Government Spending Shocks and Private Activity: The Role of Sentiments

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Abstract

This paper studies the dynamic effects of the fiscal policy shock on private activity using an array of vector autoregressive models for the post-war US data. We are particularly interested in the role of consumer sentiment in the transmission of the government spending shock. Our major findings are as follows. Private consumption and investment fail to rise persistently in response to positive spending shocks especially when shocks are anticipated, while they exhibit persistent and significant increases when the sentiment shock occurs. Employment and real wages in the private sector also respond significantly positively only to the sentiment shock. Consumer sentiment responds negatively to a positive fiscal shock, resulting in subsequent decreases in private activity. That is, our empirical findings imply that the government spending shock generates consumer pessimism, which then weakens the effectiveness of the fiscal policy. We further strengthen our claims via counterfactual simulation exercises.

Keywords: Government Spending; Consumer Sentiment; Private Activity; Sentiment Channel; Vector Autoregressive; Expectational VAR; Survey of Professional Forecasters; Threshold VAR; Counterfactual Simulations

JEL Classification: E32; E62

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1 Introduction

Observing the sluggish recovery from the recent Great Recession, the economics profession has revived the debate on the effectiveness of the fiscal policy in stimulating economic activity. Can increases in government spending help promote private sector activity? And if so, will key variables of interest such as consumption, investment, employment, and real wages respond persistently positively to expansionary fiscal policy?

There is a large literature on this issue. One group of researchers reports positive responses of consumption, real wages, and output to expansionary fiscal shocks, which are consistent with the New Keynesian macroeconomic model in general. See, among others, Rotemberg and Woodford (1992), Devereux, Head, and Laphan (1996), Fatas and Mihov (2001), Blanchard and Perotti (2002), Perotti (2005), Galí, López-Salido, and Vallés (2007).

On the contrary, many other research works provide strong evidence of negative responses of consumption and real wages to fiscal spending shocks. See, for example, Aiyagari, Chirstiano, and Eichenbaum (1992), Hall (1986), Ramey and Shapiro (1998), Edelberg, Eichenbaum, and Fisher (1999), Burnside, Eichenbaum, and Fisher (2004), Cavallo (2005), Mountford and Uhlig (2009), Ramey (2012), and Owyang, Ramey, and Zubairy (2013). As Ramey (2011) explains, these negative responses to an expansionary government spending shock are consistent with a negative wealth effect that often appears in the neoclassical macroeconomic model such as Aiyagari, Christiano, and Eichenbaum(1992) and Baxter and King (1993).[1]

One related literature focuses on the output multiplier of government spending. Empirical evidence is again mixed. For instance, Ramey and Shapiro (1998), Hall (2009), Barro and Redlick (2011), and Ramey (2011) obtained fairly low, say less than one, government spending multiplier estimates, while Hall (2009) and Christiano, Eichenbaum, and Rebelo (2009) show that fiscal multipliers can be high when the nominal interest rate is bounded at zero. Overall, the range of fiscal multiplier estimates in the literature is very wide (Ramey, 2011). Also, fiscal multiplier estimates seem to vary greatly across countries depending on key country characteristics such as the exchange rate regime and public indebtedness. See Corsetti, Meier, and Müller (2012)

[1]Increases in government spending may result in a negative wealth effect because government deficits may have to be financed by tax hikes in the future. Rational consumers reduce consumption and increase labor supply in response to spending shocks, resulting in a decrease in the real wage. Note that such responses would occur even when government raises revenues by non-distortionary lump-sum tax.

and Ilzetxki, Mendoza, and Vegh (2013) for details.

Another interesting question is whether the government spending shock is more powerful during times of slack. Again, empirical evidence is mixed. For example, Auerbach and Gorodnichenko (2012), Mittnik and Semmler (2012), and Fazzari, Morley, and Panovska (2013) report much higher fiscal multipliers in a regime of a low economic activity than those in a high regime activity, whereas Owyang, Ramey, and Zubairy (2013) and Ramey and Zubairy (2014) find no such evidence.

Observing such mixed empirical evidence on the effectiveness of fiscal stimulus, we study how the government spending shock influences private activity in the US. Finding negligibly weak or even negative responses of private activity to the fiscal spending shock, we introduce and highlight the role of consumer *sentiment* in the propagation of expansionary fiscal shocks to promote economic activity.

We are not the first who discussed the interaction between consumer sentiment and economic activity. Hall (1993) and Blanchard (1993), for example, underline the causal effects of *animal spirit* on economic activity in their explanation of the 1990-1991 recession. On the other hand, Cochrane (1994) points out that close relationship between innovations in consumer confidence and subsequent changes in economic activity appear because consumer confidence shocks reflect *news* about future economic productivity. Beaudry and Portier (2004, 2006) also propose a similar model. Barsky and Sims (2012) evaluate empirical relevance of these factors in explaining innovations in consumer confidence. They show that confidence innovations are better characterized by the latter, even though animal spirit also has non-negligible contribution. Using a nonlinear VAR framework, Bachman and Sims (2012) report high fiscal multiplier estimates during periods of economic slack. They put an emphasis on the role of confidence, which embodies information of future productivity improvements in response to fiscal spending shocks during recessions. By the same token, they argue that consumers might become more optimistic in response to the fiscal shock during times of economic slack, which sharply contrasts with our work that reports solid negative responses of consumer sentiment to the fiscal shock in all phases of business cycle.

We are particularly interested in the role of consumer sentiment in propagation mechanism of the government spending shock to private activity such as consumption and investment, excluding the government sector component from the total GDP. For this purpose, we employ an array of identification methods for the fiscal shock that includes conventional recursively identified structural VAR models and the expectational

VAR (EVAR) models of Ramey (2011) for the post war US data.[2] We employ the two EVAR models, one with her news (*NEWS*) variable and the other one with the survey of professional forecasters (*SPF*) data. Our major empirical findings are as follows.

First, government spending shocks are not effective in stimulating private activity. Consumption responds positively only for a very short period of time, then rapidly decreases when the conventional VAR models are employed. Furthermore, initial increases in consumption are mainly driven by increases in nondurable good consumption. That is, when fiscal shocks are actually *materialized*, consumers respond to it by buying more nondurable goods instead of durable goods because they view increases in income as windfall. When changes in fiscal spending are *anticipated* in the expectational VAR framework (Ramey, 2011), fiscal policy shocks become completely ineffective as we observe virtually no positive responses since the impact of the shocks. Similarly, we were unable to find any persistently positive responses of investment to fiscal spending shocks. On the other hand, we observe solid positive responses of consumption and investment to the sentiment shock from all models we consider in the present paper.

It should be noted that our results contrast with those of Bachman and Sims (2012) who reported a positive response of consumer sentiment to the fiscal shock in times of slacks. In what follows, however, we demonstrate our results are robust to alternative identification methods.[3]

Second, we observe that consumer sentiment rapidly deteriorates to a negative region since the impact of the fiscal spending shock, leading to subsequent decreases in consumption and investment. That is, unexpected increases in the government spending generate consumer pessimism, which may weaken the fiscal policy effect on the private sector GDP. We show that our empirical findings are consistent with a view that consumer sentiment *leads* private activity rather than it passively *reflects* the current state of the economy, which implies an important role of a sentiment channel in the propagation mechanism of the fiscal spending shock. We provide additional supporting evidence via nonlinear VAR model estimations and counterfactual simulation exercises.

Lastly, the fiscal shock seems to be ineffective in improving the labor market condition either, while the real wage and private sector jobs show solid positive increases when sentiment shocks occur.

We provide further evidence in favor of an important role of the sentiment channel

[2] Perotti (2011) named these models of Ramey's (2011) the expectational VAR model.

[3] In a related study, Jia and Kim (2016) report mostly negative sentiment responses from 24 different types of identification methods for fiscal spending shocks.

via counterfactual simulation exercises following the framework by Bachman and Sims (2012). Our simulation results sharply contrast with those of Bachman and Sims (2012) even when we employ the same model as theirs. We also employ a threshold VAR model that allows nonlinear effects of the fiscal policy, which provides very weak evidence of nonlinearity.

The remainder of this paper is organized as follows. Section 2 discusses our VAR models with alternative identification methods. We also discuss econometric features of our models as to the robustness of our empirical findings to alternative Wold orderings. In Section 3, we present a data description and our major empirical findings. We also discuss the existence of a consumer sentiment channel in the fiscal policy propagation mechanism to stimulate private activity. Section 4 provides an array of further VAR analyses. Section 5 report counterfactual simulation exercises and estimates from nonlinear VAR model specifications. Section 6 concludes.

2 The Econometric Model

Abstracting from deterministic terms, we employ the following vector autoregressive (VAR) model.

$$\mathbf{x}_t = \sum_{j=1}^{p} \mathbf{A}_j \mathbf{x}_{t-j} + \varepsilon_t, \tag{1}$$

where

$$\mathbf{x}_t = [\mathbf{g}_t \quad \mathbf{y}_t \quad sent_t \quad \mathbf{z}_t]'$$

$\mathbf{g}_t$ denotes a vector of (or a scalar) government spending variables, $\mathbf{y}_t$ is a vector (or a scalar) of private activity variables such as consumption ($conm_t$) and investment ($invt_t$), $sent_t$ is a scalar sentiment variable, and $\mathbf{z}_t$ is a vector of control variables that includes tax rate (tr_t), the interest rate (i_t), and the monetary aggregate (m_t). All variables are demeaned and detrended, up to quadratic trend, prior to estimations. We limit out attention to a closed economy VAR model to make the model as simple as possible.[4]

Motivated by Ramey's (2013) work, we employ an array of VAR models based on alternative identification methods for the government spending shock. Our first model,

[4]That is, we do not pay much attention to the fiscal policy effect on the net exports. For an open economy model, additional variables such as the exchange rate, foreign incomes, and the domestic and foreign prices should be added to the system.

TGOV, resembles conventional VAR models with the government spending ordered first. Put it differently, we identify the government spending shock by unexpected increases in the total government spending ($tgov_t$), that is, $\mathbf{g}_t = tgov_t$. For similar models, see, among others, Blanchard and Perotti (2002), Perotti (2005, 2008), and Galí, López-Salido, and Vallés (2007).

We also employ VAR models which is dubbed the *EVAR* (expectational VAR) approach by utilizing her "news" variable as well as the survey of professional forecasters data. That is, $\mathbf{g}_t = news_t$ (*NEWS*) and $\mathbf{g}_t = spf_t$ (*SPF*), respectively. Ramey (2011) points out that government spending shocks, when identified with standard Choleski decomposition (recursively identified) VAR models, might not be appropriate because planned changes in fiscal variables such as military spending are likely to be anticipated by market participants before the government actually implements it. In order to deal with this timing issue, she constructed a "news" variable by estimating changes in the expected present value of government spending, utilizing information from Business Week and several other mass media sources. She also constructed an alternative news variable via the one-quarter ahead forecast error of fiscal spending growth rates, using the Survey of Professional Forecasters from the Philadelphia Fed.

Perotti (2011), however, argues that Ramey's *EVAR* is equivalent to a model with $\mathbf{g}_t = [fgov_t,\ tgov_t]'$, where $fgov_t$ denotes the federal government (or military) spending. We also employ such a model and denote it *FGOV* model. Following Perotti (2011) and Ramey (2012), we also put $tgov_t$ next to $news_t$ for the *EVAR* models. Our empirical models are summarized as follows.[5]

$$
\begin{aligned}
TGOV &: \mathbf{x}_t = [tgov_t \ \ invt_t \ \ conm_t \ \ sent_t \ \ tr_t \ \ i_t \ \ m_t]' \\
FGOV &: \mathbf{x}_t = [fgov_t \ \ tgov_t \ \ invt_t \ \ conm_t \ \ sent_t \ \ tr_t \ \ i_t \ \ m_t]' \\
NEWS &: \mathbf{x}_t = [news_t \ \ tgov_t \ \ invt_t \ \ conm_t \ \ sent_t \ \ tr_t \ \ i_t \ \ m_t]' \\
SPF &: \mathbf{x}_t = [spf_t \ \ \ tgov_t \ \ invt_t \ \ conm_t \ \ sent_t \ \ tr_t \ \ i_t \ \ m_t]'
\end{aligned}
\tag{2}
$$

For visual inspection of the data, we plot estimated fiscal spending shocks (residuals) as well as original spending variables from these alternative VAR models in Figure 1. Ramey's (2011) (raw) news and SPF variables look quite different from other two variables that are trending upward. However, residuals of these variables, that is, the

[5] We also implemented estimations without the total government spending for *FGOV*, *NEWS*, and *SPF* models. We obtained qualitatively very similar results. See non-for-publication appendix for all results, which is available from authors upon request.

estimated government spending shock identified from each model, look similar each other. That is, all these four measures of fiscal shocks seem fairly consistent with each other. We also present scatter plot diagrams of cyclical components of these four key variables in Figure 2.[6] We note that $fgov_t$, $tgov_t$, and spf_t are closely positively correlated, whereas the volatility of $news_t$ is higher than other three variables due to several outliers. Figures 1 and 2 jointly provide strong support of the consistency of our 4 policy variables.

Figures 1 and 2 around here

It is well-known that econometric inferences from recursively identified VAR models might not be robust to alternative VAR orderings. Fiscal spending effects under our framework do not suffer from this ordering problem. For example, consider a VAR with $\mathbf{x}_t = [\mathbf{x}_{1,t},\ \mathbf{x}_{2,t}]$, where $\mathbf{x}_{1,t}$ is a vector of variables with a known ordering, while the ordering of $\mathbf{x}_{2,t}$ is completely unknown. Kim, Kim, and Stern (2015) demonstrate that all impulse-response functions of the entire variables in $\mathbf{x}_t$ to the shock to one of the variables in $\mathbf{x}_{1,t}$ are unaffected by arbitrary reshuffling of the $\mathbf{x}_{2,t}$ variables.

Note that $\mathbf{g}_t$ is ordered first in all models with an assumption that these spending variables are not contemporaneously influenced by innovations in other variables within one quarter.[7] Therefore, the impulse-response functions to the government spending shock under the present framework are invariant to all alternative orderings of the remaining variables in the system. That is, *all* response functions to the fiscal spending shock are "identical" even if we randomly shuffle the variables next to $\mathbf{g}_t$ in the system as long as $\mathbf{g}_t$ is ordered first.

However, response functions to the sentiment shock are *not* invariant to the ordering of the VAR, because s_t is ordered in the middle of the system. We implemented an array of robustness check analyses putting the sentiment variables in different locations from the first to the last. We obtained qualitatively very similar results, thus we maintain the ordering described in (1) throughout the paper.

[6] We use the Hodrick-Prescott filter with a 1600 of smoothing parameter to separate cyclical components from the trend components of the series.

[7] Unlike the monetary policy, fiscal policy actions may not be implemented immediately, because in most cases, congress and the goverment work together to determine the government budget prior to the fiscal year.

3 Empirical Findings

3.1 Data Descriptions

We use quarterly frequency data from 1960:I to 2013:II. We obtained most of our data from the FRED with a few exceptions. The news series ($news_t$) is obtained from Valerie Ramey's website.[8] We obtained the consumer sentiment index ($sent_t$) data from the University of Michigan's Survey of Consumers database. The consumer sentiment index comes with two sub-indices, the current economic conditions index (ICC) and the index of consumer expectations (ICE). That is, $sent_t$ is a combination of consumers' perception on the current economic conditions as well as economic conditions in the near future. As can be seen in Figure 3, they are highly correlated each other, thus we report empirical findings mostly with the consumer sentiment index.

We use "total" government expenditures for government spending variables that include transfer payments and interest payments as well as capital transfer payments.[9] All public and private spending variables ($tgov_t, fgov_t, conm_t, invt_t$) are divided by the GDP deflator and population, then log-transformed. $sent_t$ is expressed in natural logarithm. tr_t denotes the government tax receipts divided by the total GDP. As to the money market control variables, i_t denotes the three month Treasury Bills yield and m_t is the nominal M2, expressed in natural logarithm.

Figure 3 around here

The Survey of Professional Forecasters data were obtained from the Philadelphia Fed. Starting from 1968:IV, forecasters were asked to predict *nominal* defense spending until 1981:II, whereas they were asked to predict *real* federal spending since then. We used the forecasts of the GDP deflator to convert the nominal defense spending data to real spending data.[10] We also noticed 9 changes of base year in the national income and product account (NIPA) during our full sample period. Since the SPF forecast

[8] For detailed explanations on how to construct her news variable, see the following webpage. http://econweb.ucsd.edu/~vramey/research.html#data

[9] Total government expenditures is a broader measure than "government consumption expenditures and gross investment," which is a government component of the total GDP. It is even greater than "government current expenditures" because it includes items that affect government activities in the future such as capital transfer payments and net purchases of nonproduced assets.

[10] Nominal defense spending data from 1968:IV to 1981:II are obtained from Tom Stark at the Philadelphia Fed.

does not reflect such changes, we rescaled all relevant forecast data with 2009 as the common base year.[11] Following Ramey (2011), we use the actual government spending growth minus the forecast of it made one quarter earlier, that is, $g_t - E(g_t|\Omega_{t-1})$ where Ω_{t-1} is the forecasters' information set at time $t-1$, as the fiscal spending shock.

One caveat is that, following Ramey (2011), we combine forecast errors of defense spending growth with those of federal spending growth rates in order to get the data with reasonably long sample period. As she discussed, however, this news variable explains substantial portion of changes in the federal spending growth. Further, we use forecast errors instead of forecasts, which will minimize the cost of combining those two data series. We report a scatter plot diagram of the business cycle components of these two series in Figure 4. Clearly, these two series are highly positively correlated. More detailed information on data is provided in Table 1.

Figure 4 and Table 1 around here

3.2 Fiscal Spending Shocks and Private activity

As a preliminary exercise, we estimated fiscal spending effects on the private GDP that excludes the government spending component from the total GDP. Figure 5 reports the response function estimates of the private GDP to the fiscal spending shock and to the sentiment shock using 4 alternative identification methods discussed in the previous section. We also report the 95% confidence bands obtained from 500 nonparametric bootstrap simulations.

