the standard VAR is insignificant over the entire horizon, while the point estimate is basically zero on impact and then somewhat decreases. Such a result is in

[23]The latter comparison might be more appropriate, as a standard VAR is only able to identify a government spending shock which *immediately* leads to a change in government expenditure. The arrival of the news in this setup coincides with the actual change in the fiscal variable. Consequently, the impulse response of consumption in this case starts at period 0.

line with typical findings of the VAR approach concerning the effects of fiscal policy shocks. In this model, problems related to non-invertibility due to fiscal policy anticipation do not seem to be only a theoretical feature of the data, but have important consequences for empirical research. Reflecting Ramey's (2009) argument, when using standard VAR techniques, structural shocks are not identified correctly, invalidating the structural analysis in a qualitatively and quantitatively important way.[24]

Our expectation augmented VAR, on the other hand, seems to be able to align the information sets of the private agents and the econometrician. It correctly captures the response of consumption to the anticipated government spending shock (third graph of Figure 2), even in the case when foresight is not perfect but obscured by unanticipated fiscal shocks. Not only the sign and subsequent qualitative movement of consumption corresponds to the true response derived from the model, but also the estimated impulse response is very close to the theoretical one. The estimated impact response is -0.022 compared to -0.024 in the theoretical model. Moreover, a conventional 95 % confidence band includes the true impulse response for the entire horizon considered.

Overall, our expectation augmented VAR thus correctly captures the effects of an anticipated fiscal shock. It addresses the more complex informational structure of anticipated shocks within a VAR framework and delivers results closely matching the theoretical impulse responses. Opposed to standard approaches, it thus correctly takes into account the informational setup of the underlying data generating process, thereby rendering valid structural analysis feasible. In the next section, we apply our expectation augmented VAR to real-life data in order to investigate the impact of fiscal policy anticipation on the consumption response to a shock to total government expenditure and its subcomponents.

[24] As expected, these problems become less severe when the importance of unanticipated relative to anticipated government spending shocks is increased. Reducing the importance of fiscal foresight yields impulse responses for a standard VAR which are quite close to the theoretical ones.

4 Empirical investigation

4.1 Data and elasticities

With respect to the data of our empirical investigation, real private consumption, real GDP, as well as real government direct expenditure, and real government net revenue for the US are defined as in Blanchard and Perotti (2002).[25] The series are seasonally adjusted, in per capita terms, and we take logs. The frequency of the employed time series is crucial for the identification approach. In order to exclude the possibility of discretionary fiscal policy actions within one time period, quarterly data are used. The system is estimated in levels including a constant, a time trend, and a dummy to account for the large tax cut in 1975:2. The sample starts in 1947:1 and runs up to 2009:2. The number of lags for the VAR is chosen to be three as suggested by the Akaike information criterion (AIC). With respect to the output and consumption elasticities, we follow Blanchard and Perotti (2002) and assume that there is no automatic response of government spending in the current and the previous quarter, and that the consumption elasticities of net revenue are $2.08 * 0.6468$ and $0.16 * 0.6468$ for time t and $t-1$, respectively, where 2.08 and 0.16 are the output elasticities and 0.6468 is the average share of consumption in GDP over the sample period. We perform various robustness checks concerning these elasticities without any substantial change in results.[26]

4.2 Total government expenditure

The starting point of our empirical investigation is a VAR à la Blanchard and Perotti (2002), featuring highly aggregated fiscal variables. In order to investigate Ramey's (2009) hypothesis, that when fiscal policy anticipation is properly taken into account, the positive consumption response typically found in VAR studies will turn negative, our VAR models include real private consumption, real direct expenditure, and real net revenue as endogenous

[25]Figures A-2 and A-3 in the appendix plot the expenditure and tax to GDP ratio, respectively, as shown in Blanchard and Perotti (2002). The data are taken from the Bureau of Economic Analysis website (www.bea.gov).

[26]In particular, as do Blanchard and Perotti (2002), we also set the output elasticity of net revenue at $t-1$ to 0 and 0.5, and consequently the consumption elasticity to 0 and $0.5 * 0.6468$; see Section 5.

variables. In Figures 3 and 4, we present the responses of private consumption to a shock to government spending derived from a standard VAR and our expectation augmented VAR, respectively.[27] Both of those responses are basically insignificant. In the model which is not taking into account anticipation, however, consumption turns positive after the ninth quarter. Of course, the insignificant response stands somewhat in contrast to the paper by Blanchard and Perotti (2002). It should be noted, however, that we show the effect on private consumption, not GDP. Moreover, the respective sample periods under consideration are different. Whereas Blanchard and Perotti (2002) base their results on the sample 1960:1 – 1997:4, we not only use data also from the first decade of the new century but in addition include the 1950s. The latter period might be important, which we will discuss below. The main point, though, to be taken from this first set of results, is that at least at this highly aggregated level, taking into account anticipation issues does not overturn the results obtained from a standard VAR.

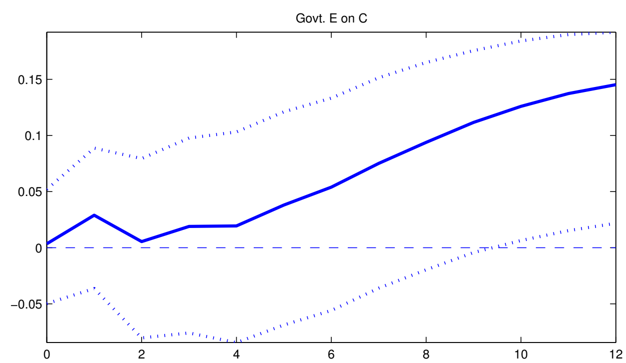

Figure 3: Reaction of private consumption to government expenditure shock. Standard SVAR model without anticipation. Sample: 1947q1-2009q2.

When considering a variable like real government direct expenditure, however, we are lumping together the different subcomponents of this variable, which could have very different effects on private consumption. For example, expenditure on education might have a different effect on economic activity than defense expenditure. Indeed, the crucial feature of models à la Baxter and King (1993) to generate a negative consumption response to an increase

[27]We plot the point estimate of the impulse response function as well as 68% bootstrap confidence bands based on 5000 replications. We show 68% confidence intervals to be comparable to the literature, e.g., Blanchard and Perotti (2002) or Ramey (2009). Moreover, the corresponding impulse response functions with respect to a shock to government revenue for the current and following specifications can be found in the appendix.

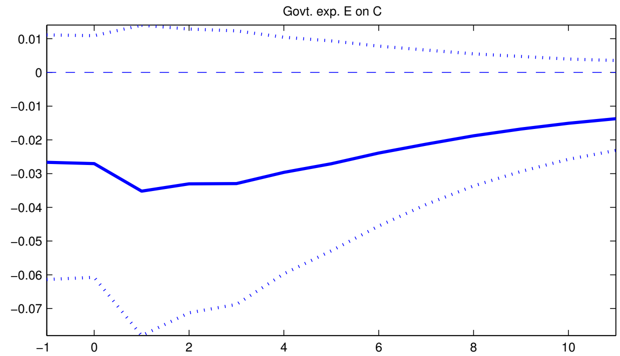

Figure 4: Reaction of private consumption to anticipated government expenditure shock. The shock occurs in period 0 and is anticipated in period -1. Sample: 1947q1-2009q2.

in government expenditure is, that the latter represents a withdrawal of resources from the economy, which does not substitute or complement private consumption nor contributes to production. Thus, even though government spending might affect utility, it does not influence private decisions except through the budget constraint. However, Baxter and King (1993) show that once government expenditure enters the production function, for example, an increase in this kind of spending can have very expansionary effects depending on the productivity of the good. Consequently, already in the framework of this model, we might expect public expenditure on non-defense items like education, infrastructure, or law enforcement, which probably contribute to aggregate productivity, to induce an increase in private consumption. Public spending on national defense, on the other hand, lacking any complementarity or substitutability with respect to private consumption or any contribution to the private production process, might lead to the opposite response.[28] In fact, a change in defense spending is probably the closest approximation to the standard policy experiment conducted in models like Baxter and King (1993), i.e., a setup where in particular unproductive government expenditure are considered. But when we combine those defense and non-defense items in a single variable and study its dynamic effects on private consumption, the respective individual responses might cancel and lead to such weak results as reported

[28]Following the same reasoning, Turnovsky and Fisher (1995) in their theoretical investigation of the macroeconomic effects of subcomponents of government spending, distinguish "government consumption expenditure" and "government infrastructure expenditure." The former includes items like national defense or social programs, whereas the latter consists of spending on roads, education, and job training, for example.

above.

