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 U.S. 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 spending fails to rise persistently in response to positive spending shocks, 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. The government spending shock generates consumer pessimism, resulting in subsequent decreases in private activity, weakening the effectiveness of the fiscal policy. We further corroborate our claims via counterfactual simulation exercises and nonlinear state-dependent VAR model estimations.

Keywords: Government Spending; Consumer Sentiment; Survey of Professional Forecasters; Nonlinear 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 roughly in line with key features of the New Keynesian macroeconomic model. See, among others, Rotemberg and Woodford (1992), Devereux, Head, and Laphan (1996), Fatás and Mihov (2001), Blanchard and Perotti (2002), Perotti (2005), Galí, López-Salido, and Vallés (2007).[1]

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 (2011b) points out, 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).[2]

One closely related literature focuses on the output multiplier of government spending. Empirical evidence is again mixed. For instance, Ramey and Shapiro (1998), Hall (2009),

[1] Consumption may rise in response to the government spending shock only in heavily restricted models. See, among others, Devereux, Head, and Laphan (1996) and Galí, López-Salido, and Vallés (2007).

[2] 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.

Barro and Redlick (2011), and Ramey (2011a) obtained fairly low government spending multiplier estimates, while Hall (2009) and Christiano, Eichenbaum, and Rebelo (2011) 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, 2011a). 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) and Ilzetzki, 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 (2015) report higher fiscal multipliers in a regime of a low economic activity than those in a high activity regime, 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 U.S. 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 (2006, 2007) also propose similar news-driven business cycle models. 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 become more optimistic in response to the fiscal shock during times of slack, which contrasts sharply with our work that reports solid negative responses of consumer sentiment to the fiscal shock in all phases of business cycle. In what follows, however, we demonstrate that their nonlinear evidence of consumer optimism vanishes when one uses properly detrended data.

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 component from the total GDP. For this purpose, we employ an array of identification methods for the fiscal shock that includes conventional recursively identified VAR models and the expectational VAR (*EVAR*) model of Ramey (2011b) that uses the survey of professional forecasters data (SPF).[3]

Our major findings are as follows. First, government spending shocks are not effective in stimulating private activity. Consumption tends to respond positively only for a very short period of time, then rapidly decreases. Furthermore, initial increases in consumption are mainly driven by increases in nondurable good and services 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 such increases in income as windfall. When changes in fiscal spending are allowed to be *anticipated* in the expectational VAR framework (Ramey, 2011b), fiscal policy shocks are mostly ineffective as we observe negligible or even negative responses since the impact of the shocks. Similarly, we were unable to find any persistently positive responses of investment to fiscal spending shocks. Also, the fiscal shock fails to enhance the labor market condition either. On the other hand, we observe solid

[3]Perotti (2011) named Ramey's (2011b) model the expectational VAR model.

positive responses of consumption, investment, and real wages to the sentiment shock from all models we consider in the present paper.

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 the view that consumer sentiment *leads* private activity rather than it passively *reflects* the current state of the economy, implying an important role of a sentiment channel in the propagation mechanism of the fiscal spending shock.

Third, we provide further evidence in favor of an important role of the sentiment channel via counterfactual simulation exercises, employing the same VAR model by Bachman and Sims (2012) for an array of alternative identification schemes for the fiscal spending shock. Results strongly support our findings when we use properly detrended data. We also employ a nonlinear, state-dependent VAR model that was used in Bachman and Sims (2012). Again, estimation results confirm our findings, and we find no evidence of nonlinear consumer optimism in response to the fiscal shock.

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 ordering. 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 additional VAR analyses. Section 5 reports counterfactual simulation exercises and the estimates from nonlinear VAR models. Section 6 concludes.

2 The Econometric Model

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

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

where $\mathbf{A}_0^{-1}$ is the lower-triangular Choleski factor, and $\mathbf{u}_t$ is a vector of orthonormal structural shocks, $E\mathbf{u}_t\mathbf{u}_t^{'} = \mathbf{I}$. $\mathbf{x}_t$ includes the following macroeconomic variables. $\mathbf{g}_t$ is 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 consumer sentiment variable, and $\mathbf{z}_t$ is a vector of control variables that includes the 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 our attention to a closed economy model so that we can compare our findings with others that use similar models in the current literature.