It should be noted that the fiscal shock has negligible or even negative effects on the private GDP in all models we consider, which is consistent with the findings reported by Ramey (2012). This implies that any evidence of positive responses of the total GDP to the fiscal shock might be mainly due to an expansion of the public sector. Contrary to the fiscal shock, the sentiment shock yields a persistently positive effect on the private GDP over 2 years, which is significant at the 5%. We note that this finding is consistent with the work by Hall (1993), Blanchard (1993), Cochrane (1994), and Bachman and Sims (2012), for example, in the sense that we also find close relationship between

[11] Ramey (2011) and Forni and Gambetti (2014) used growth rates of government spending forecasts without adjusting for changes in base year. This is not ideal because their estimations can be influenced by suddent big changes in their fiscal spending variable up to 9 times.

consumer sentiment and economic activity. However, our findings contrast sharply with those of Bachman and Sims (2012) qualitatively, because they argue that the government spending shock has a positive effect on consumer confidence during times of slack.[12] In what follows, we show that the government spending shock generates consumer *pessimism* rather than optimism, which then weakens private activity.

Figure 5 around here

Next, we report impulse-response function estimates of private consumption and investment to the fiscal spending shock in Figure 6.[13] Consumption responds significantly positively only in the short-run (less than a year) under $TGOV$ and $FGOV$ identification schemes, while no meaningful or even significantly negative responses are observed when the $EVAR$ models are employed. Investment responses to the fiscal shock turn out to be mostly negligible and insignificant with an exception of those from SPF model, where we obtained a significantly negative harmful effect of the fiscal shock on investment. These responses of consumption and investment would be consistent with negligible responses of the private GDP to the fiscal shock reported earlier.

Figure 6 around here

One of our major objectives is to identify propagation channels through which fiscal spending shocks possibly affect private activity. We view the consumer sentiment as a potential candidate. For this purpose, we report the impulse-response functions of $sent_t$ to the fiscal spending shock in Figure 7. Note that under the $TGOV$, $FGOV$, ana SPF schemes, consumer sentiment rapidly falls below zero immediately after the impact of the fiscal spending shock, which might play a key role in explaining why initially positive responses of consumption quickly deteriorate to negative ones. That is, positive fiscal spending shocks may be interpreted as a sign of weak economy, which might make consumers more pessimistic, resulting in decreases in private spending. Naturally, such changes in consumer sentiment may weaken the effectiveness of the expansionary fiscal policy as consumption and investment fall in response to the fiscal

[12] It should be noted, however, that our models do not allow such nonlinearity in the impulse-response function estimations.

[13] Complete response function estimates are reported in the non-for-publication appendix.

shock. Under the *NEWS* VAR, we observe no meaningful responses of the sentiment, which is consistent with virtually zero-responses of consumption to the fiscal shock under the same model.

In what follows, we also show that "total" consumption responses shown in Figure 6 are more closely related with those of nondurable goods and services consumption rather than durable goods consumption. That is, consumption responses to the fiscal shock seem to be mainly driven by temporary changes in nondurable goods consumption. One way to interpret Figures 6 and 7 together would be the following. When fiscal shocks are anticipated as assumed in the EVAR models, fiscal shocks tend to generate consumer pessimism, resulting in decreases or no meaningful changes in consumption. When fiscal shocks are actually materialized, that is, when identified fiscal shocks are the same as the actual increases in fiscal spending as in *TGOV* and *FGOV* models, consumers respond to it by increasing nondurable goods consumption because they view increases in income as windfall. In other words, they may do so because they believe fiscal shocks are not going to permanently change the direction of the economy towards booms.

Overall, fiscal policy effects on private activity seem to be weak and short-lived if any. Further, the fiscal spending shock seems to fail to improve, even decrease, consumer sentiment, which may cause decreases in consumption and investment. To investigate such possibility, we report and discuss our impulse-response function estimates of private activity to the sentiment shock in next section.

Figure 7 around here

3.3 Consumer Sentiment Shocks and Private activity

Responses of private activity to the sentiment shock sharply contrast with those to the fiscal shock. As can be seen in Figure 8, both investment and consumption respond positively for a prolonged period of time in response to the sentiment shock in all four models. That is, we obtained robust evidence of persistently positive effects of the sentiment shock on private activity. Especially, consumption responses are highly significant at the 5% level for over three years. Even though investment responses are not significant at the 5% level, its point estimates are substantially skewed to the positive area.

Responses of the government spending to the sentiment shock are overall negative, reported in not-for-publication appendix, though either insignificant or marginally significant. This is not surprising because fiscal spending tends to be counter-cyclical. That is, government spending normally falls below the trend when the private GDP (consumption and investment) rises during economic booms.

In contrast to the responses to the fiscal shock, the impulse-response function estimates to the sentiment shock are not invariant to alternative orderings since $sent_t$ is put after the fiscal variable and private spending variables. For robustness check, we implemented the same analysis with the sentiment variable ordered next to $\mathbf{g}_t$. We also experimented with the sentiment variable ordered last. All results were qualitatively very similar. That is, our findings on the sentiment effect are quite robust to alternative orderings.[14]

Figure 8 around here

3.4 Fiscal Shock and the Role of a Sentiment Channel

We observe that all four models including the two EVAR models imply solid positive effects of the sentiment shock on private spending. We note that these findings may provide some useful insights on the ineffectiveness of the fiscal policy in promoting private activity as reported in the previous section. That is, the fiscal spending shock may not be able to stimulate consumption and investment if it fails to generate consumer (or entrepreneur) optimism as can be seen in Figure 7. In other words, the effectiveness of the fiscal spending shock may critically hinge upon a sentiment channel.

Observing sudden increases in the government deficit, consumers may revise down their economic growth forecasts in the future, interpreting such policy actions as a clear sign of serious economic downturns, which may persist for a while. In this sense, our conjecture is consistent with the "news" effect discussed in Cochrane (1994) and Bachman and Sims (2012), even though Bachman and Sims (2012) are more optimistic on the role of the expansionary fiscal policy.

One may argue against this conjecture by the following logic. Consumption and investment may fall after the spending shock occurs for some unknown reason, and the

[14] All results are available upon request.

sentiment passively reflect such decreases in private GDP. We are skeptical to such a possibility for the following reasons.

As we can see in Figure 6, consumption tends to rise for a short period of time in response to the fiscal shock when $TGOV$ and the $FGOV$ models are employed, whereas consumer sentiment falls almost immediately after the impact under these models. These responses are inconsistent with a view that consumer sentiment passively reflects changes in the current private GDP. If that is the case, the sentiment response should have resembled initially positive responses of consumption for about a year since the impact of the fiscal shock. Furthermore, it should be noted that the consumer sentiment is constructed to measure consumers' perception on the future economic conditions as well as the current conditions. Therefore, immediate declines of the sentiment which contrast to short-run increases in consumption imply that consumer sentiment does not passively reflect changes in private activity. Put it differently, our response function estimates overall imply the existence of a sentiment channel where the sentiment plays a leading role in determining private activity.

4 Further VAR Evidence

4.1 Responses of Durable and Nondurable Goods Consumption

This subsection estimates the effects of the fiscal and the sentiment shocks on two sub-components of private consumption: consumption of durable goods ($cond_t$) and consumption of non-durable goods and services ($conn_t$). One motivation of this exercise is that consumers tend to adjust consumption pattern for durable goods such as automobiles and houses when they expect persistent changes in economic conditions, while non-durable goods consumption might be also influenced by temporary changes in incomes. For this purpose, we replace $conm_t$ with $cond_t$ or $conn_t$ in (2), then re-estimate the VAR models. Impulse-response function estimates are reported in Figures 9 and 10.

Overall, durable good consumption does not respond significantly to the fiscal shock with an exception of SPF model which shows significantly *negative* responses. Non-durable good consumption exhibit significantly positive responses for a short period of time under the $TGOV$ and $FGOV$ schemes. We note that nondurable good consump-

tion shows significantly positive responses for a while under the *SPF* identification scheme. Note also that durable good consumption responses under the same scheme exhibit much stronger decreases that dominate the positive responses of nondurable good consumption, which is consistent with decreases in the total consumption reported earlier.

Response function estimates of total consumption to the fiscal shock shown in Figure 6 resemble those of nondurable goods consumption in Figure 10 more than durable goods consumption responses in Figure 9. Put it differently, fiscal shock effects on total consumption are overall driven by responses of $conn_t$ instead of those of $cond_t$. Since consumers tend to buy more durable goods such as automobiles and home appliances when they are confident that the economy would continue to expand, these findings imply fiscal shocks fail to generate consumer optimism on economic conditions in the near future, which seems consistent with insignificant and negligible responses of durable goods consumption to the fiscal shock.

In contrast, total consumption responses to the sentiment shock are somewhat in between those of durables and nondurables consumption responses. That is, in response to a positive sentiment shock, durable goods consumption also rises significantly and persistently no matter what identification methods are employed.

Figures 9 and 10 around here

4.2 Effects on Private Employment

As Ramey (2012) points out, fiscal spending effects on private jobs may differ depending on the nature of government spending. If fiscal spending occurs mainly through government purchases of private sector goods and services, the fiscal spending shock may increase private employment. On the contrary, increases in government value added that include mainly compensation of public employees may decrease private sector jobs as the public sector employment rises given the labor force, eroding the private sector jobs.

We estimate and report private sector labor market effects of the fiscal shock as well as those of the sentiment shock. For this purpose, we replace $invt_t$ and $conm_t$ in (2) with private jobs ($pjob_t$). Results are reported in Figure 11. We observe that fiscal shocks again fail to increase private employment when *TGOV*, *FGOV*, and *SPF* models

are employed, while it temporarily increases private jobs in the short-run when *NEWS* model is used. Overall, responses of the private sector jobs are either insignificant or even negative. On the contrary, the sentiment shock has a solid positive effect on private employment that lasts several years since the shock occurs no matter what identification methods are employed.

In a nutshell, private labor market effects of the fiscal spending shock are weak and mostly insignificant, which contrast sharply with the sentiment effect that results in persistently positive increases in private sector jobs. These findings might explain why recent increases in fiscal spending fail to reduce unemployment for a prolonged period of time after the Great Recession. That is, falling private spending may weaken job creation effects of the government spending shock as it creates consumer pessimism in the economy, which in turn reduces private spending.

Figure 11 around here

4.3 Effects on Private Wages

Private wages may rise in response to the fiscal shock in either cases of government purchases of private sector goods or increases in government value added. On the other hand, private sector wages may fall if rational consumers, expecting a tax hike in the near future, increase the labor supply sufficiently. If fiscal shocks result in decreases in private activity, as implied by our estimation results, there will be negative effects on private wages due to decreases in consumption and investment.

We empirically appraise the effects of the fiscal shock on private wages by replacing $invt_t$ and $conm_t$ in (2) with private wages ($pwag_t$). As can be seen in Figure 12, we observe slightly positive effects of the fiscal shock on private wages that are mostly insignificant from three VAR specifications with an exception of *SPF* model. That is, potentially positive effects of fiscal spending shocks are likely to be muted by negative responses of private spending, which result in decreases in demand for private sector goods and services. On the contrary, private wages respond persistently and positively to the sentiment shock for over three years that are significant at the 5% levels. Solid increases in private wages seem to be caused by increases in the demand for labor, because sentiment shocks promote private activity persistently.

Figure 12 around here

4.4 Current or Forward Looking Sentiment?

We further experiment our analyses with two sub-indices of the consumer sentiment index: the index of current economic conditions (ICC) and the index of consumer expectations (ICE). For example, Bachman and Sims (2012) use ICE instead of the combined sentiment index used in the present paper. Even though their approach has some merits, the forward-looking sentiment data (ICE), behaves very similarly to the current economic conditions index (ICC) as we saw in Figure 3.

Nonetheless, we estimate VAR models after replacing the consumer sentiment index ($sent_t$) with these two sub-indices. Results are reported in Figures 13 and 14. We obtain very similar impulse-response functions as the ones reported in Figure 6. We also estimate and report the responses of these sentiment sub-indices to the fiscal shock in Figure 15, which again resemble those in Figure 7 with the combined sentiment data. Therefore, our results are robust to the choice of alternative sentiment variables.

Figures 13, 14, and 15 around here

4.5 Sub-Sample Analysis

We also investigate the consequences of combining forecast errors for the real defense spending growth rate with those for the real federal spending growth rate via the SPF data. Following Ramey (2011), we combined these two series in order to obtain long-horizon data. Key results from a shorter sample period from 1981:III to 2013:II, the period with the real federal spending growth rate forecast errors, are reported in Figure 16.[15]

In a nutshell, we obtain very similar impulse-response functions as the ones reported previously. Consumption and investment respond significantly negatively to the fiscal shock, while they rise persistently when the sentiment shock occurs.

Figure 16 around here

[15] All results are reported in the not-for-publication appendix and are available from authors.

5 Further Analysis

This section provides robustness check analysis by implementing counterfactual simulation exercises following the framework proposed by Bachman and Sims (2012). Our results contrast sharply with those of Bachman and Sims (2012). We also employ a nonlinear model. Our results imply very weak evidence of nonlinearity, which is consistent with findings by Owyang et al. (2013) and Ramey and Zubairy (2014).

5.1 Counterfactual Simulation Results

This section implements counterfactual simulation exercises that isolate the direct effects of the fiscal expansion shock on private activity from its indirect effects via the sentiment channel. Following Bachman and Sims (2012), we generate a hypothetical sequence of sentiment shocks that holds sentiment unchanged at all forecast horizons since the impact of the fiscal shock, which then can be used to eliminate the indirect effects of the fiscal shock so that one can obtain the *hypothetical direct* fiscal shock effects on private activity.

Consider the following simple tri-variate VAR model.

$$\mathbf{x}_t = \sum_{j=1}^{p} \mathbf{A}_j \mathbf{x}_{t-j} + \mathbf{A}_0^{-1} \mathbf{u}_t, \tag{3}$$

where $\mathbf{x}_t = [g_t \quad sent_t \quad y_t]'$, $\mathbf{A}_0^{-1}$ is the Choleski factor, and $\mathbf{u}_t$ is the vector of the orthonormal structural shocks, that is, $E\mathbf{u}_t\mathbf{u}_t^{'} = \mathbf{I}$. Let $\tilde{\mathbf{F}}$ denotes the top-left 3 by 3 sub-matrix of the $3p$ by $3p$ companion matrix for the state-space representation.[16] The h-period ahead impulse-response function of the i^{th} variable to the structural shock to the j^{th} variable is given by the following.

$$\psi_{i,j}(h) = s_i^{'} \tilde{\mathbf{F}}^{h-1} \mathbf{A}_0^{-1} s_j, \tag{4}$$

where s_i is a 3 by 1 selection vector with a one in the i^{th} place and zeros elsewhere.

Note that the contemporaneous sentiment response to a 1% fiscal spending shock ($u_1^g = 1$) is given by $s_2^{'} \mathbf{A}_0^{-1} s_1$. To zero out this response, we need to generate the

[16] See any time series econometrics textbook for details on the state-space representation.

following size hypothetical sentiment shock,

$$u_1^{sent} = -\frac{s_2^{'}\mathbf{A}_0^{-1}s_1}{s_2^{'}\mathbf{A}_0^{-1}s_2} \tag{5}$$

The sequence of sentiment shocks for the remaining period can be recursively calculated as follows.

$$u_h^{sent} = -\frac{s_2^{'}\tilde{\mathbf{F}}^{h-1}\mathbf{A}_0^{-1}s_1 + \sum_{r=1}^{h-1}\left(s_2^{'}\tilde{\mathbf{F}}^{h-r}\mathbf{A}_0^{-1}s_2\right)u_r^{sent}}{s_2^{'}\mathbf{A}_0^{-1}s_2}, \ h = 2, 3, \ldots \tag{6}$$

Finally, the counterfactual impulse-response function of the i^{th} variable to the 1% fiscal spending shock can be calculated as follows.

$$\hat{\psi}_{i,1}(h) = \psi_{i,1}(h) + \sum_{r=1}^{h}\left(s_i^{'}\tilde{\mathbf{F}}^{h-r}\mathbf{A}_0^{-1}s_2\right)u_r^{sent} \tag{7}$$

Our simulation exercise results are consistent with empirical findings reported earlier. We first implemented the exercises with the federal spending per capita ($fgov_t$) and the per capita private GDP.[17] Solid lines are point estimates for the impulse-response function from the benchmark tri-variate VAR model, $\psi_{i,1}(h)$, whereas dashed lines are hypothetical response functions, $\hat{\psi}_{i,1}(h)$. 95% confidence bands (dotted lines) for the benchmark VAR model are obtained from 500 nonparametric bootstrap simulations.

As we can see in Figure 17, hypothetical sentiment shocks ,$\{u_h^{sent}\}_{h=1}^{\infty}$, are mostly *positive* because sentiment overall *negatively* responds to the fiscal shock, $\psi_{2,1}(h) < 0$. Since the government spending responds negatively to the sentiment shock, this implies that $\hat{\psi}_{1,1}(h)$ tends to be weaker than $\psi_{1,1}(h)$. It should be noted that hypothetical output responses, $\hat{\psi}_{3,1}(h)$, would be overall greater than $\psi_{3,1}(h)$, because hypothetical consumer optimism shocks, $u_h^{sent} > 0$, continue to boost output. Note also that fiscal shocks might be able to stimulate private activity if consumer pessimism can be muted.

Figure 17 around here

[17] The private GDP is the total GDP minus the government spending.