Consequently, in order to avoid this blurring of results, we focus in the following on different subcomponents of government spending. In particular, we distinguish defense and non-defense expenditure. Considering defense spending is, of course, similar in spirit to Ramey's (2009) exercise of using dummy variables or other more sophisticated measures to capture large increases in government spending related to wars. Thus, we are able to check whether we can replicate Ramey's (2009) findings in an SVAR-based framework, when taking into account anticipation issues. Our method, however, is not confined to defense spending, so that we can also investigate the role of fiscal foresight when considering non-defense items of government expenditure.[29]

4.3 Defense expenditure

But first, we look at public expenditure on national defense, which exhibits some noticeable features, particularly compared to non-defense spending. Major movements in total US government expenditure since the 1950s are related to defense spending. Figure 5 shows that while real non-defense expenditure per capita has increased substantially, the increase is rather smooth and follows GDP growth. In contrast, defense spending moved considerably and is rather volatile reflecting the different engagements of the USA in international wars. Most notably, the 1950s are characterized by a strong increase in defense expenditure, mainly due to the Korean War build-up. As depicted in Figure 6, this military engagement, along with increased defense spending due to the cold war, led to an increase of the ratio of defense expenditure to GDP from less than 7 percent in 1948 to almost 15 percent in 1952.[30] Moreover, the

[29]We distinguish defense and non-defense spending and interpret them in terms of their respective degree of substitutability or complementarity or degree of productivity in the private production process in the spirit of Baxter and King (1993) and Turnovsky and Fisher (1995). Another strand of the literature highlights the importance of breaking total government spending down into purchases of goods and services and compensation of public employees (Rotemberg and Woodford 1992, Finn 1998, Forni, Monteforte, and Sessa 2009, Gomes 2009). Our focus, however, is on the different results of the narrative and SVAR approaches concerning the effects of fiscal policy and we therefore highlight defense and non-defense expenditure as subcomponents of total government spending.

[30]Concerning the choice of the sample period, we follow Ramey's (2008) argument and do not disregard the 1950s – including the Korean War – in the subsequent estimations. The Korean War, she forcefully argues, is an important source of variation in the data and should not be ignored. She notes that "[e]liminating the Korean War period from a study of the

correlation between the detrended series of total government spending and defense spending is 0.81, whereas it is only 0.39 for total government expenditure and non-defense spending.

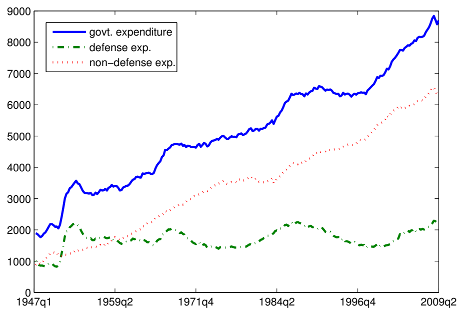

Figure 5: Real per capita government spending.

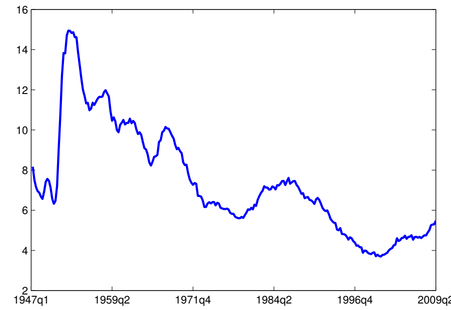

Figure 6: Ratio of defense expenditure to GDP.

Turning to the estimation results, Figure 7 shows the response of consumption to a shock to defense spending derived from a standard fiscal VAR in the spirit of Blanchard and Perotti (2002). Compared to the dynamic response to a shock to total government spending, the point estimate shifts markedly downwards, in line with our expectations derived from economic theory. However, it is mostly insignificant except for periods 3-5. In particular, the point estimate on impact is zero and not significant. A very different picture emerges, when the VAR is augmented with our new methodology to account for anticipation effects, depicted in Figure 8. The dynamic response of consumption is unambiguously negative over the entire horizon. In particular, we find that consumption falls on impact with a subsequent slow increase, exactly in line with standard economic models. Even though defense spending does not move before period 0, the private agents respond immediately when they learn about the shock, which occurs in period -1.

Thus, we can reconcile the narrative and SVAR approaches by replicating Ramey's (2009) findings in an SVAR-based framework. Our results are furthermore in line with Ramey's (2009) hypothesis, that the difference between those two approaches arises because standard VAR techniques fail to allow for anticipation issues. In order to see those effects clearly, however, it

effects of government spending shocks makes as much sense as eliminating the 1990s from a study of the effects of information technology." Not surprisingly, when disregarding the important period 1947-1959 in the following estimation, we obtain weaker results (Figures A-6 and A-7 in the appendix).

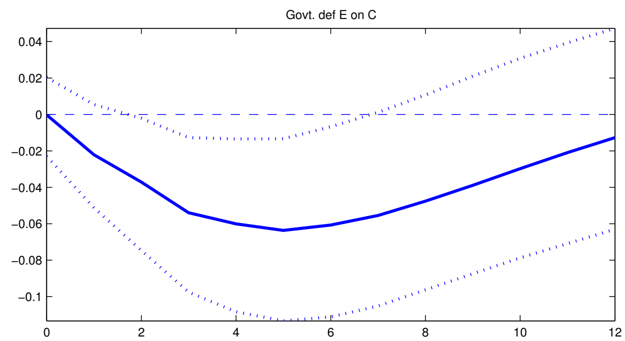

Figure 7: Reaction of private consumption to government defense expenditure shock. Standard SVAR model without anticipation. Sample: 1947q1-2009q2.

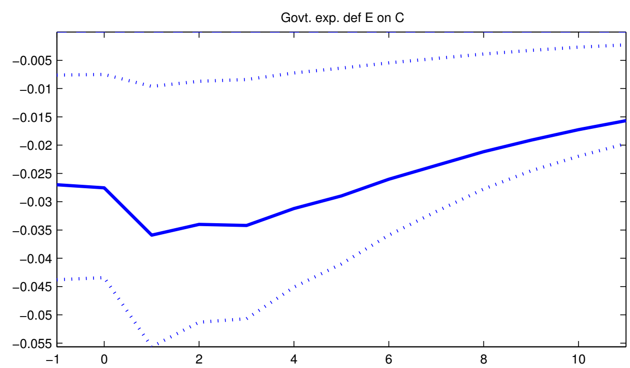

Figure 8: Reaction of private consumption to anticipated government defense expenditure shock. Sample: 1947q1-2009q2.

is necessary to look at more disaggregated variables to avoid interferences due to potentially different dynamic responses to other items of total government expenditure. All in all, our results underscore the need to appropriately take into account fiscal foresight in empirical research.

We can also look at these results from the viewpoint of the problems related to the misalignment of information sets of private agents and the econometrician due to fiscal policy anticipation. In those settings, even though we cannot obtain the true structural shocks from current and *past* endogenous variables, the system is invertible in current and *future* variables. Thus, as pointed out by Leeper, Walker, and Yang (2009), for example, it is possible to understand the two aforementioned approaches within the single framework of finding instruments for future variables. In this regard, it is encouraging that two different approaches of tackling those problems, in particular two different sets of instruments - “war dummies” on the one hand and future identified shocks to defense spending on the other - yield very similar results.

4.4 Non-defense expenditure

Next, we move to non-defense spending. As explained at the beginning of this section, we might expect private consumption to react differently to rather wasteful defense and potentially productive non-defense expenditure. Since private agents reoptimize and thus respond to new information as soon as it arrives regardless of whether it concerns defense or non-defense items of government spending, fiscal foresight is not confined to changes in the former variable. Thus, we move beyond Ramey's (2009) exercise and take advantage of the flexibility of our econometric approach, and investigate the consequences of fiscal policy anticipation for dynamic responses to non-defense expenditure.