Motivated by Ramey's (2012) work, we employ an array of VAR models based on alternative identification methods for the government spending shock. Our first model, *TGOV*, is similar to conventional recursively identified VAR models that identify the government spending shock by unexpected increases in the total government spending ($tgov_t$), that is, $\mathbf{g}_t = tgov_t$. See, among others, Blanchard and Perotti (2002), Perotti (2005, 2008), and Galí, López-Salido, and Vallés (2007).

Motivated by Oh and Reis' (2012) work that suggests an important role of targeted transfers during the Great Recession, we employ the government total expenditures that includes transfer payments in addition to the government consumption and gross investment expenditures. Since transfers are considered the automatic stabilizers, $tgov_t$ is ordered next to $\mathbf{y}_t$.[4] That is,

$$\mathbf{x}_t^{TGOV} = [\mathbf{y}_t,\ tgov_t,\ \mathbf{z}_t,\ sent_t]' \tag{2}$$

[4]We thank a referee and the editor for pointing this out.

We also employ the so-called expectational VAR ($EVAR$) model, denoted the SPF model, that utilizes the survey of professional forecasters data, $\mathbf{g}_t = spf_t$. Ramey (2011b) points out that recursively identified government spending shocks may not be appropriate because planned changes in fiscal spending variables such as military spending are likely to be anticipated by market participants before the government actually implements it. She constructed a news variable via the one-quarter ahead forecast error of fiscal spending growth rates, using the Survey of Professional Forecasters from the Philadelphia Fed.[5] spf_t is ordered first following Ramey (2011b). That is,

$$\mathbf{x}_t^{SPF} = [spf_t,\ \mathbf{y}_t,\ \mathbf{z}_t,\ sent_t]' \tag{3}$$

Perotti (2011) argues, however, that Ramey's $EVAR$ model 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 the $FGOV$ model. Since transfers are included in the federal government total spending, we put $[fgov_t,\ tgov_t]'$ next to $\mathbf{y}_t$ as follows.

$$\mathbf{x}_t^{FGOV} = [\mathbf{y}_t,\ fgov_t,\ tgov_t,\ \mathbf{z}_t,\ sent_t]' \tag{4}$$

Note that $sent_t$ is ordered last in all models unlike Bachman and Sims (2012) who put it in the middle of the VAR. This is because we try to identify the sentiment shock separated from its endogenous responses to other variables as much as possible, allowing $sent_t$ to respond to all other shocks, although our major findings are robust to alternative ordering used by Bachman and Sims (2012).[6]

It is well-known that econometric inferences from recursively identified VAR models might not be robust to alternative VAR ordering. It should be noted, however, that our major

[5] We do not employ her news variable that is constructed by changes in the expected present value of government spending, utilizing information from mass media sources. It is known that this variable may be uninformative for the post-war data. Results with this news variable are available in Jia and Kim (2016).

[6] See Jia and Kim (2016) for results with alternative ordering. We thank a referee and the editor for this suggestion.

findings do not suffer from these issues. For example, in the *SPF* model (3), *all* response functions to the government spending (spf_t) shock and to the sentiment ($sent_t$) shock are numerically identical even if we randomly shuffle all other variables. See Christiano, Eichenbaum, and Evans (1999) for details.

3 Empirical Findings

3.1 Data Descriptions

We use quarterly frequency data from 1960:I to 2013:II. We obtained most data from the FRED with a few exceptions. The consumer sentiment index ($sent_t$) is from the University of Michigan's Survey of Consumers database. $sent_t$ is a combination of its two sub-indices, the current economic conditions index (ICC) and the index of consumer expectations (ICE). That is, it reflects consumers' perception on the current state of the economy as well as economic conditions in the near future. All three indices are highly correlated each other, thus we report empirical findings mostly with the consumer sentiment index.

We use the government "total" expenditures for $\mathbf{g}_t$ that include transfer payments and interest payments as well as capital transfer payments.[7] All public and private spending variables ($tgov_t, fgov_t, conm_t, invt_t$) are in real per capita terms, divided by the GDP deflator and population, then log-transformed. $sent_t$ is expressed in natural logarithm. tr_t denotes the federal 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.