The negative response of consumer sentiment we report here is at odds with that of Bachman and Sims (2012). In order to investigate the robustness of our results, we estimate the impulse-response functions from (3) using an array of popularly used identification methods. Figure 18 reports the response function estimates of consumer sentiment to fiscal spending shocks that are identified with 4 different measures of real government spending per capita: the real government consumption expenditures and gross investment; the real federal government consumption expenditures and gross investment; real state and local government consumption expenditures and gross investment; real federal government defense consumption expenditures. In all cases, we obtain either negative or negligibly positive responses. More detailed exercises are available in Jia and Kim (2016).

Figure 18 around here

We also implemented a similar exercise with the total GDP instead of the private GDP. Results in Figure 19 provide similar findings. We note that Bachman and Sims (2012) obtained small but positive responses of consumer sentiment to the fiscal expansion shock, though insignificant. Their model uses the log government spending (consumption and investment) and the forward looking sentiment index (ICE). Employing the same model specification, we obtained very similar results as ours in Figure 18 including negative responses of sentiment to the fiscal spending shocks.[18]

Figure 19 around here

5.2 Nonlinear Model Estimates

Lastly, we study the possibility of nonlinear responses of the sentiment to the fiscal shock. For this purpose, we employ the following two-regime threshold VAR (TVAR)

[18] We obtained the Real Government Consumption Expenditures and Gross Investment data (GCEC1) from the FRED. We log transformed the series for our VAR models. We also used per capita real government spending data. Whichever specifications are used, our VAR models always yielded negative dynamic responses of sentiment to the fiscal shock.

model. Abstracting from deterministic terms, we use,

$$\mathbf{x}_t = \left(\sum_{j=1}^{p} \mathbf{A}_j^R \mathbf{x}_{t-j} \right) I(\tau_{t-d} < \tau^*) + \left(\sum_{j=1}^{p} \mathbf{A}_j^B \mathbf{x}_{t-j} \right) I(\tau_{t-d} > \tau^*) + \varepsilon_t, \tag{8}$$

where I is the indicator function and τ_{t-d} is a d-period lagged threshold variable that represents the present state of the economy. We use the (total) GDP growth rate for this threshold variable in order to investigate nonlinear responses of the sentiment to the fiscal shock during different phases of the business cycle. $\mathbf{A}_j^R(L)$ and $\mathbf{A}_j^B(L)$ are lag polynomial matrices during economic recessions ($\tau_{t-d} < \tau^*$) and booms ($\tau_{t-d} > \tau^*$), respectively. We use a one-dimensional grid search method to identify τ^* by minimizing $\ln \left\| \hat{\Sigma} \right\|$, where $\hat{\Sigma}$ is the variance-covariance matrix given a fine grid point $\tau_{t-d} \in \{\tau_{0.15}, ..., \tau_{0.85}\}$. We trimmed 15% of the data from each side to make sure we use enough number of observations in each regime. Conventional delay parameter $d = 1$ was employed.

It should be noted that we need to reduce the dimension of our VAR system substantially for proper estimations of this type of TVAR models. For example, our $FGOV$ model with three lags requires estimations of $8^2 \times 3$ reduced-form coefficients for each regime, which may not be feasible with a small grid point such as $\tau_{0.15}$, because not enough number of observations may be used to estimate coefficients with such specifications. Since we are mainly interested in nonlinear responses of the sentiment to the fiscal spending shock, we employ a simple tri-variate TVAR model with $\mathbf{x}_t = [g_t \;\; priy_t \;\; sent_t]'$, where $g_t = tgov_t, \; fgov_t, \; ramy_t, \; spf_t$. Regime-specific impulse-response function estimates of the sentiment to the fiscal shock are reported in Figure 20.[19]

From all 4 VAR models, we obtain solid negative responses of the sentiment to the fiscal shock in both regimes, which sharply contrasts to the work of Bachman and Sims (2012). Instead of finding positive (optimism) responses, we observed that the fiscal spending shock during recessions generates consumer pessimism as in our previous results from the linear model. We also obtain solid negative responses of $sent_t$ to the fiscal shock during economic booms as well. Put it differently, our evidence of consumer pessimism in response to the fiscal shock seems to be robust to different states of the

[19] We report regime-specific impulse-response function estimates based on the point estimates, since the main objective of this exercise is to see whether there's evidence of quaitatively different responses of $sent_t$ in different phases of business cycle. For more rigorous analysis, we need to estimate the generalized impulse-response functions for nonlinear models (Koop, Pesaran, and Potter, 1996).

economy, which is consistent with the work of Owyang, Ramey, and Zubairy (2013) and Ramey and Zubairy (2014). We also note that consumer sentiment shows improvement for a while since the occurrence of the fiscal shock during economic booms especially in *SPF* model. However, $sent_t$ rapidly falls and enters a negative region, showing no persistent improvement in the sentiment.

Figure 20 around here

6 Conclusion

The recent Great Recession accompanied by the slow recovery triggered an active debate on the effectiveness of the fiscal policy in stimulating economic growth. Empirical evidence is at best mixed and the economics profession has failed to reach a consensus.

This paper takes a different road and attempts to understand what influences the effects of the fiscal policy on the private sector economy. For this purpose, we introduce the role of consumer sentiment in a propagation mechanism for government spending shocks towards economic activity in the private sector. As Ramey (2011) points out, statistical inferences may be influenced by alternative identification methods for the spending shock. Thus, we employ an array of recursively identified VAR models as well as the two expectational VAR models. We obtain solid evidence of the existence of a consumer sentiment channel that is robust to alternative identification methods.

Our major findings are as follows. First, our empirical results imply a very weak, even negative effect of the government spending shock on private sector spending such as consumption and investment, which confirms the conclusion by Ramey (2012). On the contrary, innovations in the consumer sentiment generate solid positive responses of consumption and investment for a prolonged period of time. Third, consumer sentiment negatively responds to the government spending shock since the impact, while under the conventional VAR schemes, consumption shows positive responses, mainly from nondurable good consumption, for a brief period of time, then quickly deteriorates to a negative region. This implies that the fiscal policy may become ineffective in stimulating economic activity because it generates consumer pessimism that results in subsequent decreases in consumption and investment. That is, consumer sentiment channel may be a key in understanding the propagation mechanism of fiscal policy

shocks. Similar evidence are also obtained from private sector labor market variables. Employment and real wages in the private sector respond significantly positively only to the sentiment shock. Our nonlinear VAR models and counterfactual simulation exercises also provide strong supports for an important role of the consumer sentiment channel in the propagation mechanism of the fiscal shock.

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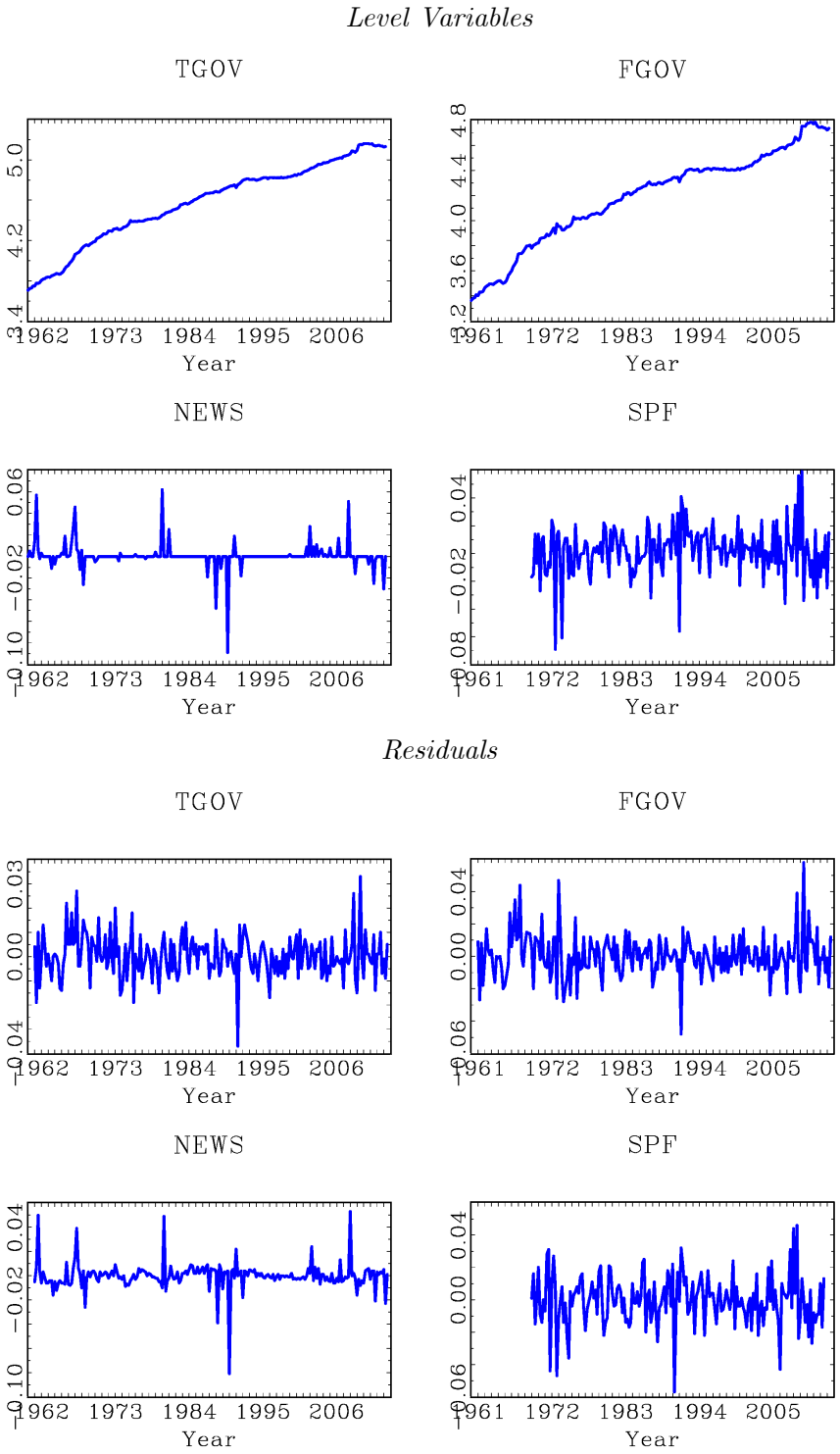
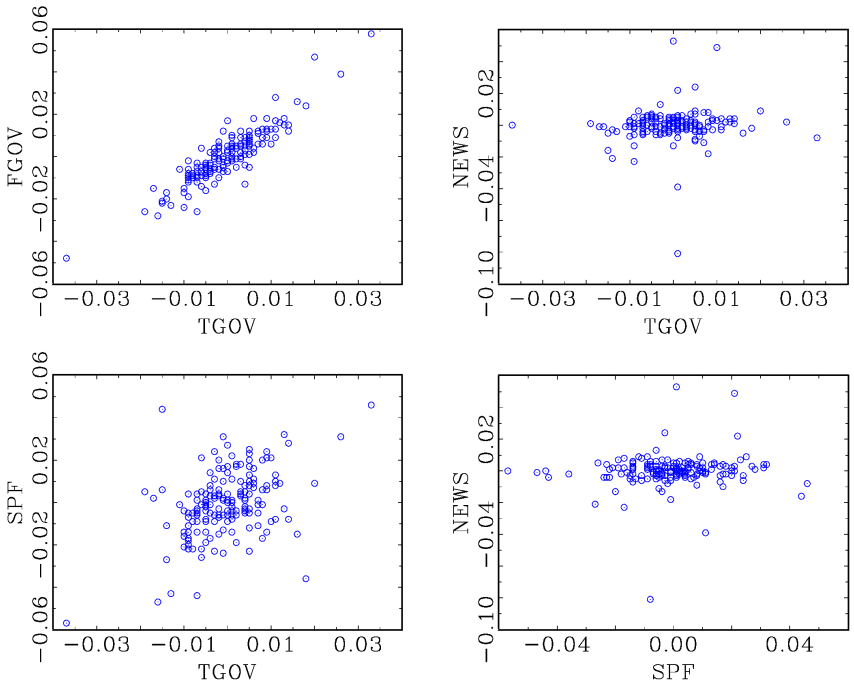
Figure 1. Government Spending Data: Raw Data and Residuals



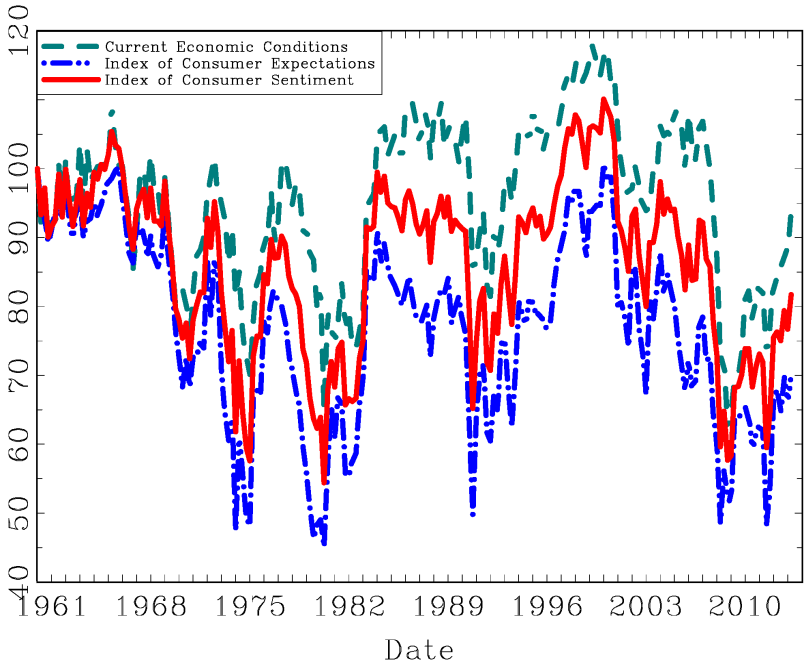
Note: TGOV, FGOV, NEWS, and SPF denote the total government spending, federal government spending, news variable (Ramey, 2011), and SPF variable (Ramey, 2011). Residuals are obtained from VAR regressions.

Figure 2. Government Spending Data: Cyclical Components



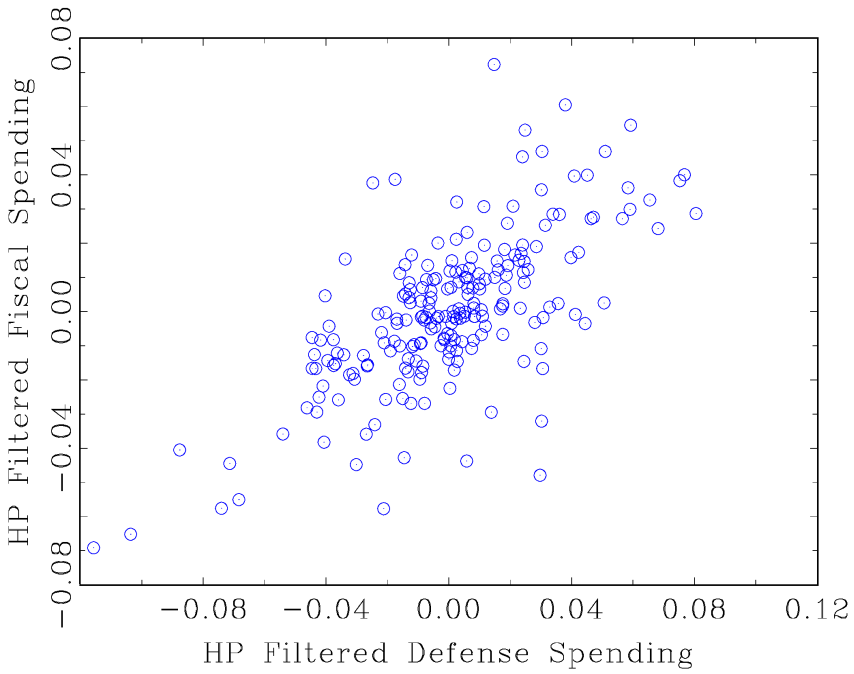
Note: We use the Hodrick-Prescott filter to separate cyclical components of the series from the trend components of the series. We use 1600 of smoothing parameter for quarterly data.