In Figure 9, we plot the impulse-response function of private consumption to a shock to government expenditure, where the latter does not include defense spending. It is derived from a three variable VAR estimated over the entire sample period without taking into account anticipation. In this standard framework, we find a significantly positive consumption response after 6 quarters. Thus, the dynamics move broadly in the direction implied by economic theory. The point estimate, however, is still basically zero on impact and insignificant, and it takes a couple of quarters for the response to move significantly into positive territory. As Figure 10 makes clear, extending the VAR

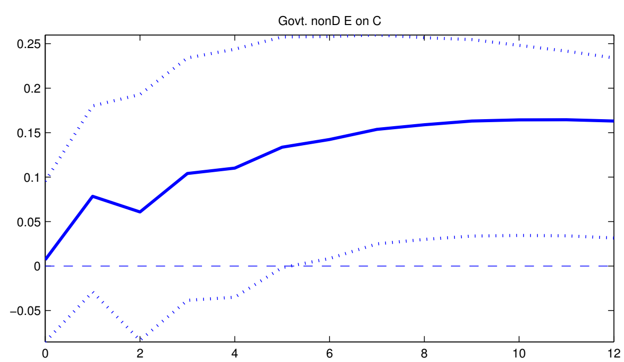

Figure 9: Reaction of private consumption to government non-defense expenditure shock. Standard SVAR model without anticipation. Sample: 1947q1-2009q2.

to allow for anticipation of fiscal shocks yields a different picture. We now find a significantly positive consumption response already in period -1, when the increase in non-defense expenditure is anticipated. Furthermore, the response stays significantly positive over the entire horizon under consideration, where after a peak in period 1 it declines steadily.

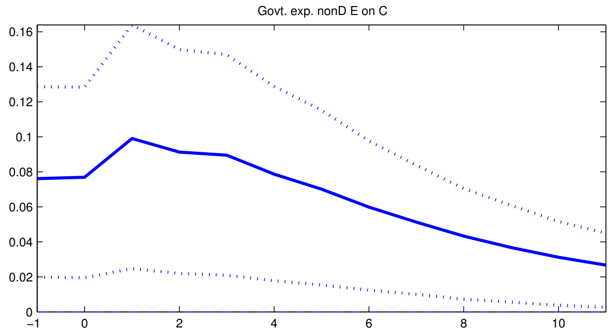

Figure 10: Reaction of private consumption to anticipated government non-defense expenditure shock. Sample: 1947q1-2009q2.

Analogous to the results obtained for defense spending, anticipation effects are also of empirical relevance when considering non-defense expenditure. This finding is in line with Ramey's (2009) overall argument, even though we obtain a significant *increase* in private consumption. Thus, it is important to distinguish the potentially different dynamic responses to the separate subcomponents of total government expenditure.

An unambiguously positive consumption response would be expected when considering the model of Baxter and King (1993) for the case of productive government expenditure, for example.[31] Given the opposite findings for defense and non-defense expenditure, the effects of fiscal policy when lumping together those two items in one fiscal aggregate are likely to be weak.

As a final analysis of this section, we take up another point made by Ramey (2009). She argues that aggregate VARs are not very good at capturing shocks to spending which is determined locally. Consequently, in order to make sure that our findings are not driven by the fact that large parts of non-defense expenditure are made by states and local authorities, we look at *federal* non-defense consumption spending.[32] As depicted in Figures 11 and 12, we find our previous results confirmed. In particular, the consumption response derived from our expectation augmented VAR is again significantly positive on impact and over the entire horizon. But also the dynamic response based on a standard

[31]Of course, this result is also in line with the model of Galí, López-Salido, and Vallés (2007), so that this particular set of impulse response functions is not particularly helpful in guiding modeling efforts.

[32]Please note, that since state and local governments do not have expenditure on national defense, federal defense spending equals total defense spending.

VAR is very similar. These results suggest that the difference between defense and non-defense spending is not determined by the fact that large parts of non-defense spending are made by states and local authorities.

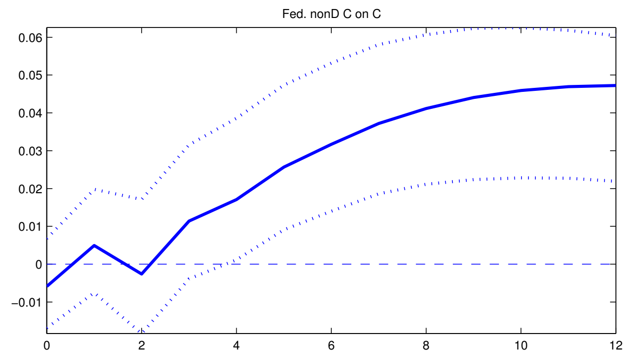

Figure 11: Reaction of private consumption to federal non-defense expenditure shock. Standard SVAR model without anticipation. Sample: 1947q1-2009q2.

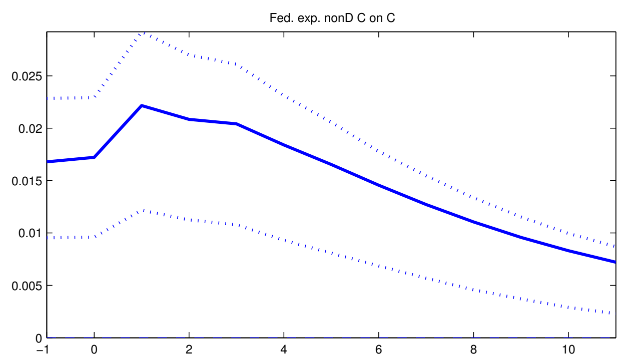

Figure 12: Reaction of private consumption to anticipated federal non-defense expenditure shock. Sample: 1947q1-2009q2.

All in all, our findings highlight the importance of taking into account fiscal foresight when studying empirically the dynamic effects of changes in fiscal policy on economic activity. Our results are in line with Ramey's (2009) hypothesis, that standard VARs fail to take into account anticipation issues and therefore yield incorrect inferences. Motivated by economic theory, we emphasize the need to look at different subcomponents of total government spending and show with our flexible approach that they have different effects on the macroeconomy. Lumping together the different items in a single fiscal aggregate blurs the results. For defense spending, we are able to replicate Ramey's (2009) findings of a decrease in private consumption in an SVAR-based framework and can thereby reconcile the narrative and SVAR approaches of studying the effects of fiscal policy. For non-defense spending, we also find an important role for fiscal policy anticipation, but in this case private consumption increases significantly. This result is exactly what would be expected when considering standard neoclassical or New-Keynesian models of fiscal policy for the case of productive public expenditure, for example.

Our findings also correspond to the results of the very recent papers by Kriwoluzky (2009) and Mertens and Ravn (2009). These authors also study the effects of fiscal foresight on the dynamic responses to government expenditure shocks.[33] Neither paper, however, looks at subcomponents of total government spending. By distinguishing defense and non-defense spending, we can put their findings into perspective and also qualify the result in an earlier version of this paper of a negative consumption response in an expectation augmented VAR (Tenhofen and Wolff 2007). For instance, similar to our finding for the consumption response to total government expenditure, Kriwoluzky (2009) also obtains a rather weak response in the first couple of quarters. Mertens and Ravn (2009), on the other hand, conclude based on their results that anticipation of fiscal policy does not alter the positive effects of fiscal policy on consumption and output. Finally, from the viewpoint of the problems related to the misalignment of information sets due to fiscal foresight, we find encouraging that different approaches of tackling these problems, in particular different sets of instruments, yield basically the same results. In the next section, we turn to the robustness of our findings.

5 Robustness checks

First, we want to make sure that our results are not driven by the omission of other, potentially important macroeconomic variables. In particular, we consider adding measures of real output and/or a short-term interest rate to the specifications mentioned above.