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

[7] The government total expenditures is a broader measure than the "government consumption and gross investment expenditures," which is the government component of the total GDP.

forecasts of the GDP deflator to convert the nominal defense spending data to real spending data.[8]

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 does not reflect such changes, we rescaled all relevant forecast data with 2009 as the common base year.[9] Following Ramey (2011b), 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. We combine forecast errors of defense spending growth rates with those of federal spending growth rates in order to get the data with reasonably long sample period. As Ramey (2011b) discussed, this 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.[10]

3.2 Fiscal Spending Shocks and Private activity

We first estimate the fiscal spending effect on the private GDP ($pgdp_t$) that excludes the government consumption and gross investment from the total GDP.[11] Figure 1 reports the response function estimates of the private GDP to the fiscal spending shock and to the sentiment shock using the three models presented in the previous section. We also report the 95% confidence bands obtained from 500 nonparametric bootstrap simulations from the empirical distribution.

As can be seen in the first column of Figure 1, the fiscal shock has negligible or even negative effects on the private GDP in all models we consider, which is consistent with the

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

[9] Ramey (2011b) and Forni and Gambetti (2016) 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 9 outliers (big changes due to changes in base year) in their fiscal spending variable.

[10] Our previous version paper investigated consequences of combining these two series using sub-sample analysis. Major findings from a shorter (homogeneous) sample period from 1981:III to 2013:II remain valid. We obtained similar impulse-response functions. Results are available in Jia and Kim (2016).

[11] We use three lags for our VAR estimations based on the Akaike Information Criteria with a maximum 4 lags.

findings by Ramey (2012). This implies that positive responses of the total GDP, if any, to the fiscal shock are likely to be driven by an expansion of the public sector. Contrary to the fiscal shock, the sentiment shock yields persistently positive effects (second column) on the private GDP for almost 3 years, which is significant at the 5%.

We note that these findings are consistent with the work by Hall (1993), Blanchard (1993), Cochrane (1994), and Bachman and Sims (2012), in the sense that we find a close relationship between consumer sentiment and economic activity. However, as we can see in the third column, our findings contrast sharply with those of Bachman and Sims (2012) who argue that the government spending shock has a positive effect on consumer confidence during times of slack. Put it differently, we report solid evidence of consumer pessimism in all models that may explain why the fiscal policy fails to stimulate private activity. In Section 5, we show that these findings remain valid even in nonlinear, state-dependent VAR models that were used by Bachman and Sims (2012).

Figure 1 around here

Next, we report impulse-response function estimates of private consumption ($conm_t$) and investment ($invt_t$) to the fiscal spending shock in Figure 2. Consumption responds significantly positively only for about a quarter under the $TGOV$ and $FGOV$ identification schemes, while no meaningful, even negative responses are observed when the SPF model is employed. Investment responses to the fiscal spending shock turn out to be mostly negligible and insignificant. These responses of consumption and investment are consistent with negligible and even negative responses of the private GDP to the fiscal shock reported in Figure 1.

On the other hand, consumption and investment respond significantly positively for a prolonged period of time to the sentiment shock in all models. That is, we obtained solid evidence of the persistently positive sentiment effects on private activity.

Figure 2 around here

3.3 Responses of Durable and Nondurable Goods Consumption

One of our objectives is to identify the propagation channel of the fiscal spending shock to promote private activity. We view the consumer sentiment as a potential candidate. As we've seen in Figure 1, 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.

Sudden and large increases in government spending may be interpreted as a sign of weak economy and may spread a feeling of pessimism, 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 decline.

We note that the "total" consumption ($conm_t$) responses in Figure 2 are more closely related with those of nondurable goods and services consumption ($conn_t$) rather than durable goods consumption ($cond_t$) in Figure 3. That is, consumption responses to the fiscal shock seem to be mainly driven by temporary changes in nondurable goods consumption. When fiscal spending is allowed to be anticipated as in the *SPF* model, 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. Since consumers tend to buy less durable goods such as automobiles and home appliances when they are not confident that the economy would continue to expand, these findings imply that fiscal shocks fail to generate consumer optimism on economic conditions in the near future.

In contrast, all consumption including durable good consumption respond significantly positively and persistently when the sentiment shock occurs no matter what models are employed.

Figure 3 around here

3.4 Fiscal Shock and the Role of the Sentiment Channel

We observe solid positive effects of the sentiment shock on private spending in all three models. 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 optimism. 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 their economic growth forecasts downward, 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 sentiment passively reflects such decreases in private GDP. We are skeptical to such a possibility for the following reasons.