Figure 3. Consumer Sentiment Index Data



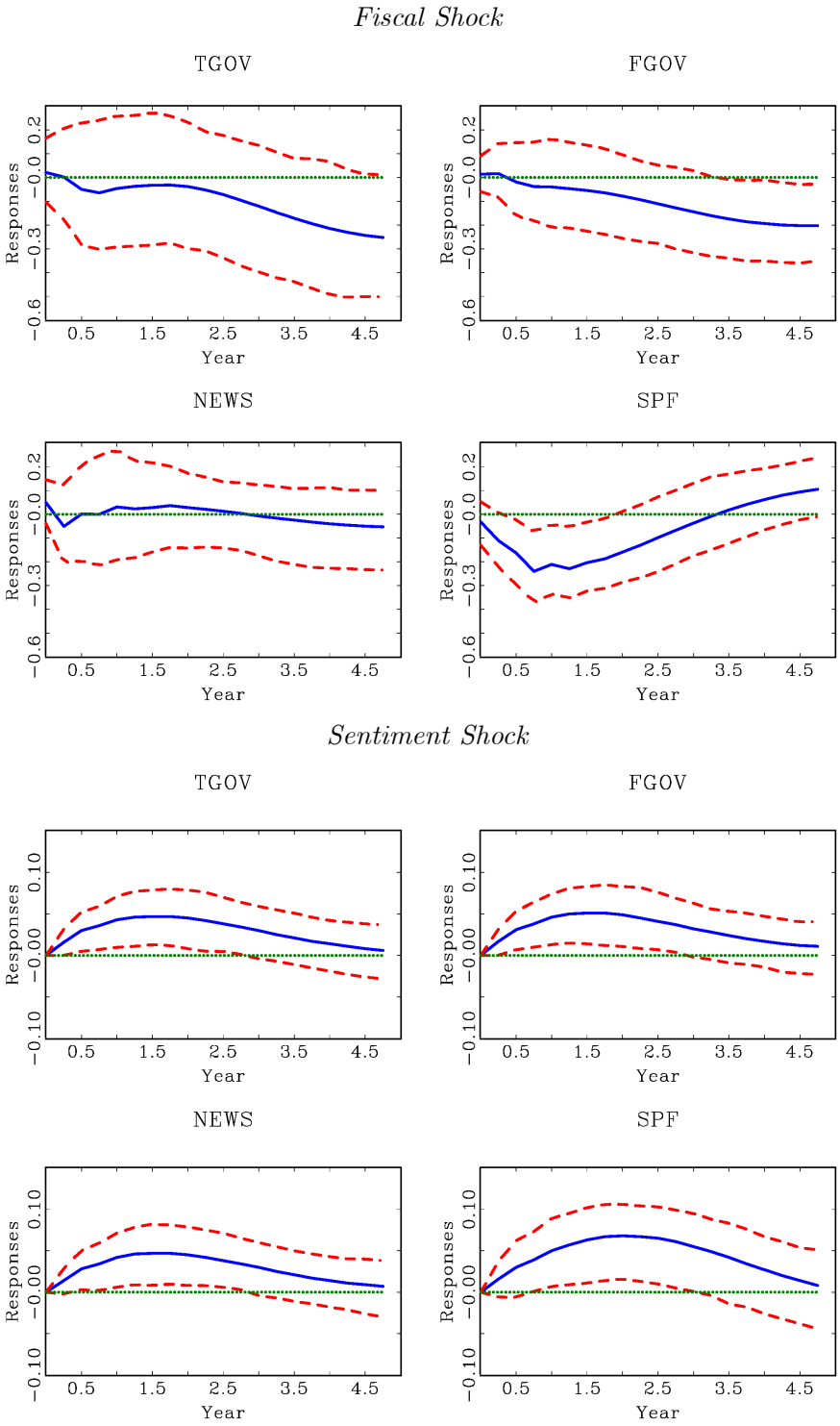
Note: We obtained the data from Surveys of Consumers website at the University of Michigan. All indices are normalized to be 100 in 1960Q1 by authors.

Figure 4. Defense Spending Growth and Federal Spending Growth



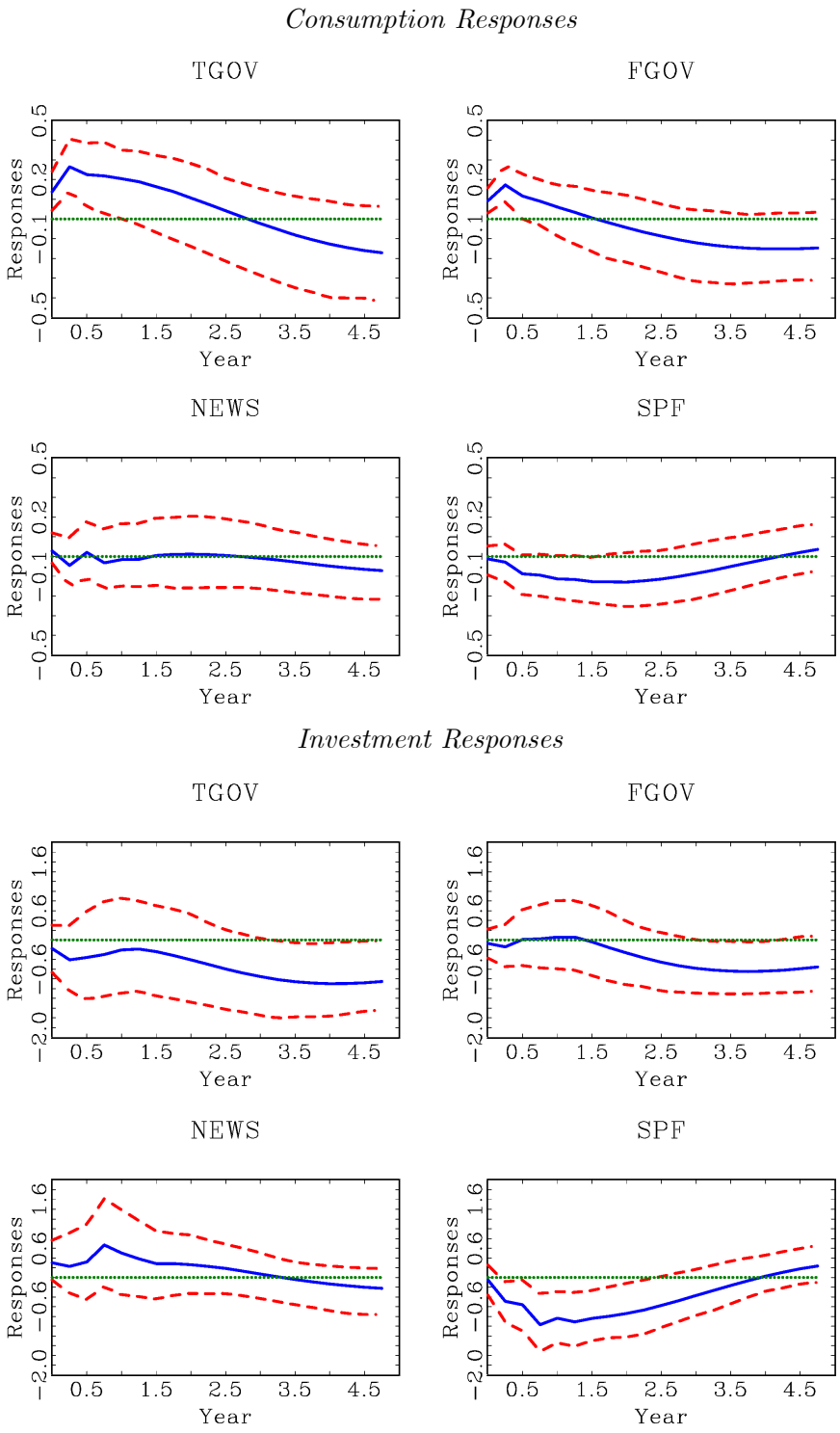
Note: We use the Hodrick-Prescott filter to separate cyclical components of the series from the raw data. We use 1600 of smoothing parameter for quarterly data.

Figure 5. Private GDP Responses



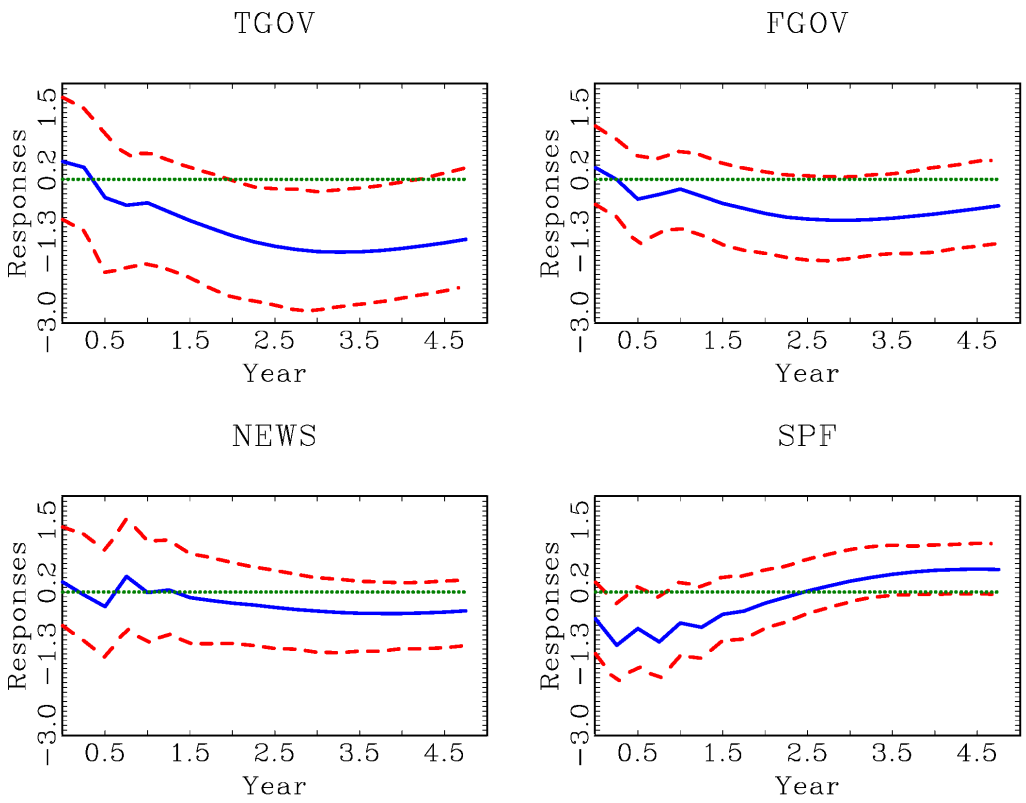
Note: Private GDP is obtained by substracting the government spending from the total GDP. We report responses of the private GDP to the fiscal spending shock from each model. Dashed lines are the 95% confidence band of the response function from 500 nonparametric bootstrap simulations.

Figure 6. Private Activity Responses to the Fiscal Shock



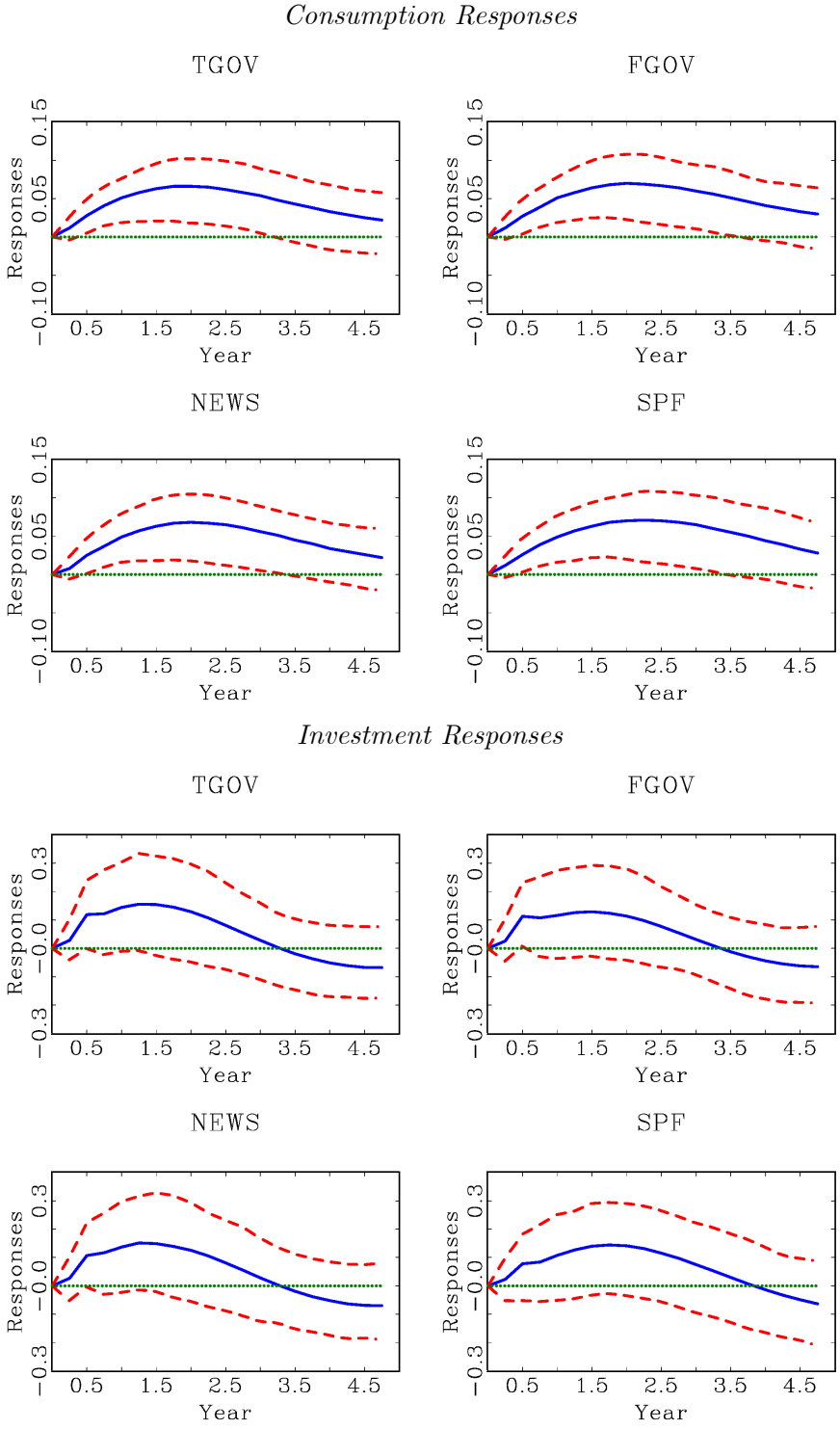
Note: Dashed lines are the 95% confidence band of the response function from 500 nonparametric bootstrap simulations.

Figure 7. Sentiment Responses to the Fiscal Shock



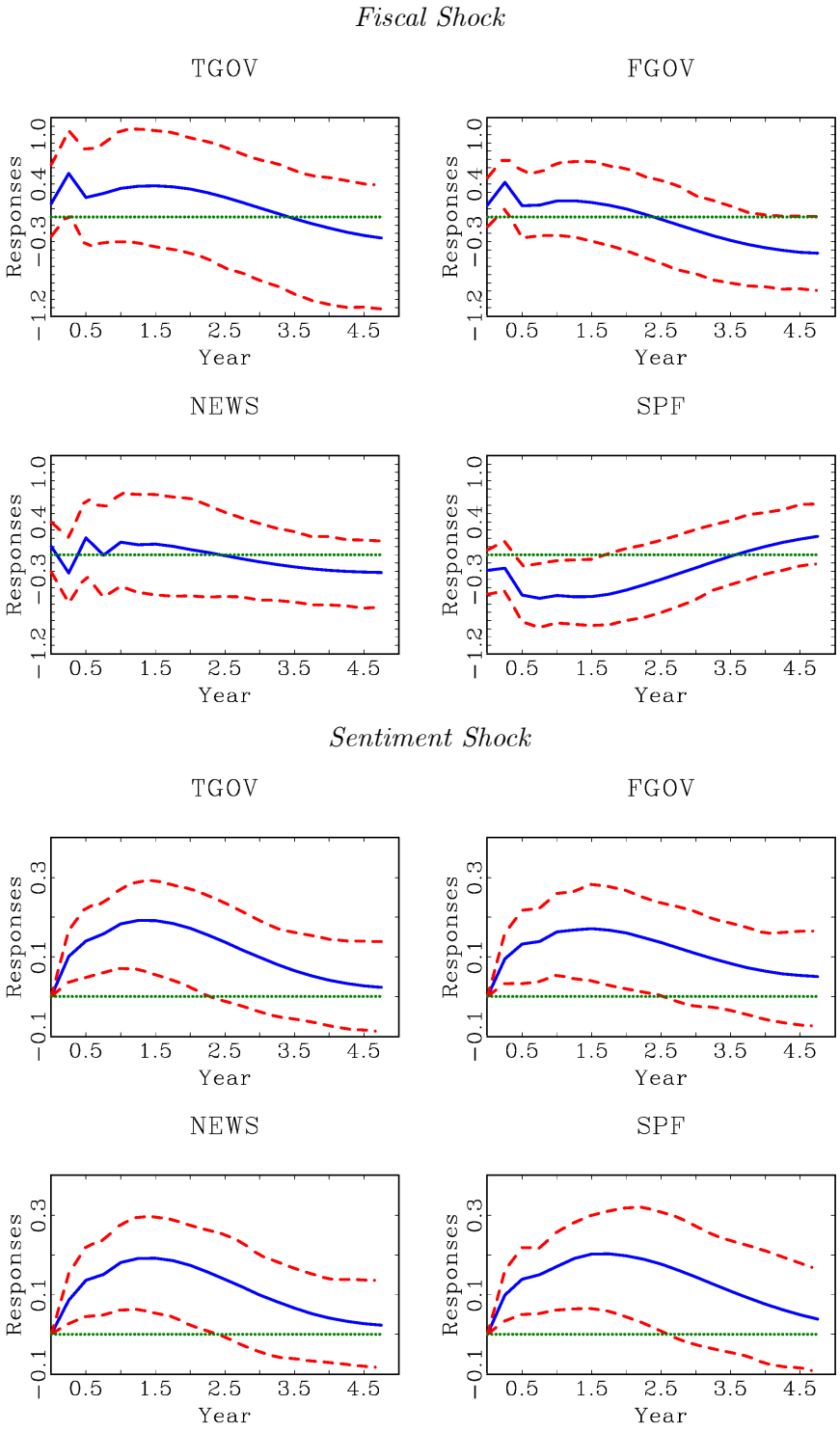
Note: Dashed lines are the 95% confidence band of the response function from 500 nonparametric bootstrap simulations.