With respect to the latter variable, while Blanchard and Perotti (2002) also do not control for short-term interest rates, follow-up papers by Perotti add such a variable to a standard fiscal SVAR. Since monetary policy is not

[33]The former employs sign restrictions derived from a DSGE model to identify the structural shocks of a vector MA (VMA) model estimated by likelihood methods. The latter consider a vector error-correction model (VECM) and use Blaschke matrices as suggested by Lippi and Reichlin (1993, 1994) to obtain non-fundamental innovations.

orthogonal to fiscal policy, its inclusion might alter our results. We therefore extend our SVAR approach to also feature a short-term interest rate. In particular, following Giordano, Momigliano, Neri, and Perotti (2007) and Tenhofen, Wolff, and Heppke-Falk (2010), we assume a recursive ordering for the equations of the non-fiscal variables. Accordingly, whereas consumption is assumed not to react to the short-term interest rate contemporaneously, this is not true vice versa. This ordering assumption, reflecting the more sluggish nature of consumption compared to financial variables like interest rates, is common practice in the monetary VAR literature. Furthermore, when estimating the interest-rate equation, we have to add to the set of instruments the structural shock to consumption, v_t^c, obtained from the consumption equation, in order to get unbiased estimates. Apart from that, the additional equation for the interest rate also includes expectation terms of the fiscal variables, in order to be consistent with our assumption of fiscal policy anticipation.[34]

With respect to data, in our estimation we use the 3-month T-bill rate.[35] Concerning the (semi-)elasticities, we follow Perotti (2005) in assuming that government spending does not react to changes in the interest rate in the current and also in the previous quarter. Indeed, the government spending variable does not include interest payments. Regarding the impact on revenue, we also follow Perotti (2005) and assume no contemporaneous response, but also no response to movements in the interest rate in period $t-1$. However, we checked robustness of the results to changes in these elasticities. Our findings are not altered in substance and available from the authors.

Figures 13 and 14 show the results for a defense expenditure shock once the respective specification is extended to control for the 3-month T-bill rate. As in the benchmark case, we find consumption to fall on impact in our expectation augmented SVAR, while in the case of the standard SVAR it is insignificant on impact. Furthermore, the resulting impulse responses are quite similar to the ones arising in the corresponding three-variable benchmark case. Thus, the inclusion of an interest rate does not significantly alter the effects of government defense spending on private consumption.

[34]For more details on the estimation when the block of non-fiscal variables includes more than one variable, see Giordano, Momigliano, Neri, and Perotti (2007) and Tenhofen, Wolff, and Heppke-Falk (2010).

[35]The corresponding time series is taken from the FRED database of the Federal Reserve Bank of St. Louis.

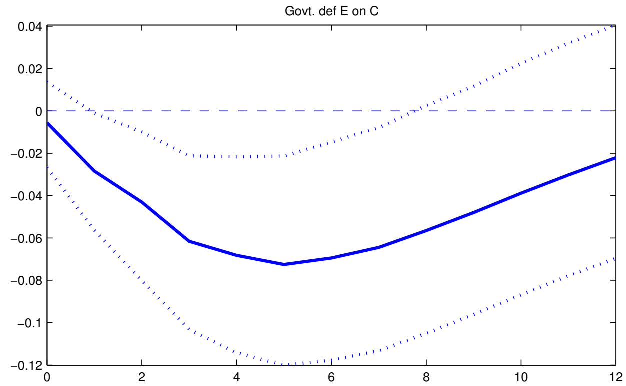

Figure 13: Reaction of private consumption to government defense expenditure shock. Standard SVAR model without anticipation. VAR includes 3-month T-bill rate. Sample: 1947q1-2009q2.

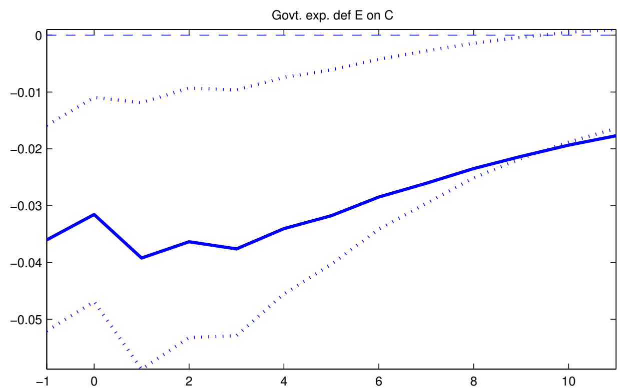

Figure 14: Reaction of private consumption to anticipated government defense expenditure shock. VAR includes 3-month T-bill rate. Sample: 1947q1-2009q2.

Next, we consider the effects of including real GDP in addition to the 3-month T-bill rate and the three variables of our specification focusing on defense spending, i.e., real private consumption, real government defense expenditure, as well as real government net revenue. GDP and private consumption are two closely linked variables. The SVAR approach up to now did not control for the developments of the former variable. It is therefore possible that our results are spuriously driven by the omission of this important determinant of private consumption as well as of government activity. We therefore extend the specification of the preceding paragraph to also control for real GDP per capita. This extension is analogous to the one just discussed, where we assume that output does not react contemporaneously to consumption and the short-term interest rate, whereas consumption does react to developments in output within the same period, but not to movements in the interest rate. The latter variable, in turn, is considered to be the least sluggish one among the non-fiscal variables, so that it is assumed to react to both output and consumption contemporaneously.[36] Whereas the assumption with respect to the interest rate is probably uncontroversial, the ordering of the other two variables might be less so. Consequently, in order to check the robustness of our findings, we changed the ordering of output and consumption in our estimation. However, this does not affect our results. As already indicated in Section 4, with respect to the output elasticities, we assume the same values as in Blanchard and Perotti (2002), which are furthermore in line with our assumptions concerning the consumption elasticities.

Considering Figure 15, we indeed find, in line with standard economic theory as well as our previous results, that shocks to government defense expenditure lead to a decrease in private consumption in our expectation augmented VAR, even when controlling for output per capita, where the consumption response is also quantitatively of similar size. Thus, the inclusion of GDP does not affect our main results.[37]

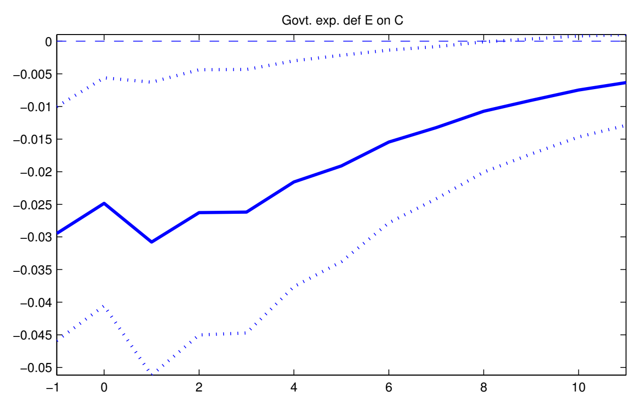

Figure 15: Reaction of private consumption to anticipated government defense expenditure shock. VAR includes GDP and 3-month T-bill rate. Sample: 1947q1-2009q2.

When looking at non-defense expenditure, we also find our main results

[36]Note, that in the estimation of the consumption equation, we have to extend the set of instruments to include the structural shock to output, v_t^y. When estimating the interest-rate equation, we furthermore have to add the structural shock to consumption, v_t^c.

[37]The corresponding graph for the standard fiscal VAR is also basically unchanged and given in the appendix (Figure A-16).

confirmed (Figures 16 to 18).[38] The inclusion of a short-term interest rate or GDP does not alter the previous findings. Consumption increases, in particular on impact, in response to a non-defense spending shock in our expectation augmented VAR. In the standard VAR, on the other hand, consumption only increases after a couple of periods and the point estimate is basically zero on impact and insignificant.

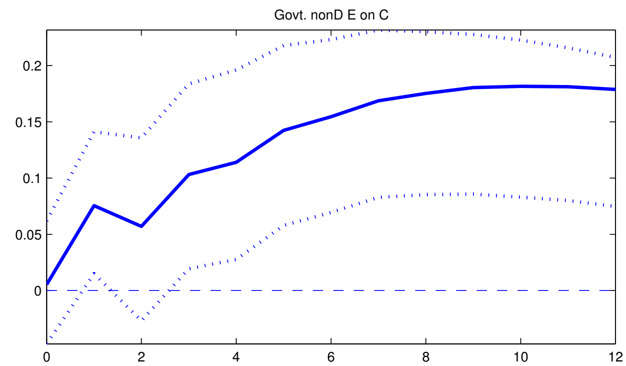

Figure 16: Reaction of private consumption to government non-defense expenditure shock. Standard SVAR model without anticipation. VAR includes 3-month T-bill rate. Sample: 1947q1-2009q2.