As we can see in Figures 1 and 2, consumption tends to rise for a short period of time in response to the fiscal shock, whereas consumer sentiment falls almost immediately after the impact under these models. These responses are inconsistent with the 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 condi-

tions as well as the current conditions. Therefore, immediate decreases of the sentiment and short-run increases in consumption jointly imply that consumer sentiment does not passively reflect changes in private activity. Put it differently, our response function estimates imply the existence of the sentiment channel where sentiment plays a leading role in determining private activity.

4 Additional VAR Analysis

4.1 Effects on Private Employment and Wages

As Ramey (2012) points out, fiscal spending effects on private jobs ($pjob_t$) 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 is 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.

Private wages ($pwag_t$) 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.

Figure 4 reports the estimated fiscal policy effects on private labor market conditions that are obtained by replacing $\mathbf{y}_t$ in (2) through (4) with $pwag_t$ or $pjob_t$. We observe that fiscal shocks again fail to increase private employment in all models. Responses of the private sector jobs are overall negative, implying that public jobs may crowd out private sector jobs via increases in government value-added. Private wages overall respond positively but insignificantly in the $TGOV$ and $FGOV$ models, while insignificantly negative responses are

observed in the *SFP* model. On the contrary, the sentiment shock has solid positive effects on private employment and wages that last several years since the shock occurs whichever models are employed.

In a nutshell, the effects of the fiscal spending shock on private labor market conditions 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 4 around here

4.2 Sub-Sample Analysis

We implement a robustness check analysis for our key findings over different sample periods, employing a fixed-size rolling window scheme.

We begin with estimations of our VAR models (2), (3), and (4) to obtain the first set of the impulse-response functions using the initial $T_0 < T$ observations, $\{\mathbf{x}_t\}_{t=1}^{T_0}$. Then, we moved the sample period of the data forward by adding one more observation to the sample but dropping one earliest observation, $\{\mathbf{x}_t\}_{t=2}^{T_0+1}$, then re-estimate the response functions. We repeat this until we utilize the last set of observations, $\{\mathbf{x}_t\}_{t=T-T_0+1}^{T}$. Note that we maintain the same number of observations (T_0) throughout the whole exercises.

We report some results in Figure 5 employing a 30-year rolling window scheme that corresponds to 120 quarterly observations. The x-axis (Date) is a sequence of the 30-year rolling windows indexed from 1989:IV to 2013:II, whereas the y-axis (Year) is the time horizon of the response function indexed from 0 to 5 years. Lighter surface areas denote

negative responses of private GDP to the fiscal spending shock, while darker areas are positive responses.

Results overall confirm our previous findings using the full sample period. In response to the government spending shock, private GDP declines in all models, then slowly adjusts to the new long-run equilibrium. The sentiment shock, on the other hand, stimulate private spending persistently since the impact of the shock.

Figure 5 around here

5 Further Analysis

This section provides empirical findings from an array of counterfactual simulation exercises as well as nonlinear, state-dependent VAR models that allow regime-specific impulse-response analysis. We follow the framework proposed by Bachman and Sims (2012) who argue that fiscal spending shocks generate consumer optimism during times of slack. With properly detrended data, however, our exercises upset their findings, and confirm our empirical results presented earlier. Consumer sentiment responds overall negatively to fiscal spending shocks. And we find very weak evidence of nonlinearity, which is consistent with findings by Owyang, Ramey, and Zubairy (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 changes in sentiment. 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 will 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.

Following Bachman and Sims (2012), we employ the following tri-variate VAR model.

$$\mathbf{x}_t = \sum_{j=1}^{p} \mathbf{A}_j \mathbf{x}_{t-j} + \mathbf{A}_0^{-1} \mathbf{u}_t, \tag{5}$$

where $\mathbf{x}_t = [g_t \;\; sent_t \;\; y_t]'$. Note that they used different ordering from ours presented earlier in (2), (3), and (4).