Figure 8. Private Activity Responses to the Sentiment Shock



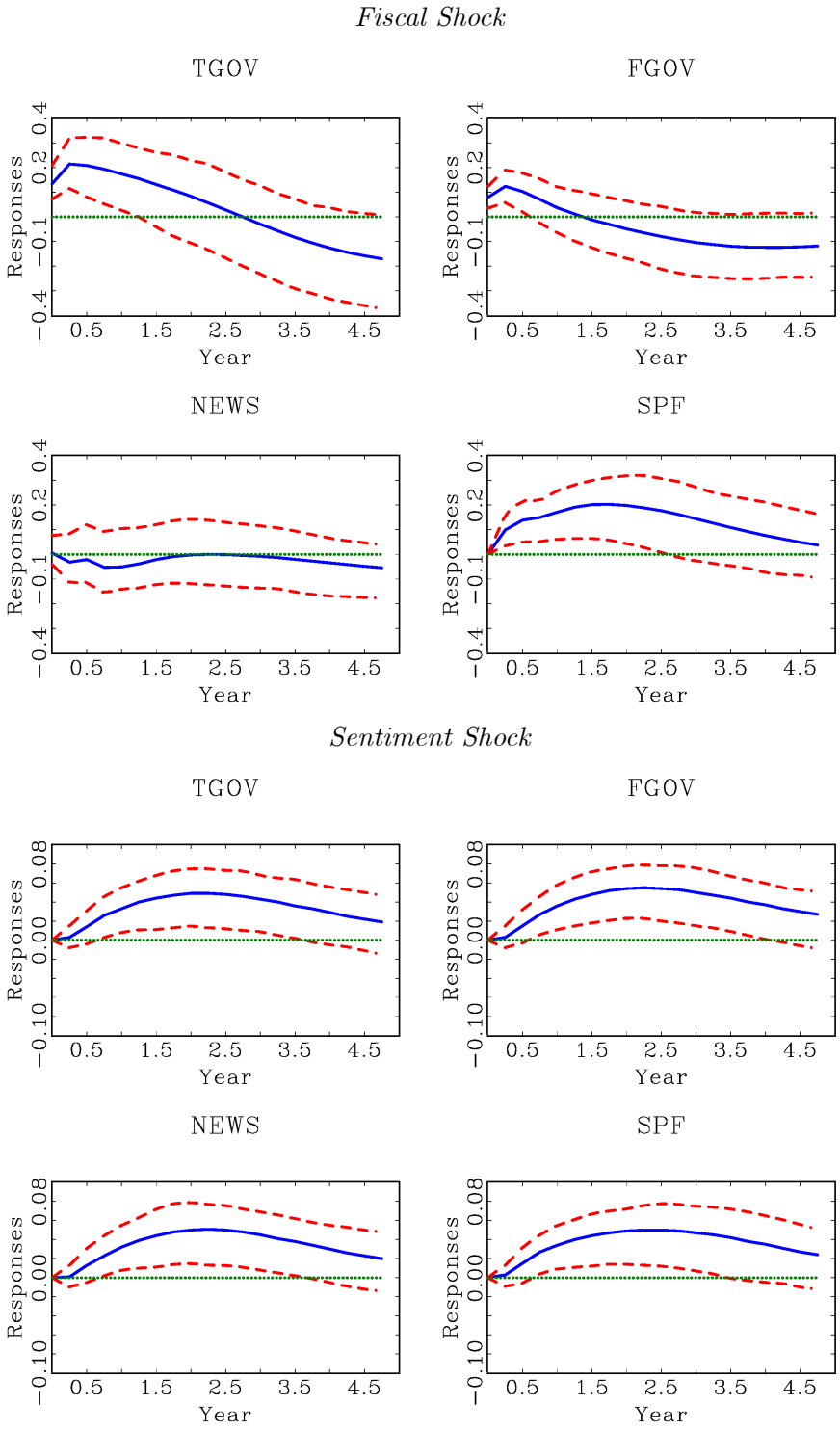
Note: Dashed lines are the 95% confidence band of the response function from 500 nonparametric bootstrap simulations.

Figure 9. Responses of Durable Goods Consumption to the Fiscal Shock



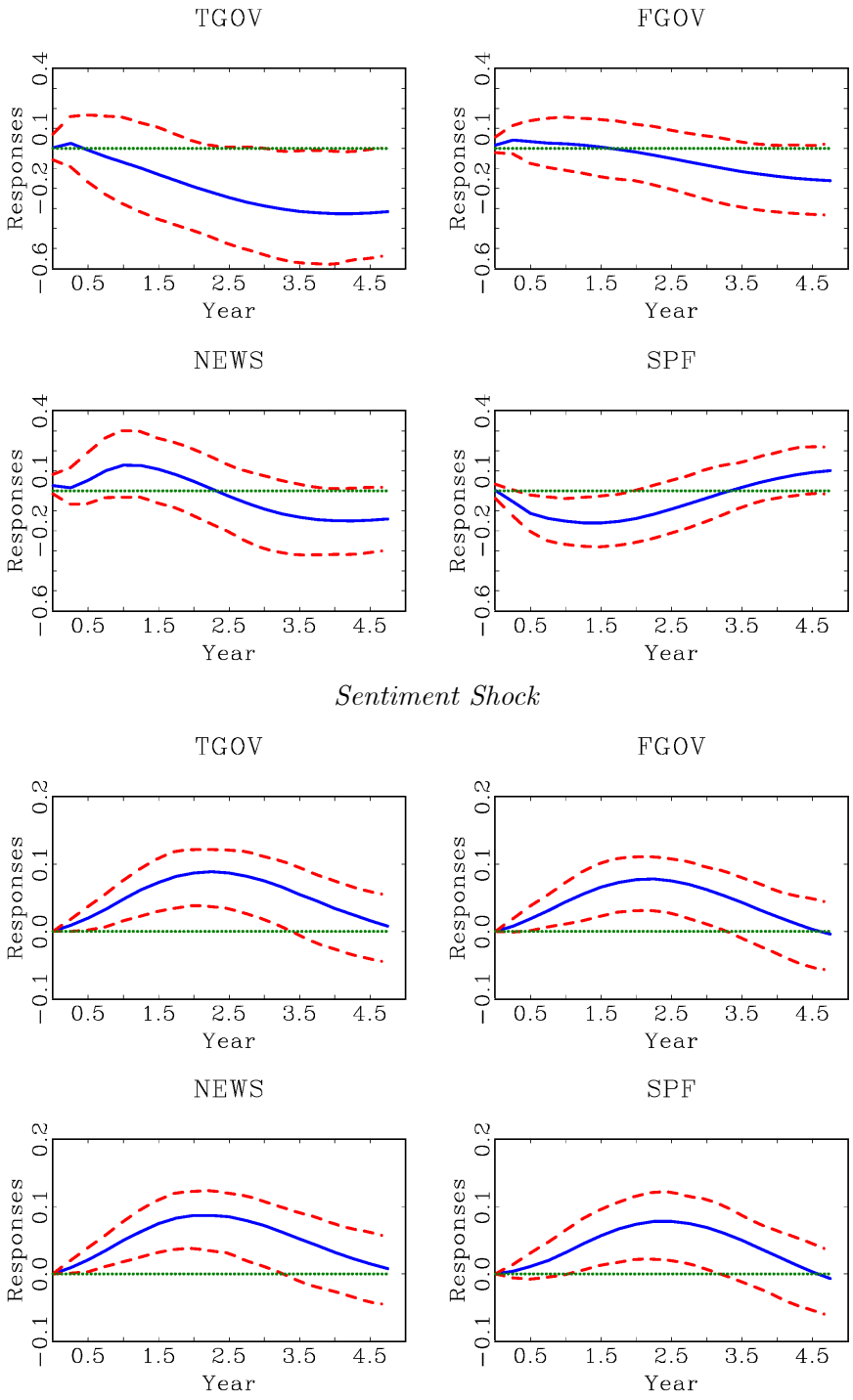
Note: Dashed lines are the 95% confidence band of the response function from 500 nonparametric bootstrap simulations.

Figure 10. Responses of Nondurables Good and Services Consumption



Note: Dashed lines are the 95% confidence band of the response function from 500 nonparametric bootstrap simulations.

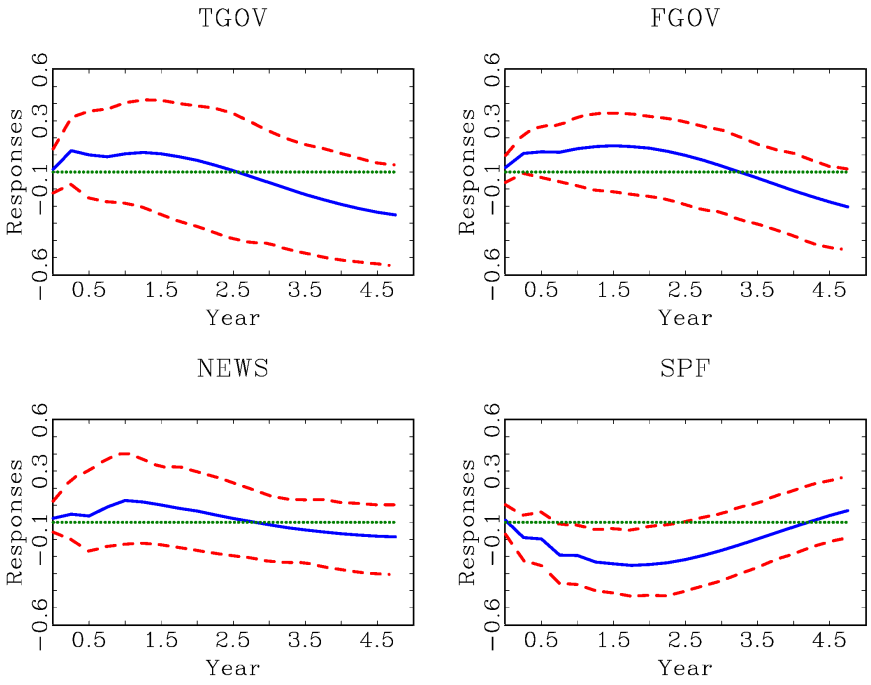
Figure 11. Responses of Private Job



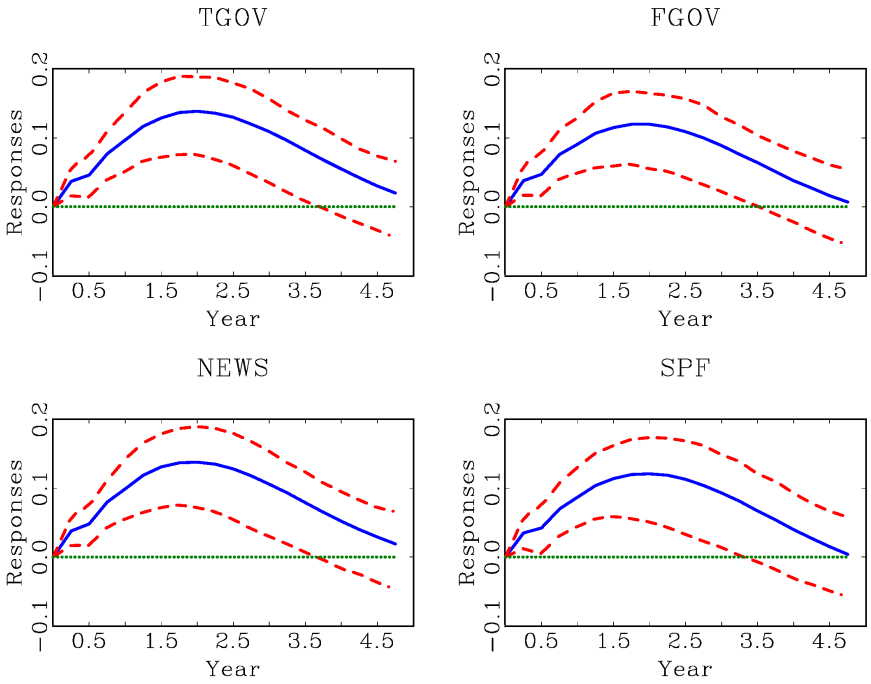
Note: Dashed lines are the 95% confidence band of the response function from 500 nonparametric bootstrap simulations.

Figure 12. Responses of Private Wage

Fiscal Shock

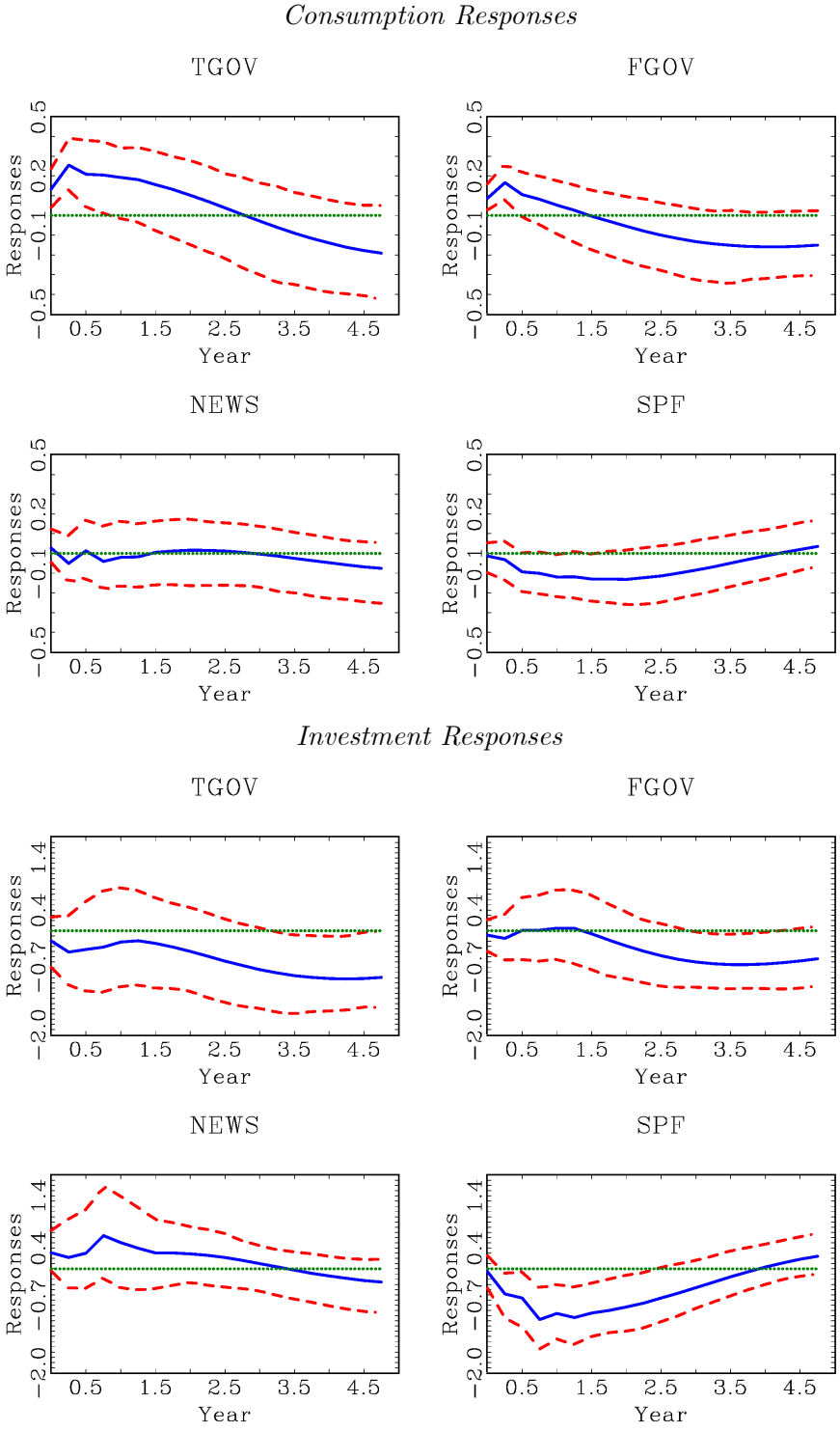


Sentiment Shock



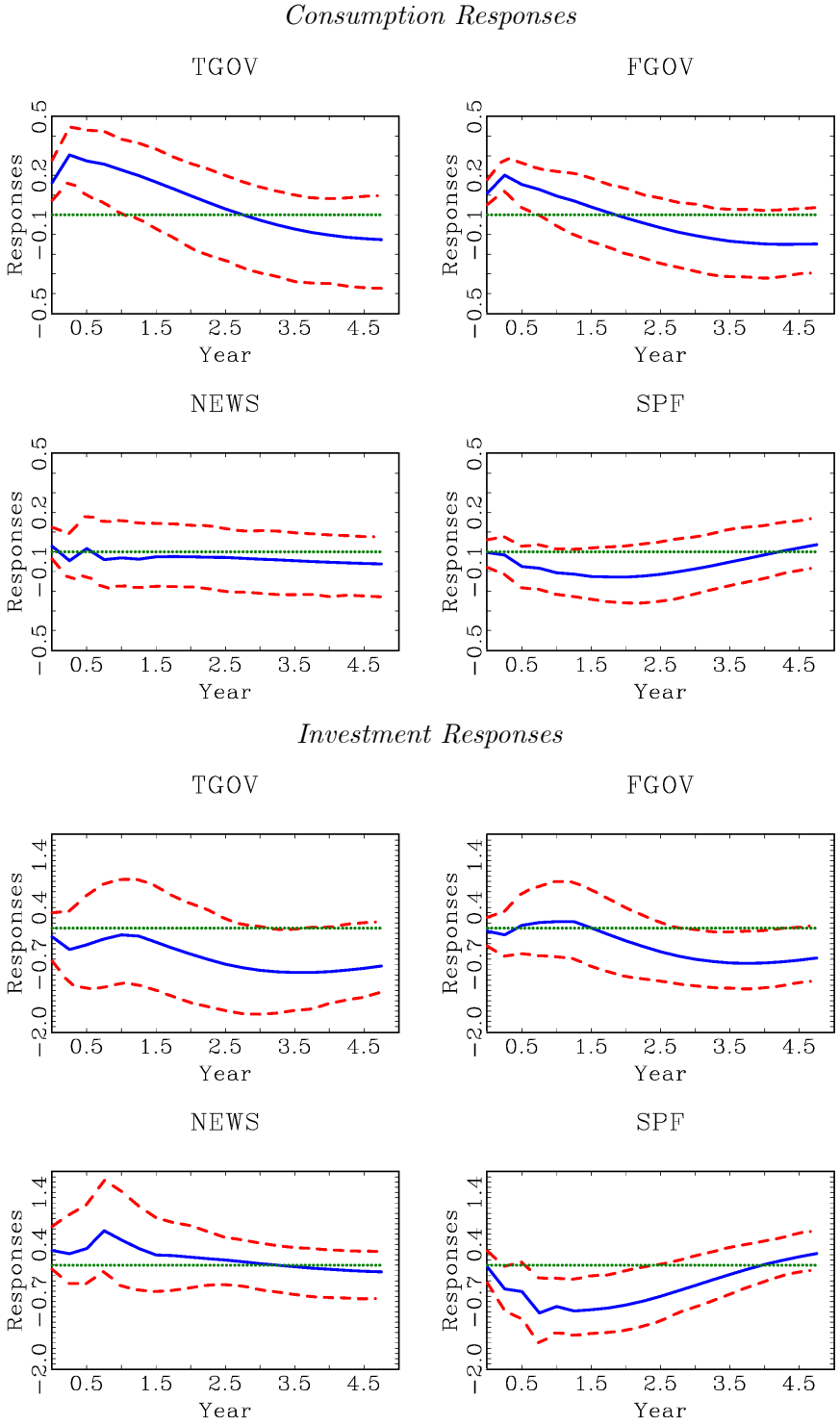
Note: Dashed lines are the 95% confidence band of the response function from 500 nonparametric bootstrap simulations.