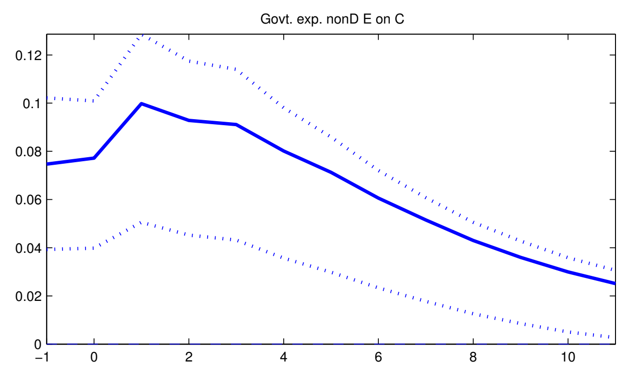

Figure 17: Reaction of private consumption to anticipated government non-defense expenditure shock. VAR includes 3-month T-bill rate. Sample: 1947q1-2009q2.

Our final robustness check focuses on the elasticities. First, in our specification featuring defense expenditure, we set the elasticity of revenue to private consumption at $t-1$ to zero. Figure A-18 in the appendix shows that the negative consumption response is unaffected. Increasing this elasticity to

[38]The graph concerning the standard VAR when including real GDP as well as a short-term interest rate is again given in the appendix (Figure A-17).

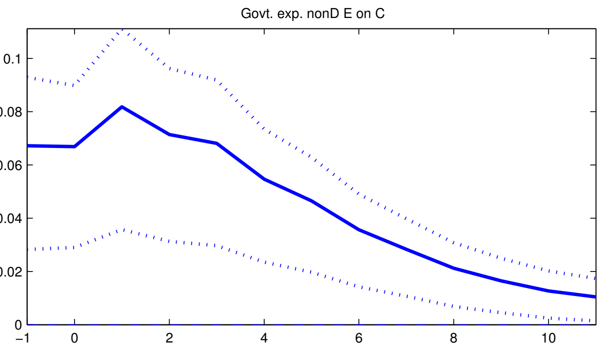

Figure 18: Reaction of private consumption to anticipated government non-defense expenditure shock. VAR includes GDP and 3-month T-bill rate. Sample: 1947q1-2009q2.

$(0.5 * 0.6468)$ yields Figure A-19, where the response to a shock to defense spending also remains negative and significant. Next, when doing the same exercise based on our specification featuring non-defense expenditure, we also find our previous results confirmed. Regardless whether we use an elasticity of revenue to private consumption at $t-1$ of zero or $(0.5 * 0.6468)$, private consumption increases significantly on impact and over the entire horizon considered (Figures A-20 and A-21 in the appendix). Furthermore, using the tax revenue elasticity to GDP as the elasticity of tax revenue to consumption does not change the results (Figures A-22 to A-25 in the appendix). All in all, even when adding macroeconomic variables to the system or when changing the exogenous elasticities needed to identify the SVAR, we clearly find our previous findings confirmed.

6 Conclusions

How does private consumption react to public expenditure shocks? In this paper, we develop a new SVAR approach which allows for anticipation of fiscal policy shocks. Our goal is to avoid problems encountered by standard VARs and align the information sets of the private agents and the econometrician, which makes valid structural analysis feasible. We are able to exactly capture a situation, where private agents perfectly know fiscal shocks one period in advance. Even though our method is not general in the sense of being applicable in the presence of all possible kinds of information flows, the findings of our simulation exercise document that our approach is robust to situations with a potentially different information structure. When confronted with data simulated from a model featuring fiscal foresight and an equilibrium process with a non-invertible MA component, our new method correctly captures macroeconomic dynamics. In contrast, standard VARs do not capture the dynamics properly. This performance is even more noticeable as our economic model features both anticipated and unanticipated fiscal shocks, so that private agents only have imperfect foresight, which makes it more difficult for our method to trace out the individual dynamic effects.

The empirical investigation highlights the importance of taking into account anticipation issues in fiscal VAR studies. In contrast to the rather weak and mostly insignificant consumption responses in a standard VAR in the spirit of Blanchard and Perotti (2002), our expectation augmented VAR yields unambiguous responses. In this regard, we show that it is important to distinguish subcomponents of total government spending, which might have different effects on the macroeconomy. This focus on more disaggregated variables is facilitated by the flexibility of our econometric approach and allows us to qualify recent findings in the literature. Considering total government expenditure, on the other hand, does not yield clear-cut results. This is due to the fact that when considering this aggregate, we lump together subcomponents with potentially different effects on the macroeconomy.

The response of private consumption to a shock to defense spending in our expectation augmented VAR corresponds to Ramey's (2009) finding of a negative consumption response. Thus, we are able to reconcile the narrative and SVAR approaches of studying the effects of fiscal policy. Non-defense spending, on the other hand, yields a significantly positive response of private consumption. All in all, our findings are in line with Ramey's (2009) overall argument, that standard VAR techniques fail to allow for anticipation issues which invalidates the structural analysis. Moreover, the results reported for the expectation augmented VAR are what would be expected when considering standard macroeconomic models for different degrees of productivity of public expenditure. Defense and non-defense spending are very different in nature, where the latter has a more productive character.

References

BAXTER, M., AND R. G. KING (1993): "Fiscal Policy in General Equilibrium," *The American Economic Review*, 83(3), 315–334.

BIAU, O., AND E. GIRARD (2005): "Politique Budgétaire et Dynamique Économique En France: L'approche VAR Structurelle," *Economie et Prévision*, 169-71, 1–24.

BLANCHARD, O., AND R. PEROTTI (2002): "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output," *Quarterly Journal of Economics*, 117 (4), 1329–68.

BURNSIDE, C., M. EICHENBAUM, AND J. D. M. FISHER (2004): "Fiscal Shocks and their Consequences," *Journal of Economic Theory*, 115(1), 89–117.

DE CASTRO, F., AND P. H. DE COS (2008): "The Economic Effects of Fiscal Policy: The Case of Spain," *Journal of Macroeconomics*, 30(3), 1005–1028.

DEVEREUX, M. B., A. C. HEAD, AND B. J. LAPHAM (1996): "Monopolistic Competition, Increasing Returns, and the Effects of Government Spending," *Journal of Money, Credit and Banking*, 28(2), 233–254.

EDELBERG, W., M. EICHENBAUM, AND J. D. M. FISHER (1999): "Understanding the Effects of a Shock to Government Purchases," *Review of Economic Dynamics*, 2(1), 166–206.

FATÁS, A., AND I. MIHOV (2001): "The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence," *CEPR discussion paper*, No. 2760, Centre for Economic Policy Research, London.

FERNÁNDEZ-VILLAVERDE, J., J. F. RUBIO-RAMÍREZ, T. J. SARGENT, AND M. W. WATSON (2007): "ABCs (and Ds) of Understanding VARs," *The American Economic Review*, 97(3), 1021–1026.

FINN, M. G. (1998): "Cyclical Effects of Government's Employment and Goods Purchases," *International Economic Review*, 39(3), 635–657.

FISHER, J. D. M. (2006): "The Dynamic Effects of Neutral and Investment-Specific Technology Shocks," *The Journal of Political Economy*, 114(3), 413–451.

Forni, L., L. Monteforte, and L. Sessa (2009): "The general equilibrium effects of fiscal policy: Estimates for the Euro area," *Journal of Public Economics*, 93(3-4), 559–585.

Galí, J., J. D. López-Salido, and J. Vallés (2007): "Understanding the Effects of Government Spending on Consumption," *Journal of the European Economic Association*, 5(1), 227–270.