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.[12] 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.

$$\psi_{i,j}(h) = s_i' \tilde{\mathbf{F}}^{h-1} \mathbf{A}_0^{-1} s_j, \tag{6}$$

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

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 following size hypothetical sentiment shock,

$$u_1^{sent} = -\frac{s_2' \mathbf{A}_0^{-1} s_1}{s_2' \mathbf{A}_0^{-1} s_2} \tag{7}$$

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

$$u_h^{sent} = -\frac{s_2' \tilde{\mathbf{F}}^{h-1} \mathbf{A}_0^{-1} s_1 + \sum_{r=1}^{h-1} \left(s_2' \tilde{\mathbf{F}}^{h-r} \mathbf{A}_0^{-1} s_2 \right) u_r^{sent}}{s_2' \mathbf{A}_0^{-1} s_2}, \;\; h = 2, 3, \ldots \tag{8}$$

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

$$\hat{\psi}_{i,1}(h) = \psi_{i,1}(h) + \sum_{r=1}^{h} \left(s_i' \tilde{\mathbf{F}}^{h-r} \mathbf{A}_0^{-1} s_2 \right) u_r^{sent} \tag{9}$$

It should be noted that we employ the same VAR model that are used in Bachman and

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

Sims (2012) to identify the factors that generate different results from theirs. For this, we use the same fiscal spending variable as theirs, the federal government consumption and gross investment expenditures ($fc\&i_t$). In addition, we employ the total government consumption and gross investment spending ($tc\&i_t$), the federal government defense spending ($defn_t$), and the state and local government consumption and gross investment expenditures ($sc\&i_t$).

Unlike Bachman and Sims (2012), we demean and detrend all data $\mathbf{x}_t$ prior to estimations because g_t and y_t are clearly trending upward as can be seen in Figure 6.[13] Without proper detrending, estimations of the impulse-response function may not be legitimate in the presence of trend, because the VAR system may contain a unit root or a near unit root that can generate exploding response functions.[14]

Figure 6 around here

In Figure 7, we report hypothetical response functions (solid lines) $\hat{\psi}_{i,1}(h)$. Dashed lines are the unconstrained impulse-response functions $\psi_{i,1}(h)$ and their 95% confidence bands from 500 nonparametric bootstrap simulations. As can be seen in the first column, sentiment responses are completely turned off (solid lines) after we add the sequence of hypothetical sentiment shock in (8). Note that these additional sentiment shocks are mostly *positive* because $sent_t$ overall *negatively* responds to the fiscal shock, $\psi_{2,1}(h) < 0$. Since these hypothetical consumer optimism shocks, $u_h^{sent} > 0$, continue to boost output, hypothetical responses of the private GDP (solid lines) in the second column are overall greater than original responses (dashed lines), that is, $\hat{\psi}_{1,3}(h) > \psi_{1,3}(h)$, which implies that the propagation of the fiscal spending shock might be weakened as it creates consumer pessimism.

The total government consumption and investment ($tc\&i_t$) includes consumption and investment of the federal government ($fc\&i$) and the state and local government ($sc\&i_t$).

[13] We include up to quadratic trend in addition to an intercept and linear trend. Results are similar as long as an intercept and linear trend are present.

[14] We calculated eigenvalues of the VAR system with an intercept only, which confirmed our conjecture. Eigenvalues of the VAR with an intercept and time trend were all less than one in modulus.

It is interesting to see that the negative effects of the $fc\&i_t$ shock on $pgdp_t$ cancel out the positive effects of the $sc\&i_t$ shock, resulting in negligible effects of the $tc\&i$ shock on $pgdp_t$. Furthermore, unlike the $fc\&i_t$ shock, the $sc\&i_t$ shock generates consumer optimism in the short-run, creating stimulus on private spending.

Our empirical results contrast sharply with those of Bachman and Sims (2012), even though we used similar VAR models with the same identification scheme. With properly detrended data, the federal government spending shock consistently generates consumer pessimism, which weakens the propagation of expansionary fiscal policy shocks to promote economic activity.