Figure 13. Responses to the Fiscal Shock with ICE



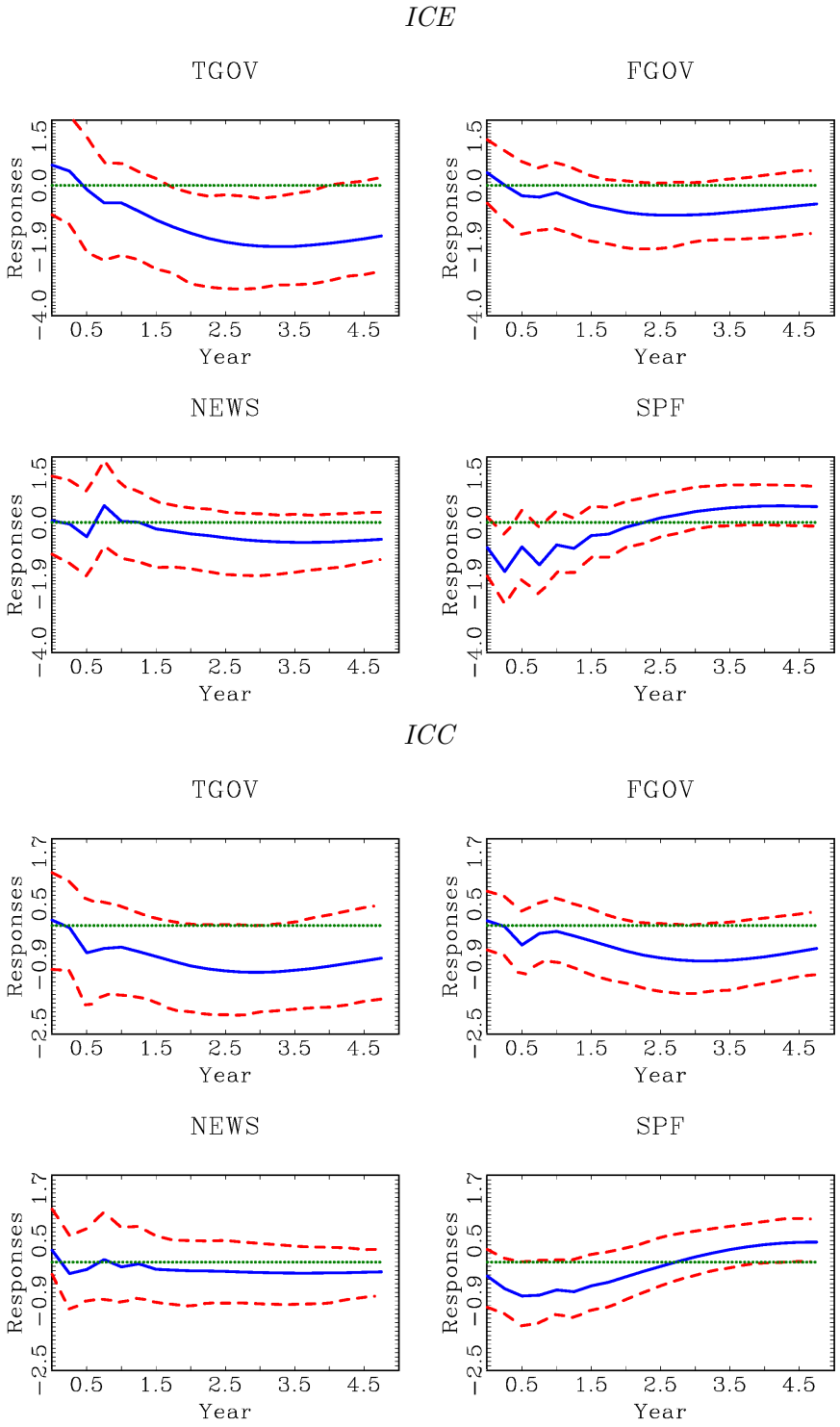
Notes: ICE denotes the index of consumer expectations.

Figure 14. Responses to the Fiscal Shock with ICC



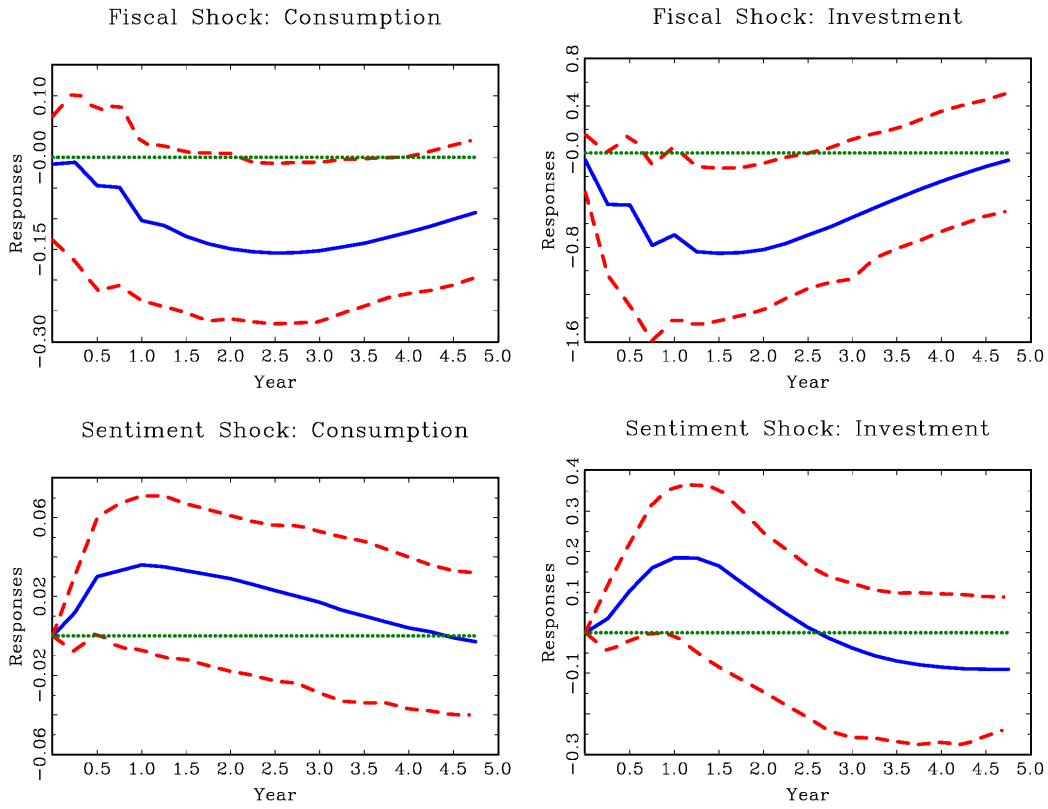
Notes: ICC denotes the index of current economic conditions.

Figure 15. Sentiment Responses to the Fiscal Shock: Sub-Indices



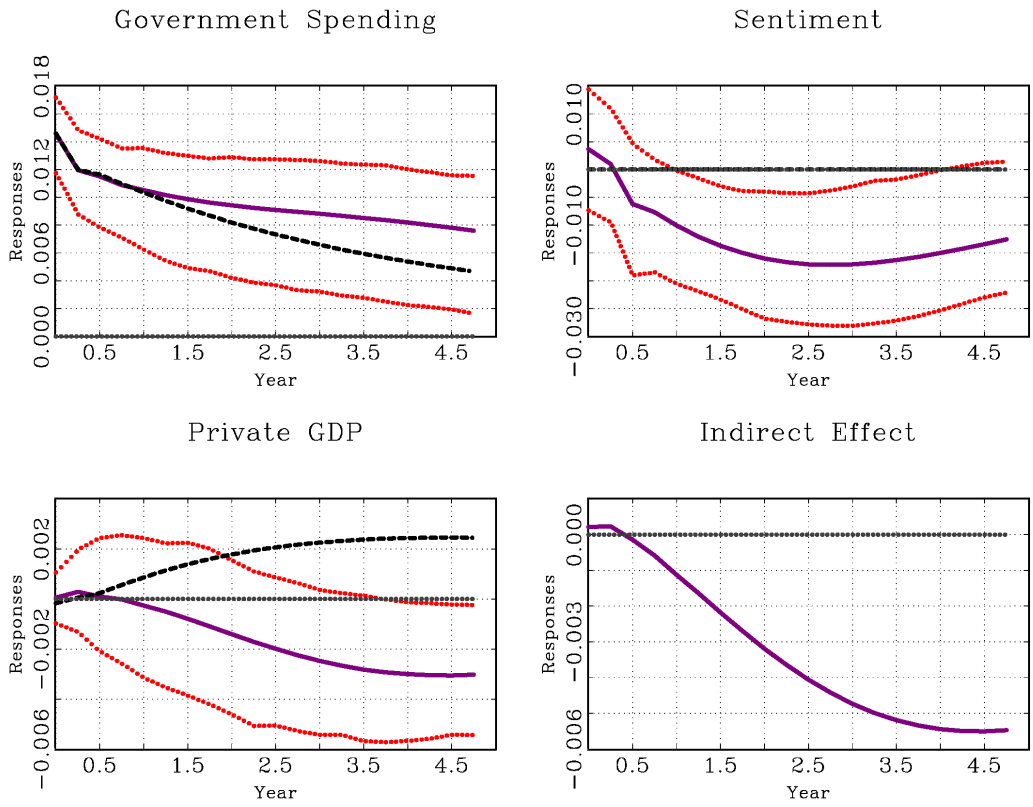
Notes: ICE and ICC denote the index of consumer expectations and the index of current economic conditions, respectively.

Figure 16. Sub-Sample Analysis: 1981:III - 2013:II



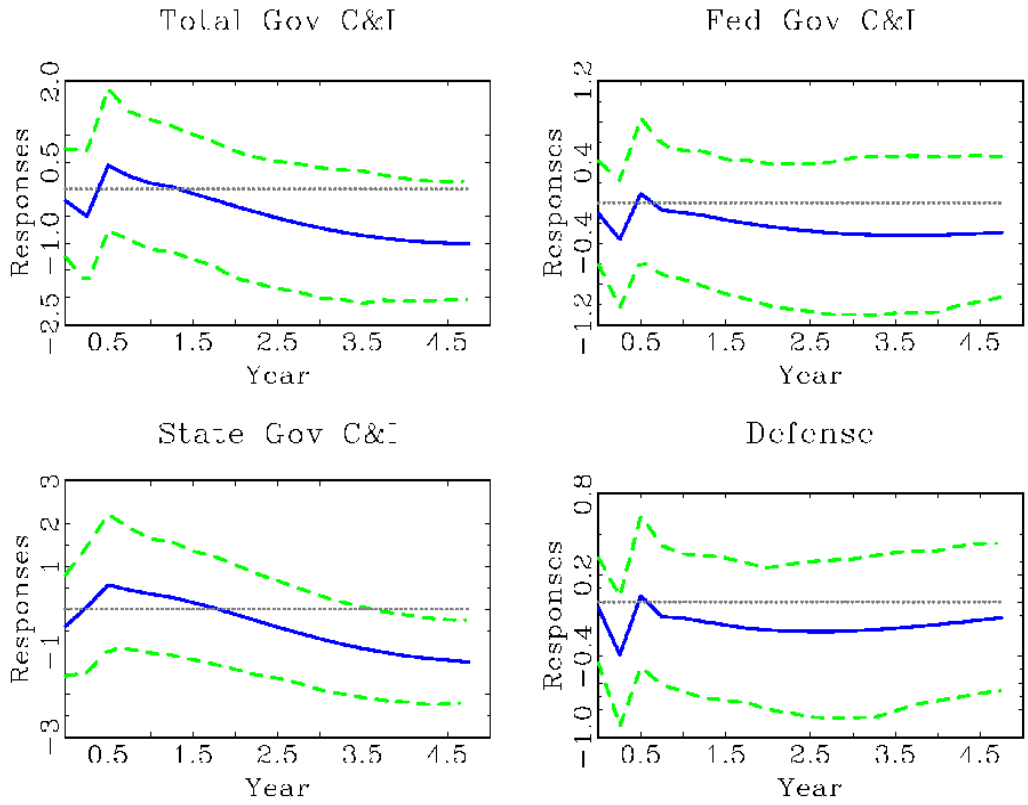
Notes: Response function estimates are from *SPF* model with the *SPF* forecast error of the federal spending growth rate excluding the forecast error of the defense spending growth rate.

Figure 17. Counterfactual Simulation Exercises: Private GDP



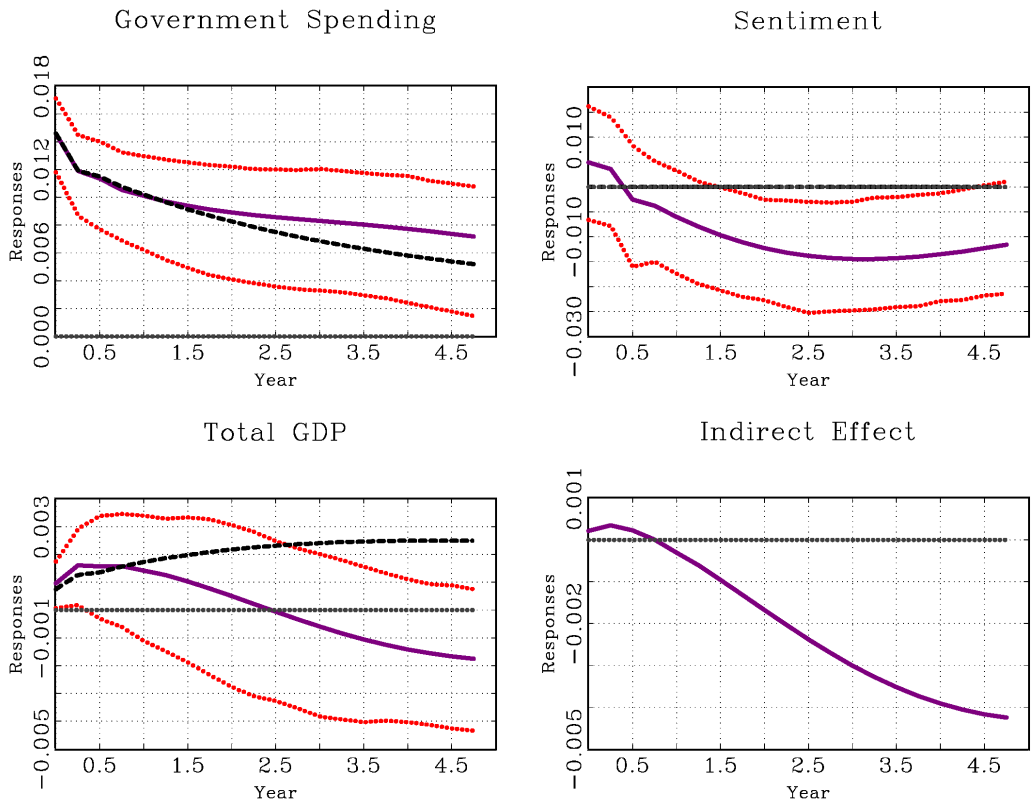
Notes: The estimates are from tri-variate VAR models with the fiscal variable, the sentiment variable, and the private GDP. The solid lines are the impulse-response function estimates from unconstrained models. The dashed lines are the hypothetical response functions with additional shocks that hold sentiment unchanged for all forecast horizons. The last figure measures the estimated indirect effect of the sentiment shock on the private GDP.

Figure 18. Sentiment Responses with Alternative Identification Methods



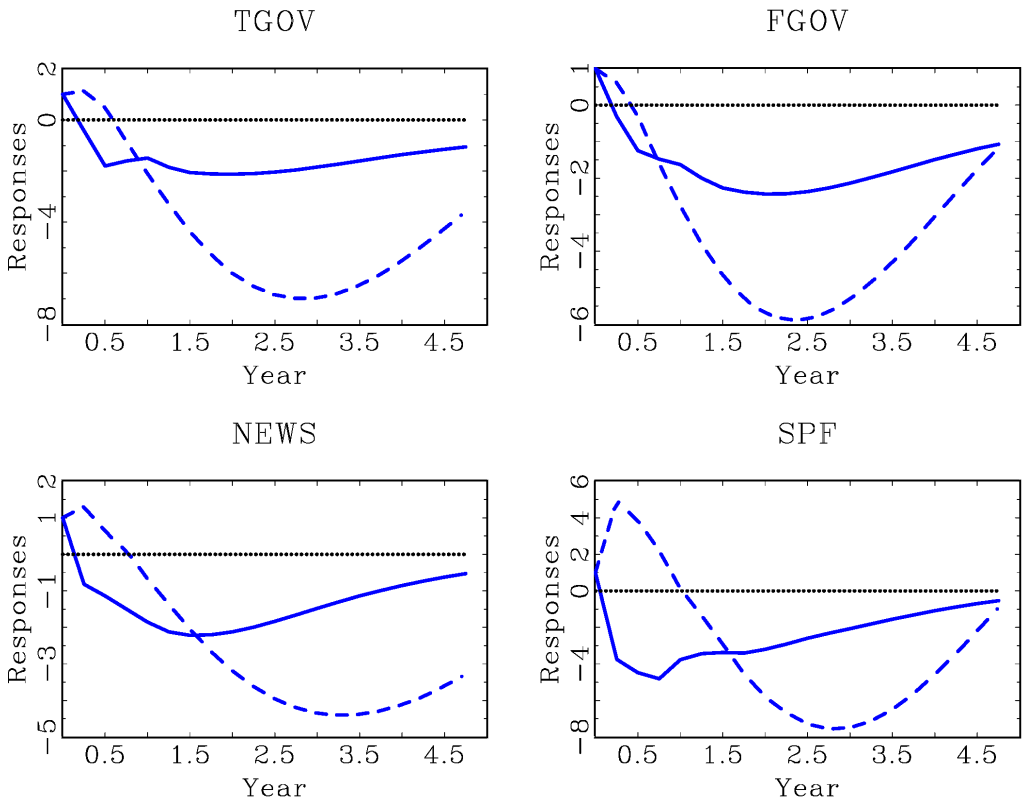
Notes: The estimates are from tri-variate VAR models with the fiscal variable, the sentiment variable, and the private GDP. The solid lines are the impulse-response function estimates from unconstrained models. Dashed lines are the 95% confidence band of the response function from 500 nonparametric bootstrap simulations.