Giordano, R., S. Momigliano, S. Neri, and R. Perotti (2007): "The Effects of Fiscal Policy in Italy: Estimates from a VAR Model," *European Journal of Political Economy*, 23, 707–733.

Gomes, P. (2009): "Fiscal Policy and the Labour Market: the Effects of Public Sector Employment and Wages," *London School of Economics, mimeo.*

Greenwood, J., Z. Hercowitz, and G. W. Huffman (1988): "Investment, Capacity Utilization, and the Real Business Cycle," *The American Economic Review*, 78(3), 402–417.

Greenwood, J., Z. Hercowitz, and P. Krusell (1997): "Long-Run Implications of Investment-Specific Technological Change," *The American Economic Review*, 87(3), 342–362.

——— (2000): "The role of investment-specific technological change in the business cycle," *European Economic Review*, 44, 91–115.

Hamilton, J. D. (1994): *Time Series Analysis*. Princeton University Press, Princeton, New Jersey.

Hansen, L. P., and T. J. Sargent (1980): "Formulating and Estimating Dynamic Linear Rational Expectations Models," *Journal of Economic Dynamics & Control*, 2, 7–46.

——— (1991): "Two Difficulties in Interpreting Vector Autoregressions," in *Rational Expectations Econometrics*, ed. by L. P. Hansen, and T. J. Sargent, pp. 77–119. Westview Press.

In, F., and J. H. Yoon (2007): "Determination of asset prices with an investment-specific technology model: Implications for the equity premium puzzle," *Journal of Economic Dynamics & Control*, 31, 2637–2658.

Kriwoluzky, A. (2009): "Pre-Announcement and Timing – the Effects of a Government Expenditure Shock," *European University Institute, mimeo.*

Leeper, E. M., T. B. Walker, and S.-C. S. Yang (2009): "Fiscal Foresight and Information Flows," *Indiana University, mimeo.*

Linnemann, L., and A. Schabert (2003): "Fiscal Policy in the New Neoclassical Synthesis," *Journal of Money, Credit, and Banking*, 35(6), 911–29.

Lippi, M., and L. Reichlin (1993): "The Dynamic Effects of Aggregate Demand and Supply Disturbances: Comment," *The American Economic Review*, 83(3), 644–652.

——— (1994): "VAR analysis, nonfundamental representations, Blaschke matrices," *Journal of Econometrics*, 63(1), 307–325.

Mertens, K., and M. O. Ravn (2009): "Measuring the Impact of Fiscal Policy in the Face of Anticipation: a Structural VAR Approach," *CEPR Discussion Paper*, No. 7423, Centre for Economic Policy Research, London.

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

Perotti, R. (2005): "Estimating the Effects of Fiscal Policy in OECD Countries," *CEPR Discussion Paper Series*, No. 4842, Centre for Economic Policy Research, London.

——— (2008): "In Search of the Transmission Mechanism of Fiscal Policy," in *NBER Macroeconomics Annual 2007*, ed. by D. Acemoglu, K. Rogoff, and M. Woodford, vol. 22, pp. 169–226. University of Chicago Press.

Quah, D. (1990): "Permanent and Transitory Movements in Labor Income: An Explanation for "Excess Smoothness" in Consumption," *The Journal of Political Economy*, 98(3), 449–475.

Ramey, V. A. (2008): "Comment," in *NBER Macroeconomics Annual 2007*, ed. by D. Acemoglu, K. Rogoff, and M. Woodford, vol. 22, pp. 237–246. University of Chicago Press.

——— (2009): "Identifying Government Spending Shocks: It's All in the Timing," *University of California, San Diego, mimeo.*

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

Romer, C. D., and D. H. Romer (1989): "Does Monetary Policy Matter? A New Test in the Spirit of Friedman and Schwartz," in *NBER Macroeconomics Annual 1989*, ed. by O. J. Blanchard, and S. Fischer, vol. 4, pp. 121–170. University of Chicago Press.

——— (2009): "The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks," *The American Economic Review, forthcoming.*

Rotemberg, J. J., and M. Woodford (1992): "Oligopolistic Pricing and the Effects of Aggregate Demand on Economic Activity," *The Journal of Political Economy*, 100(6), 1153–1207.

Sims, C. A., and T. Zha (2006): "Does Monetary Policy Generate Recessions?," *Macroeconomic Dynamics*, 10, 231–272.

Tenhofen, J., and G. B. Wolff (2007): "Does Anticipation of Government Spending Matter? Evidence from an Expectation Augmented VAR," *Deutsche Bundesbank Discussion Paper*, No. 14/2007, Deutsche Bundesbank, Frankfurt am Main.

Tenhofen, J., G. B. Wolff, and K. H. Heppke-Falk (2010): "The Macroeconomic Effects of Exogenous Fiscal Policy Shocks in Germany: A Disaggregated SVAR Analysis," *Journal of Economics and Statistics, forthcoming.*

Townsend, R. M. (1983): "Forecasting the Forecasts of Others," *The Journal of Political Economy*, 91(4), 546–588.

Turnovsky, S. J., and W. H. Fisher (1995): "The composition of government expenditure and its consequences for macroeconomic performance," *Journal of Economic Dynamics & Control*, 19(4), 747–786.

A Appendix

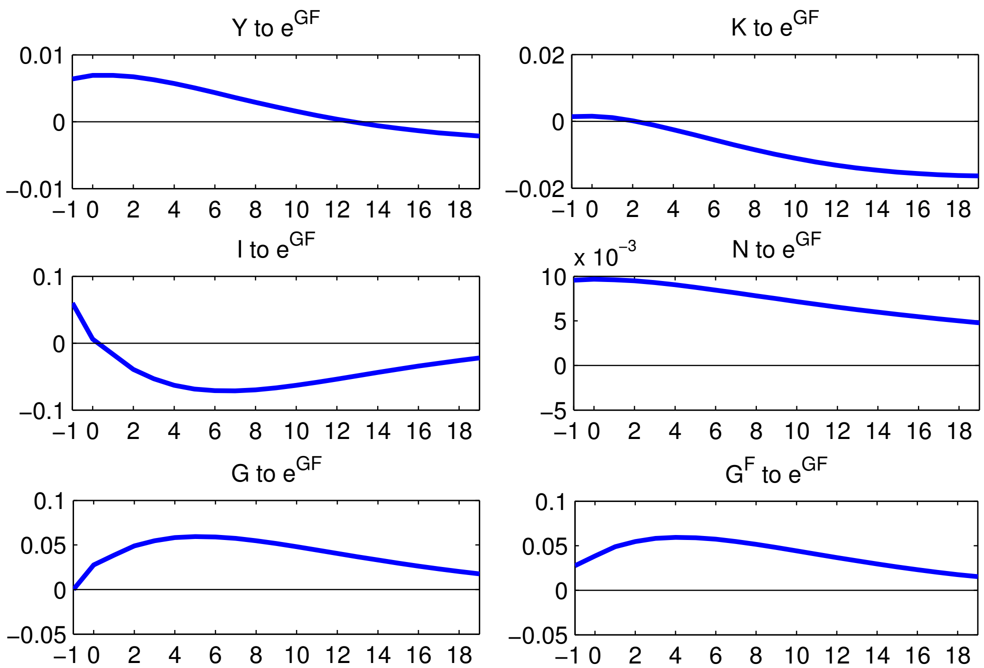

Figure A-1: Theoretical impulse responses to a one standard deviation anticipated shock to government spending.

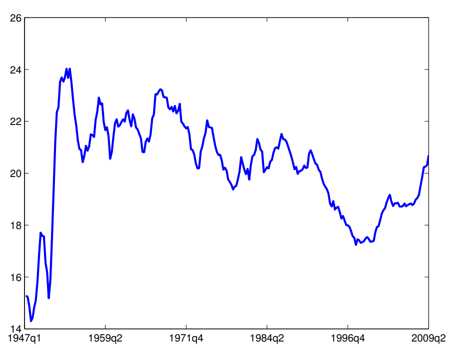

Figure A-2: Government direct expenditure to GDP ratio.