Figure 7 around here

5.2 Nonlinear Model Estimates

This subsection investigates the possibility that fiscal policy may be more effective during times of slack. Following Auerbach and Gorodnichenko (2012) and Bachman and Sims (2012), we employ a nonlinear, state-dependent VAR model that allows regime-specific fiscal policy effects on private spending. As in previous subsection, we demean and detrend the data prior to estimations.

$$\mathbf{x}_t = \sum_{j=1}^{p} \mathbf{A}_{1,j}\mathbf{x}_{t-j} + \sum_{j=1}^{p} \mathbf{A}_{2,j}\mathbf{x}_{t-j}z_{t-j} + \sum_{j=1}^{p} \mathbf{A}_{3,j}\mathbf{x}_{t-j}z_{t-j}^2 + \mathbf{A}_0^{-1}\mathbf{u}_t, \tag{10}$$

where

$$E\mathbf{A}_0^{-1}\mathbf{A}_0^{-1\prime} = \mathbf{\Sigma}_t, \ \left(E\mathbf{u}_t\mathbf{u}_t^{\prime} = I\right)$$
$$\mathbf{\Sigma}_t = \mathbf{\Sigma}_e\left(1 - f(z_{t-1})\right) + \mathbf{\Sigma}_r\left(f(z_{t-1})\right)$$

z_t is a standardized seven quarter backward moving average of the real GDP growth. $f(z_t)$ is defined as follows,

$$f(z_t) = \frac{\exp(-\gamma z_t)}{1 + \exp(-\gamma z_t)}, \ \gamma > 0 \tag{11}$$

$f(z_t)$ is a probability measure of being in recession given z_t. Note that the Choleski factor varies with the state of the economy because $\mathbf{\Sigma}_t$ is a weighted average of the variance covariance matrices, $\mathbf{\Sigma}_e$ (boom) and $\mathbf{\Sigma}_r$ (recession).[15]

Figure 8 reports the response function estimates of the private GDP (first row) and of the total GDP (second row) to the fiscal spending shock identified with the federal government consumption and gross investment ($fc\&i_t$) and the federal government defense spending ($defn_t$) as well as the federal government total spending ($fgov_t$).[16] Note that the model with $fc\&i_t$ and the total GDP (gdp_t) corresponds to the one reported in Bachman and Sims (2012) except that we detrended the data.[17] Solid lines are the response function in the recession regime, while dashed lines are 15.87 percentiles, 50 percentiles, and 84.13 percentiles of the response function in the boom regime, which constitutes the one standard deviation confidence band, generated by 500 nonparametric bootstrap simulations.[18]

We obtain solid negative effects of the fiscal spending shock on private spending from all models we consider in both regimes. Furthermore, we fail to find regime-specific fiscal policy effect on private activity, which is at odds with empirical results presented by Bachman and Sims (2012). The recession response functions are overall contained in the confidence band of the corresponding boom response function.

Figure 8 around here

[15] Eric Sims kindly provided his code with the data. Following their work, we set $\gamma = 1.5$ and recession is defined when $f(z_t) \geq 0.8$. For detailed explanations on estimations, see Bachman and Sims (2012).

[16] Following Bachman and Sims (2012), we report regime-specific impulse-response function estimates. For more rigorous analysis, we need to estimate the generalized impulse-response functions for nonlinear models (Koop, Pesaran, and Potter, 1996).

[17] Our analysis utilizes a longer sample period. However, as we showed in previous section, our major findings are robust to alternative sample periods.

[18] We report 1 standard deviation bands as in Bachman and Sims (2012). Having 95% confidence bands does not change results because the recession response functions are still contained inside the band.

In Figure 9, we also report the response function point estimates of $sent_t$ to the fiscal shock in the recession regime along with the one standard deviation confidence band of the response function in the boom. Again, we fail to find evidence of nonlinearity. $sent_t$ exhibits overall negative and similar responses in both regimes no matter what identification scheme are used.

In a nutshell, we obtained very weak evidence of nonlinearity, employing similar VAR models in Bachman and Sims (2012) for detrended data. We confirmed consumer pessimism and weak propagation mechanisms of expansionary fiscal spending policy from the linear model. Put it differently, our major findings are overall consistent with the work of Owyang, Ramey, and Zubairy (2013) and Ramey and Zubairy (2014) who also reported weak evidence of nonlinearity.

Figure 9 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 identify important propagation channels of the fiscal policy to stimulate the economy. For this purpose, we attempt to evaluate the role of consumer sentiment in the effectiveness of expansionary government spending shock on economic activity in the private sector. As Ramey (2011b) 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 expectational VAR model. We obtain solid evidence of the existence of a consumer sentiment channel that is robust to alternative identification schemes.