Figure 19. Counterfactual Simulation Exercises: Total GDP



Notes: The estimates are from tri-variate VAR models with the fiscal variable, the sentiment variable, and the total GDP. The solid lines are the impulse-response function estimates from unconstrained models. The dashed lines are the hypothetical response functions with additiona shocks that hold sentiment unchanged for all forecast horizons. The last figure measures the estimated indirect effect of the sentiment shock on the GDP.

Figure 20. Sentiment Responses to the Fiscal Shock: Threshold VAR



Notes: Sentiment responses to the fiscal shock are reported. The threshold variable (τ_{t-1}) is one-period lagged log differenced real (total) GDP. Solid lines are responses during recessions ($\tau_{t-1} < \tau^*$), while dashed lines are those in booms ($\tau_{t-1} > \tau^*$). The estimates are from trivariate VAR models with the fiscal variable, the private GDP, and the sentiment variable.

Table 1. Data Descriptions

Data ID	Description
GDP	Gross Domestic Product
PCE	Personal Consumption Expenditures
PCEDG	Personal Consumption Expenditures: Durable Goods
PCEND	Personal Consumption Expenditures: Nondurable Goods
PCES	Personal Consumption Expenditures: Services
GPDI	Gross Private Domestic Investment
W068RCQ027SBEA	Government total expenditures
W019RCQ027SBEA	Federal government total expenditures
GDPDEF	Gross Domestic Product: Implicit Price Deflator, Index 2009 =100
W006RC1Q027SBEA	Federal government current tax receipts
POP	Total Population: All Ages including Armed Forces Overseas
TB3MS	3-Month Treasury Bill: Secondary Market Rate
M2	M2 Money Stock
USPRIV	All Employees: Total Private Industries
A132RC1Q027SBEA	Compensation of employees: Wages and salaries, Private industries
UMCSENT	Consumer Sentiment Index: Survey of University of Michigan
News	Defense News Series: Valerie Ramey's website
SPF	Survey of Professional Forecasters from Philadelphia Fed.

Note: We obtained most data from the Fred. UMCSENT is from the Surveys of Consumers website at the University of Michigan. "News" variable is from Valerie Ramey's website. "SPF" denotes the mean responses of the real federal government spending data from the Survey of Professional Forecasters database obtained from the Philadelphia Fed website. The data prior to 1981 SPF data are obtained from Tom Stark at the Philadelphia Fed.

Not-for-Publication Appendix

Figure A1. Private GDP VAR

$\mathbf{x}_t = [fgov_t \;\; priy_t \;\; sent_t \;\; tr_t \;\; i_t \;\; m_t]'$

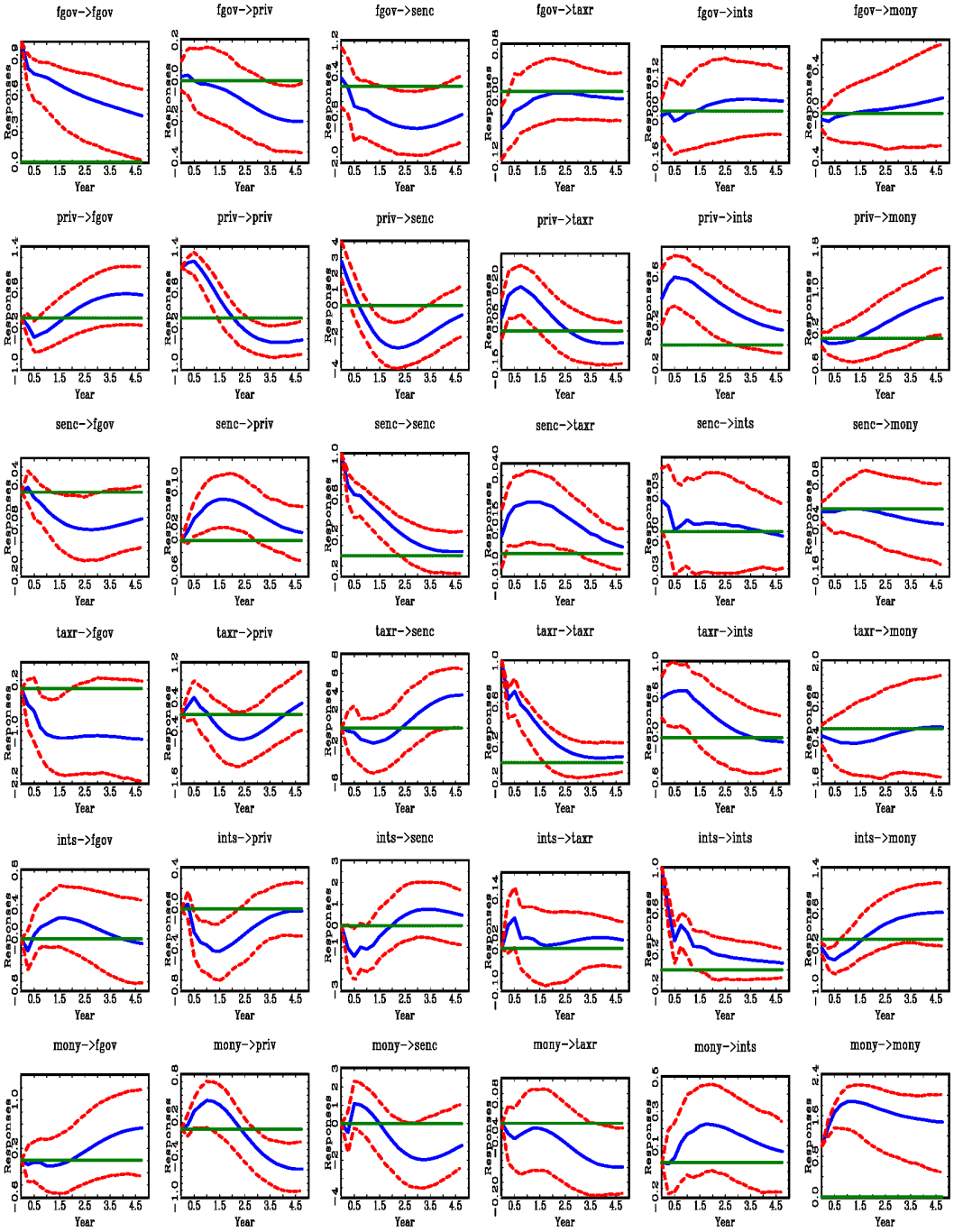


Figure A2. TG VAR

$\mathbf{x}_t = [tgov_t \;\; invt_t \;\; conm_t \;\; sent_t \;\; tr_t \;\; i_t \;\; m_t]'$

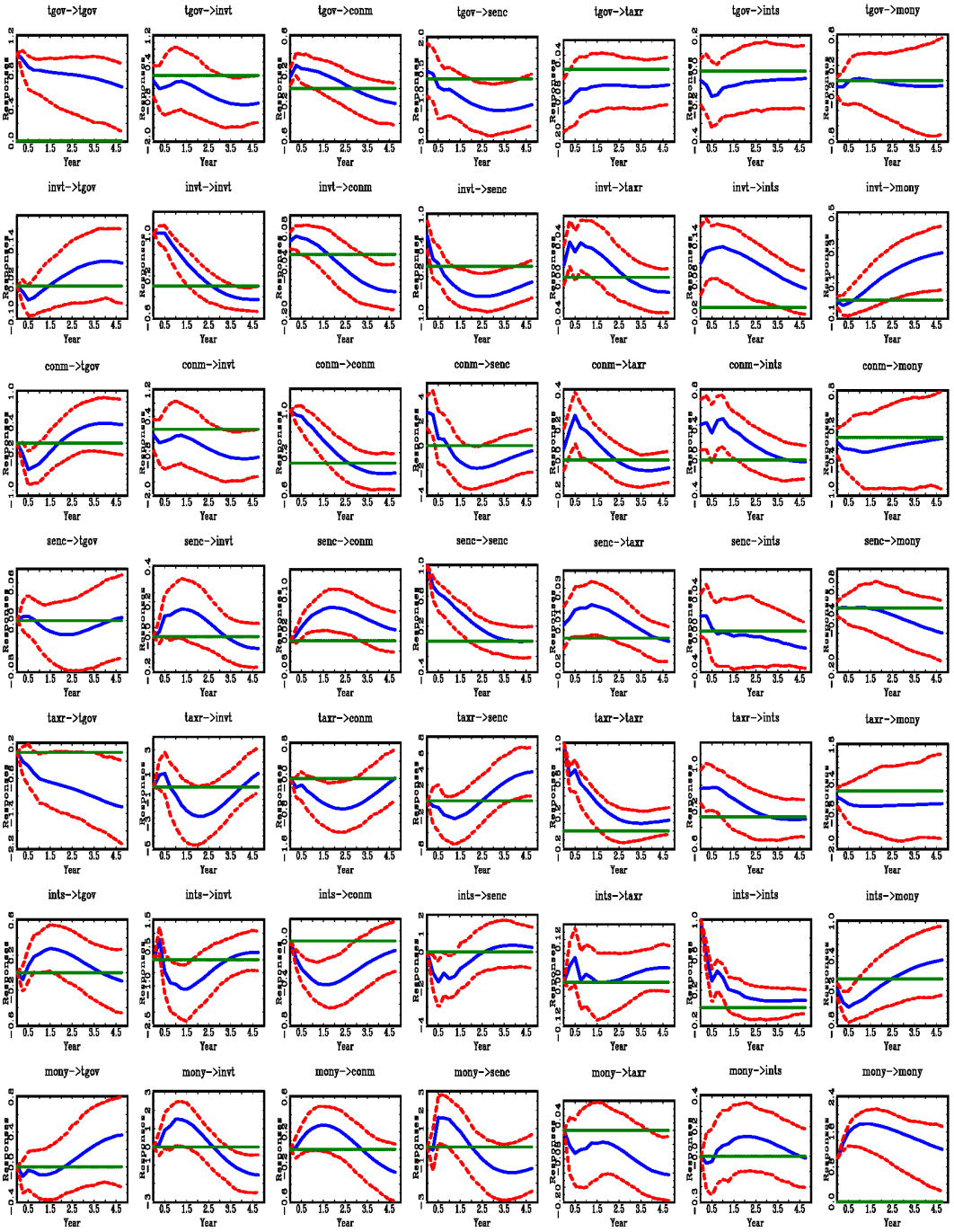


Figure A3. NEWS VAR I

$\mathbf{x}_t = [news_t \; invt_t \;\; conm_t \;\; sent_t \;\; tr_t \;\; i_t \;\; m_t]'$

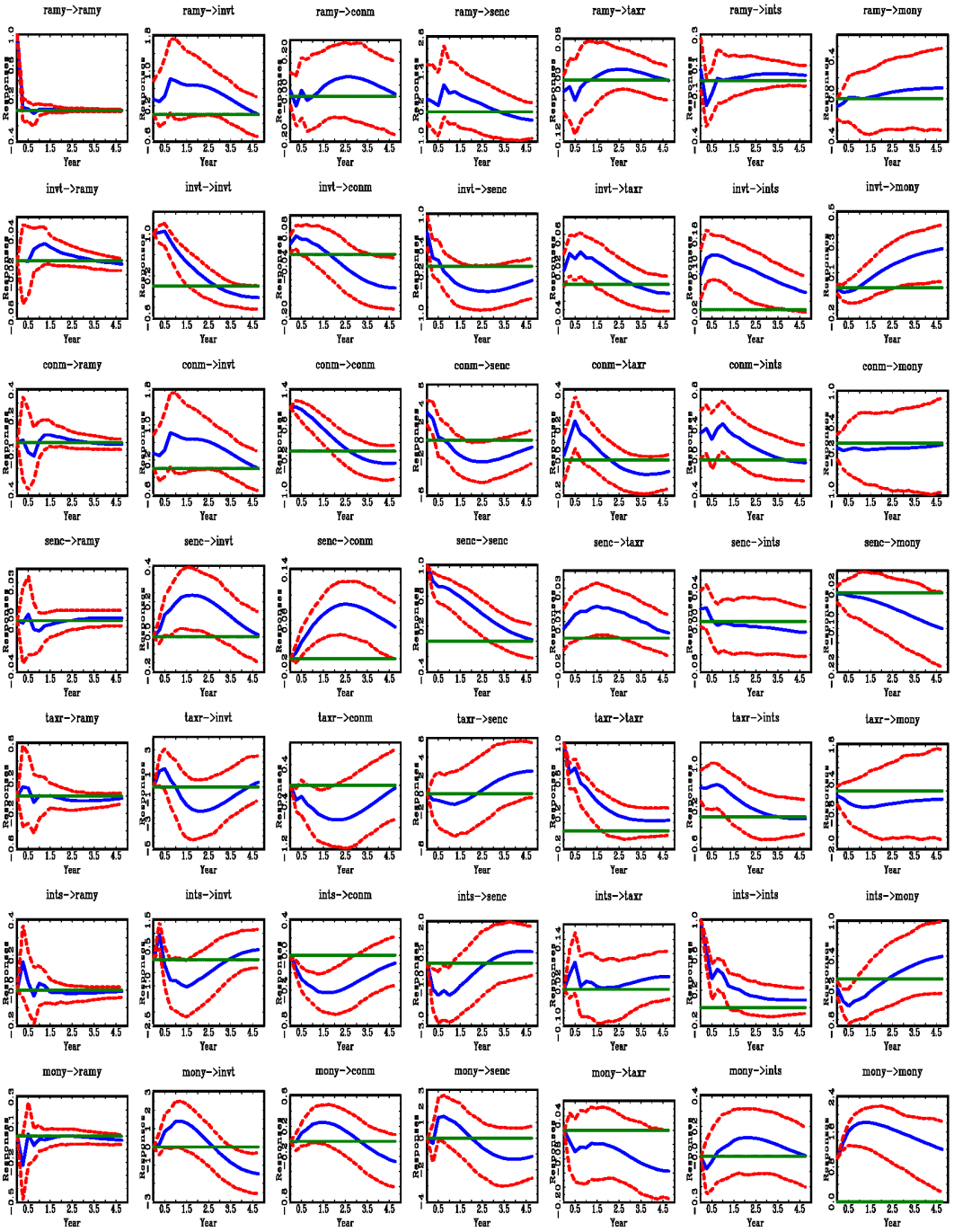


Figure A4. SPF VAR I

$\mathbf{x}_t = [spf_t \;\; invt_t \;\; conm_t \;\; sent_t \;\; tr_t \;\; i_t \;\; m_t]'$