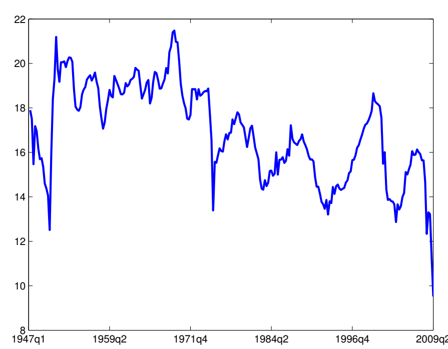

Figure A-3: Government net revenue to GDP ratio.

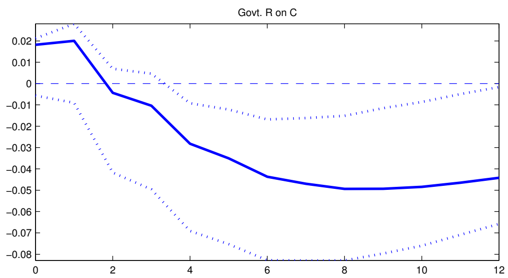

Figure A-4: Reaction of private consumption to government revenue shock. Standard SVAR model without anticipation. Sample: 1947q1-2009q2.

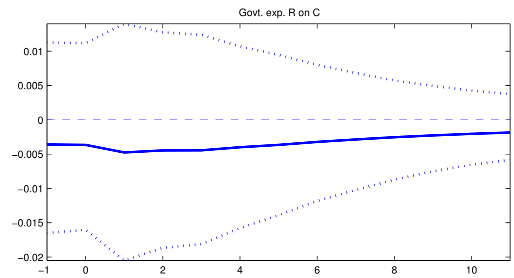

Figure A-5: Reaction of private consumption to anticipated government revenue shock. Sample: 1947q1-2009q2.

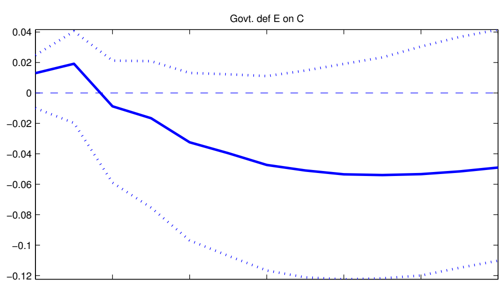

Figure A-6: Reaction of private consumption to government defense expenditure shock. Standard SVAR model without anticipation. Sample: 1960q1-2009q2.

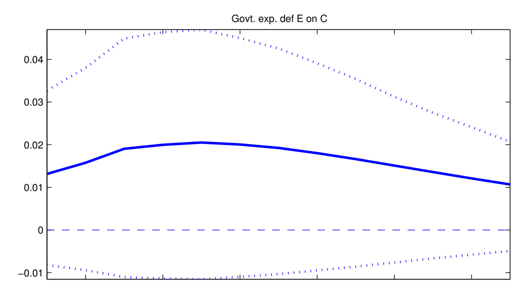

Figure A-7: Reaction of private consumption to anticipated government defense expenditure shock. Sample: 1960q1-2009q2.

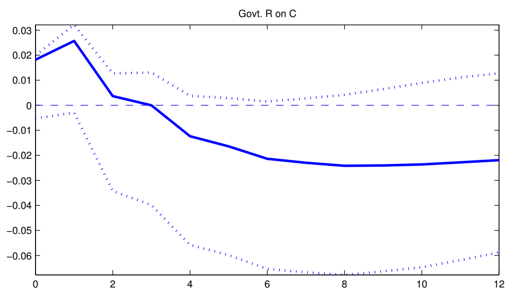

Figure A-8: Reaction of private consumption to government revenue shock. Standard SVAR model without anticipation. Sample: 1947q1-2009q2, model including defense spending.

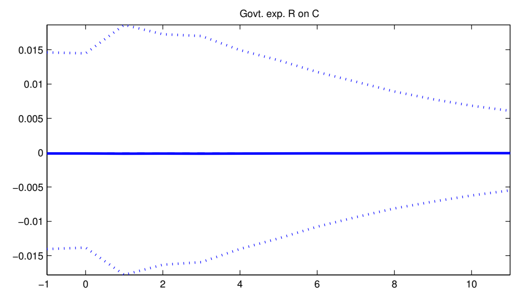

Figure A-9: Reaction of private consumption to anticipated government revenue shock. Sample: 1947q1-2009q2, model including defense spending.

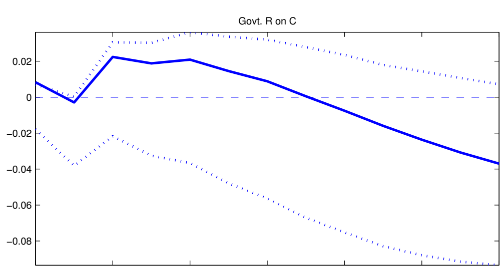

Figure A-10: Reaction of private consumption to government revenue shock. Standard SVAR model without anticipation. Sample: 1960q1-2009q2, model including defense spending.

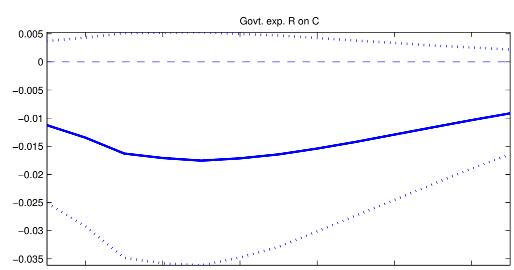

Figure A-11: Reaction of private consumption to anticipated government revenue shock. Sample: 1960q1-2009q2, model including defense spending.

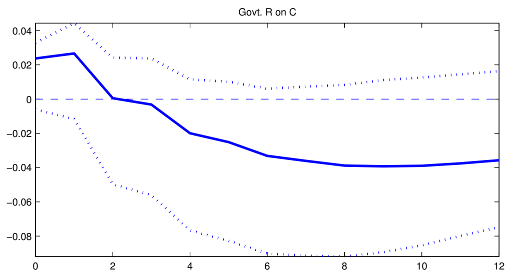

Figure A-12: Reaction of private consumption to government revenue shock. Standard SVAR model without anticipation. Sample: 1947q1-2009q2, model including non-defense spending.

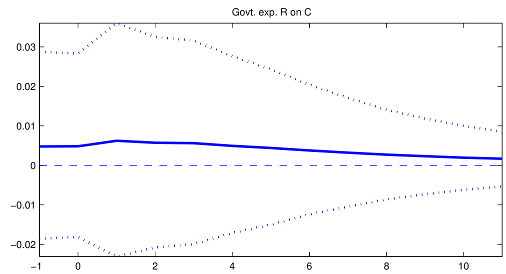

Figure A-13: Reaction of private consumption to anticipated government revenue shock. Sample: 1947q1-2009q2, model including non-defense spending.

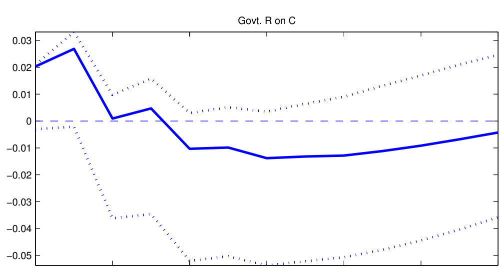

Figure A-14: Reaction of private consumption to government revenue shock. Standard SVAR model without anticipation. Sample: 1947q1-2009q2, model including federal non-defense spending.

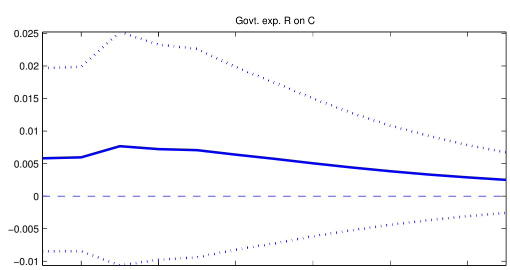

Figure A-15: Reaction of private consumption to anticipated government revenue shock. Sample: 1947q1-2009q2, model including federal non-defense spending.

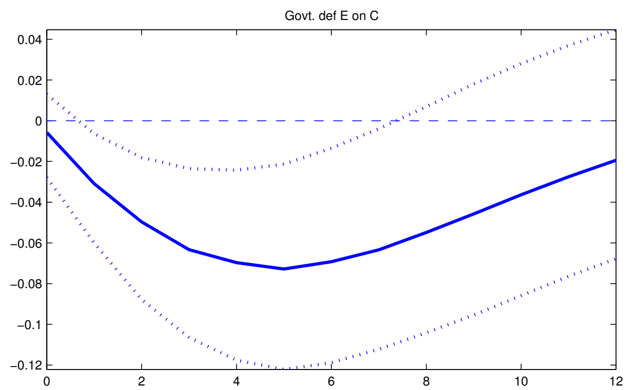

Figure A-16: Reaction of private consumption to government defense expenditure shock. Standard SVAR model without anticipation. VAR includes GDP and 3-month T-bill rate. Sample: 1947q1-2009q2.

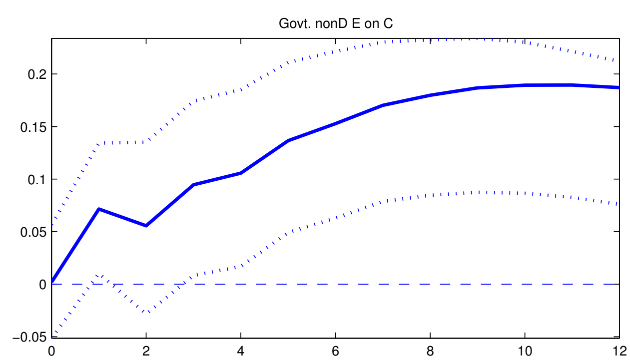

Figure A-17: Reaction of private consumption to government non-defense expenditure shock. Standard SVAR model without anticipation. VAR includes GDP and 3-month T-bill rate. Sample: 1947q1-2009q2.

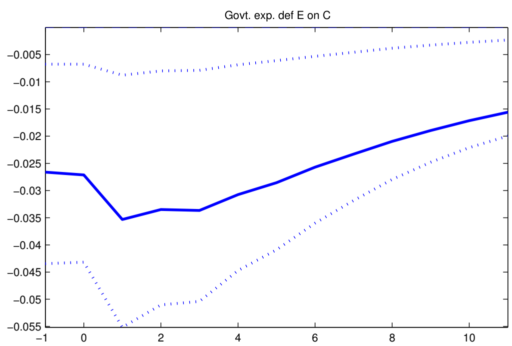

Figure A-18: Reaction of private consumption to anticipated government defense expenditure shock. Sample: 1947q1-2009q2, elasticity of tax revenue to consumption at $t-1$: 0.

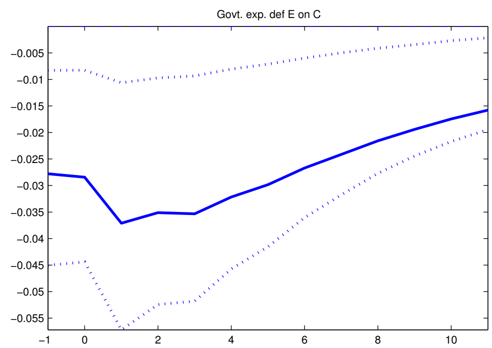

Figure A-19: Reaction of private consumption to anticipated government defense expenditure shock. Sample: 1947q1-2009q2, elasticity of tax revenue to consumption at $t-1$: 0.5*0.6468.

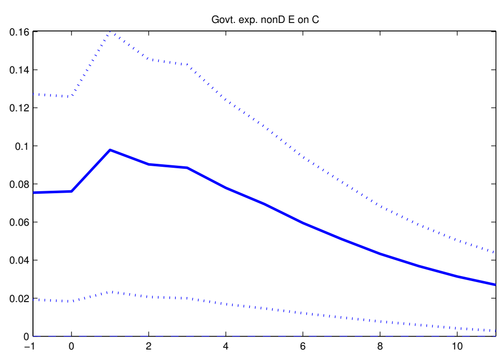

Figure A-20: Reaction of private consumption to anticipated government non-defense expenditure shock. Sample: 1947q1-2009q2, elasticity of tax revenue to consumption at $t-1$: 0.

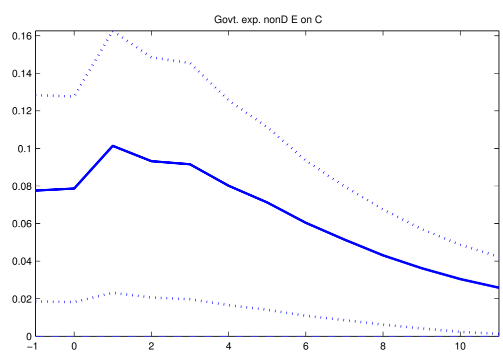

Figure A-21: Reaction of private consumption to anticipated government non-defense expenditure shock. Sample: 1947q1-2009q2, elasticity of tax revenue to consumption at $t-1$: 0.5*0.6468.

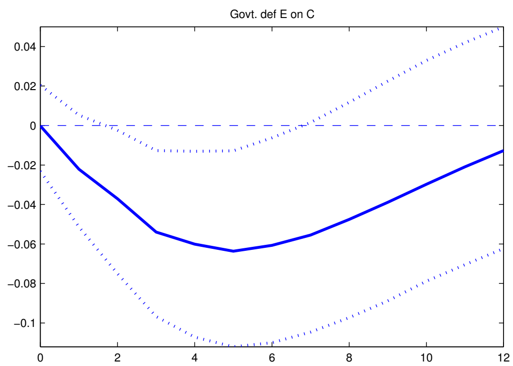

Figure A-22: Reaction of private consumption to government defense expenditure shock. Standard SVAR model without anticipation. Sample: 1947q1-2009q2, elasticity of tax revenue to consumption at t: 2.08.

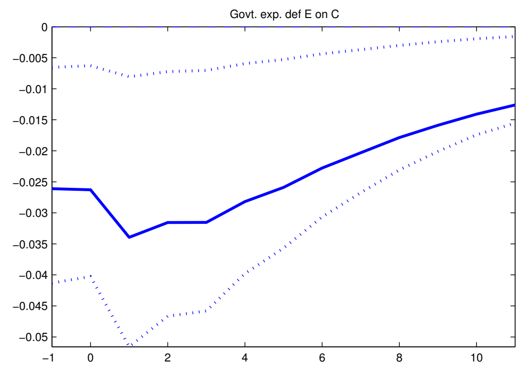

Figure A-23: Reaction of private consumption to anticipated government defense expenditure shock. Sample: 1947q1-2009q2, elasticity of tax revenue to consumption at t: 2.08.

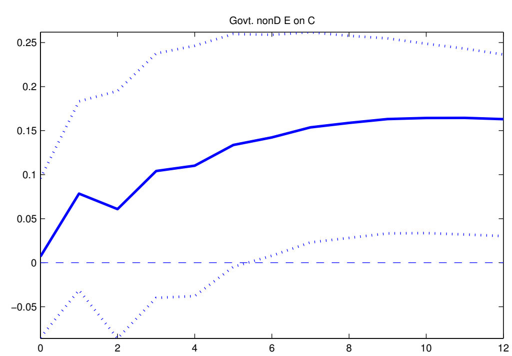

Figure A-24: Reaction of private consumption to government non-defense expenditure shock. Standard SVAR model without anticipation. Sample: 1947q1-2009q2, elasticity of tax revenue to consumption at t: 2.08.

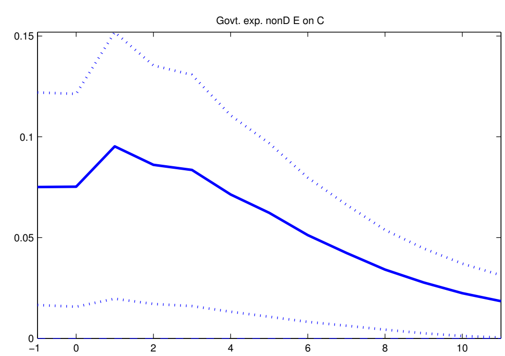

Figure A-25: Reaction of private consumption to anticipated government non-defense expenditure shock. Sample: 1947q1-2009q2, elasticity of tax revenue to consumption at t: 2.08.