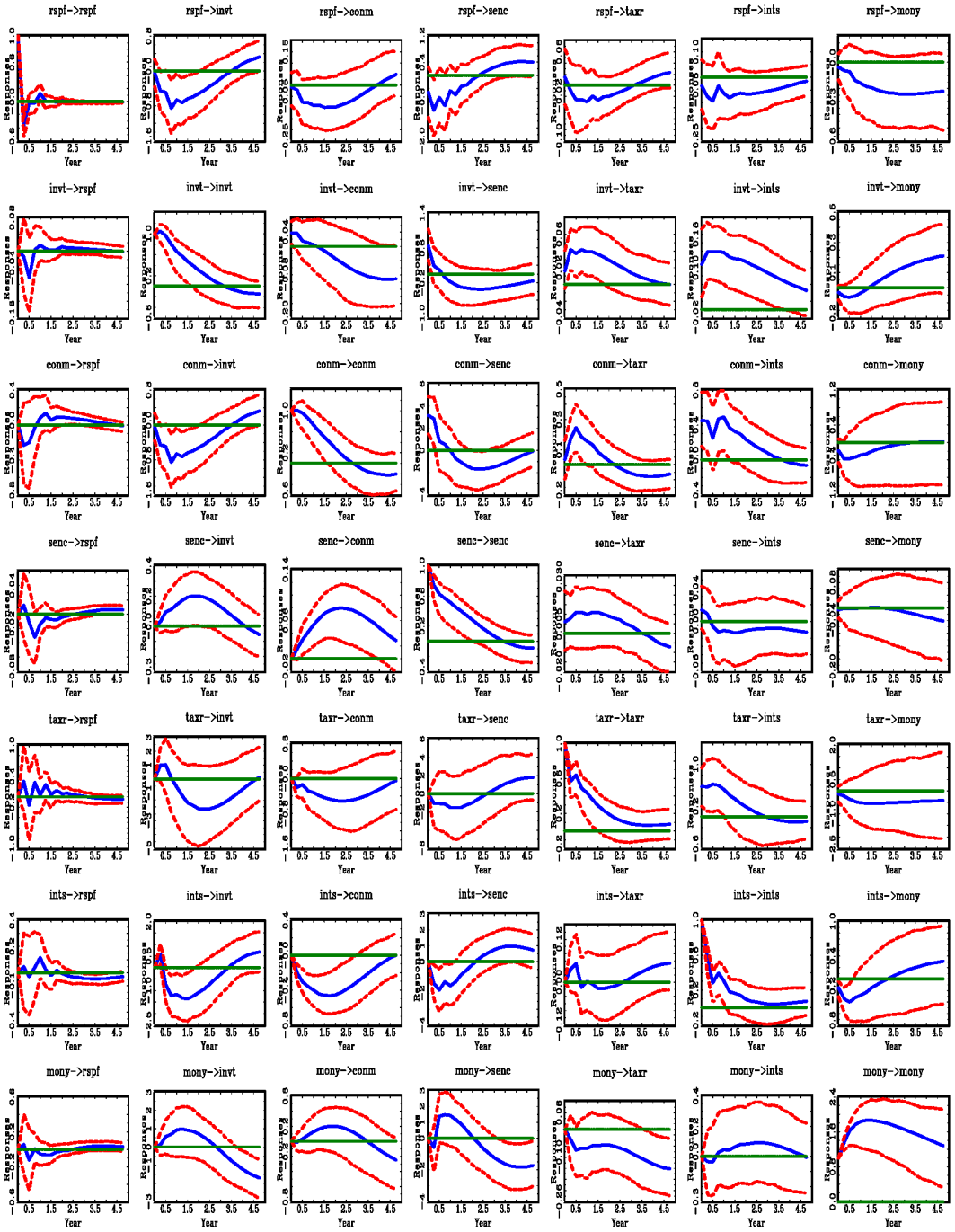


Figure A5. FG VAR

$\mathbf{x}_t = [fgov_t \;\; tgov_t \;\; invt_t \;\; conm_t \;\; sent_t \;\; tr_t \;\; i_t \;\; m_t]'$

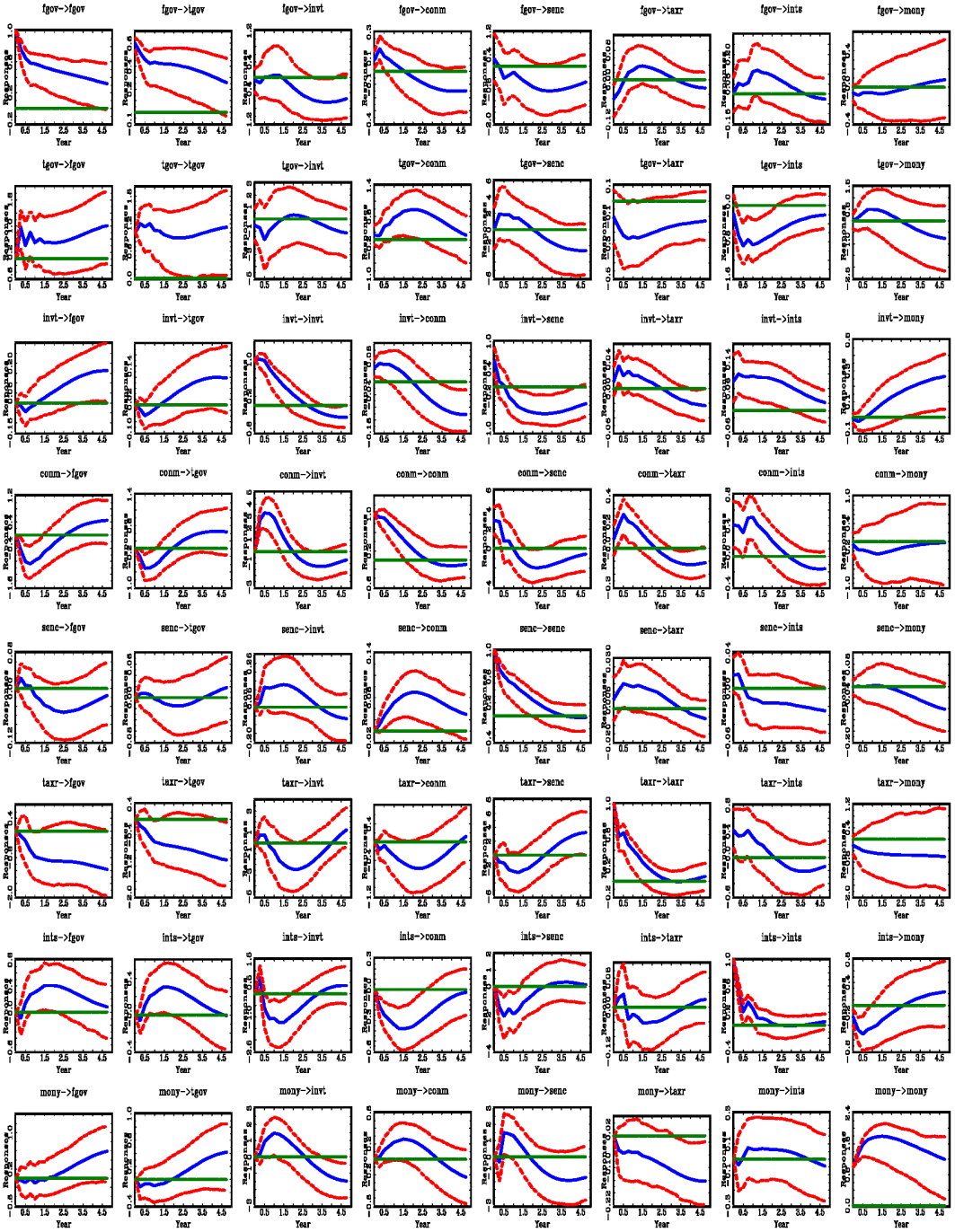


Figure A6. NEWS VAR II

$\mathbf{x}_t = [news_t \;\; tgov_t \;\; invt_t \;\; conm_t \;\; sent_t \;\; tr_t \;\; i_t \;\; m_t]'$

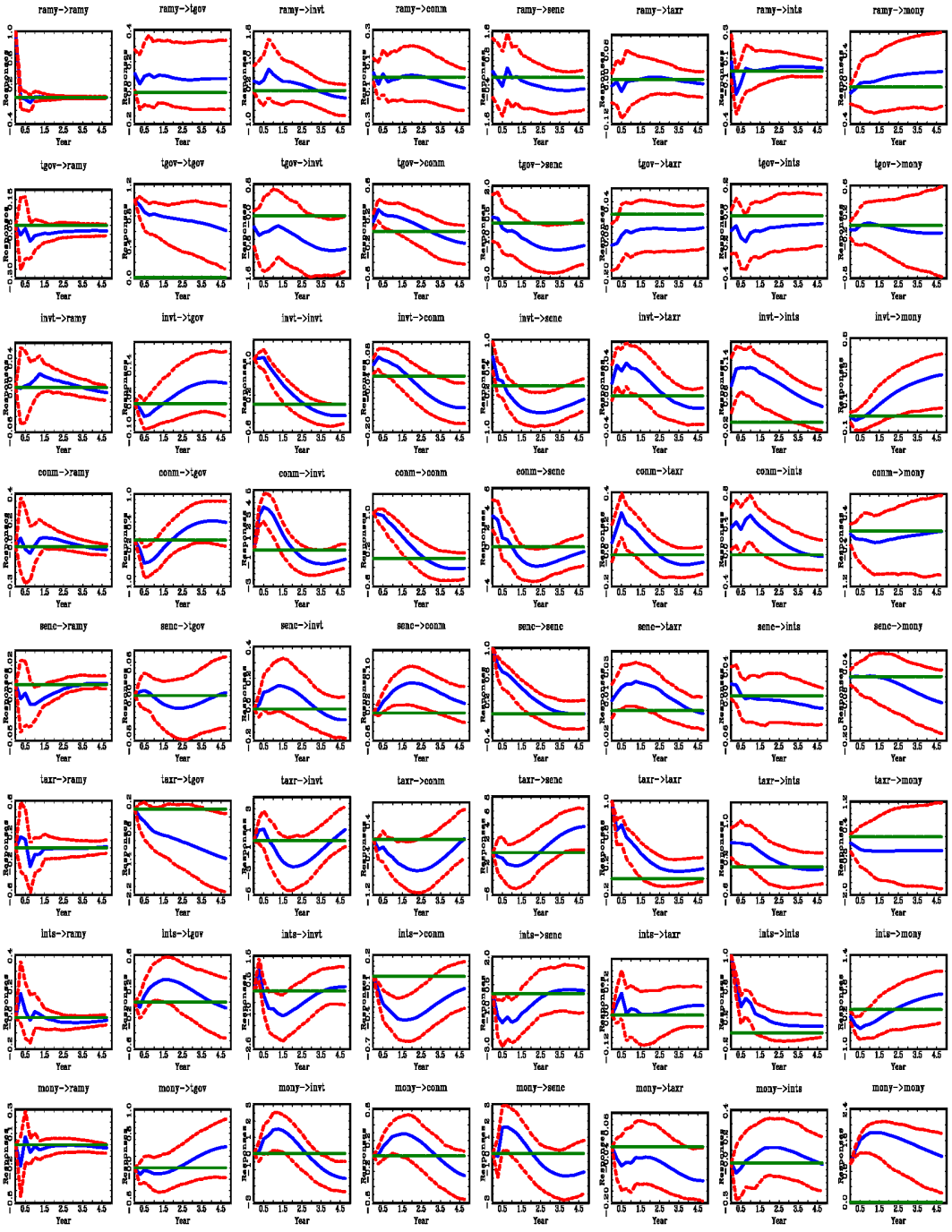


Figure A7. SPF VAR II

$\mathbf{x}_t = [spf_t \;\; tgov_t \;\; invt_t \;\; conm_t \;\; sent_t \;\; tr_t \;\; i_t \;\; m_t]'$

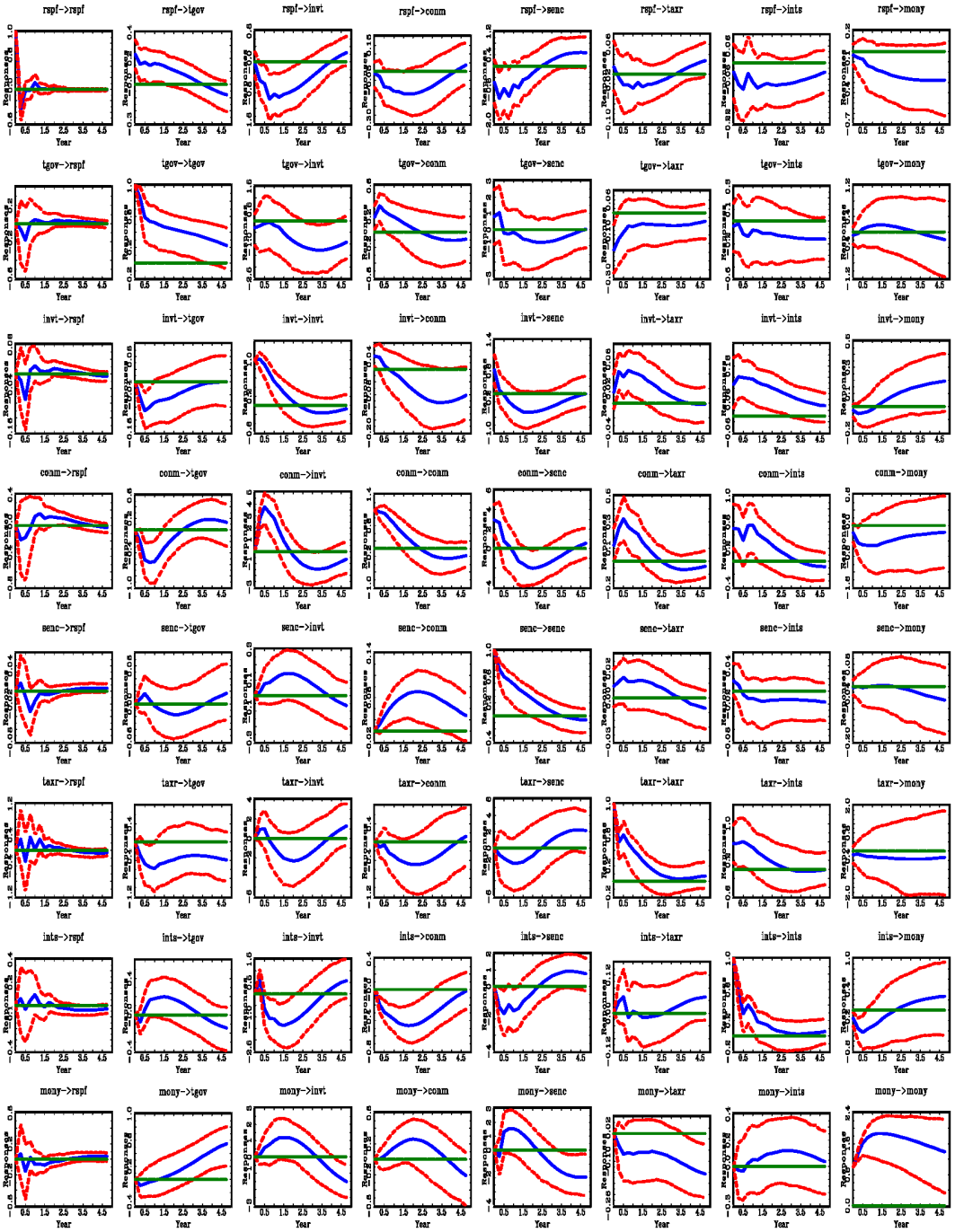


Figure A7. SPF VAR I: 1981:III - 2013:II

$\mathbf{x}_t = [spf_t \;\; invt_t \;\; conm_t \;\; sent_t \;\; tr_t \;\; i_t \;\; m_t]'$

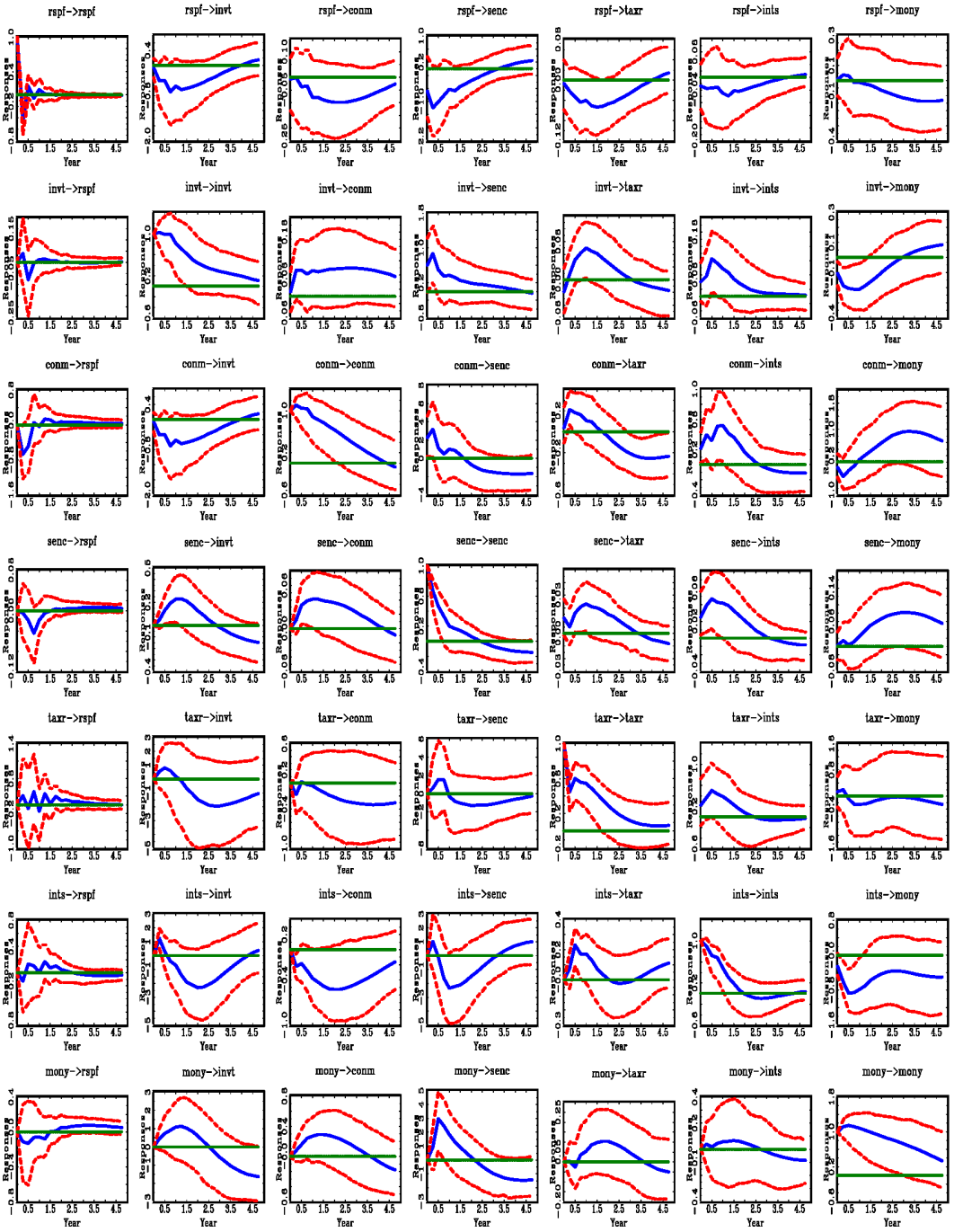


Figure A8. SPF VAR II: 1981:III - 2013:II

$\mathbf{x}_t = [spf_t \;\; tgov_t \;\; invt_t \;\; conm_t \;\; sent_t \;\; tr_t \;\; i_t \;\; m_t]'$