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. We note that consumer sentiment negatively responds to the government spending shock since the impact, while under the recursively identified VAR models, consumption rises initially for a brief period of time, mainly due to an increase in nondurable good consumption, 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 to 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 findings contrast sharply with those of Bachman and Sims (2012) who argue that expansionary fiscal policy can promote economic activity via consumer optimism during recessions. Using the same nonlinear, state-dependent VAR model, but with demeaned and detrended data, we demonstrate such evidence completely disappears. Counterfactual simulation exercises confirm our empirical findings for an important role of consumer pessimism in the propagation mechanism of the fiscal shock.

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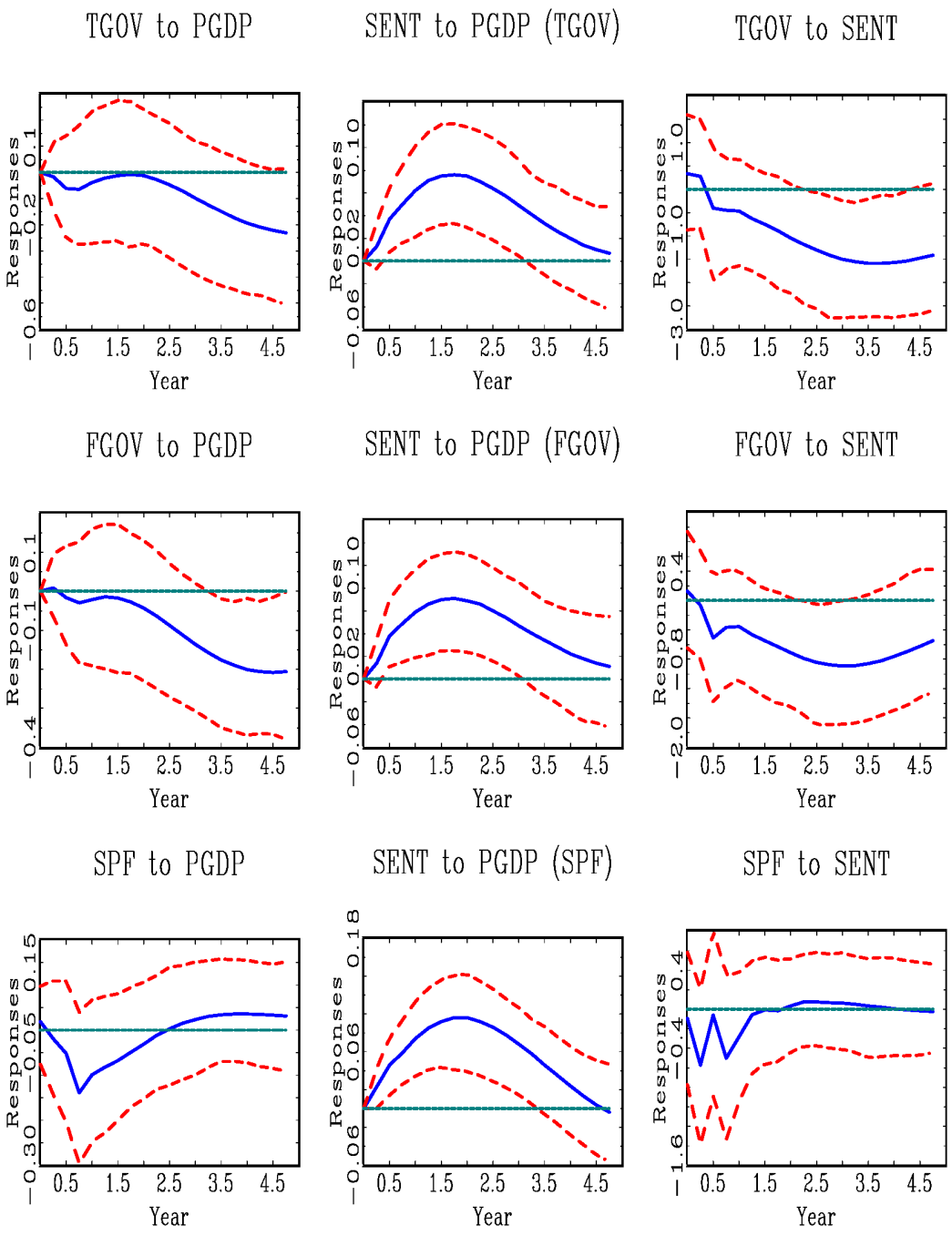
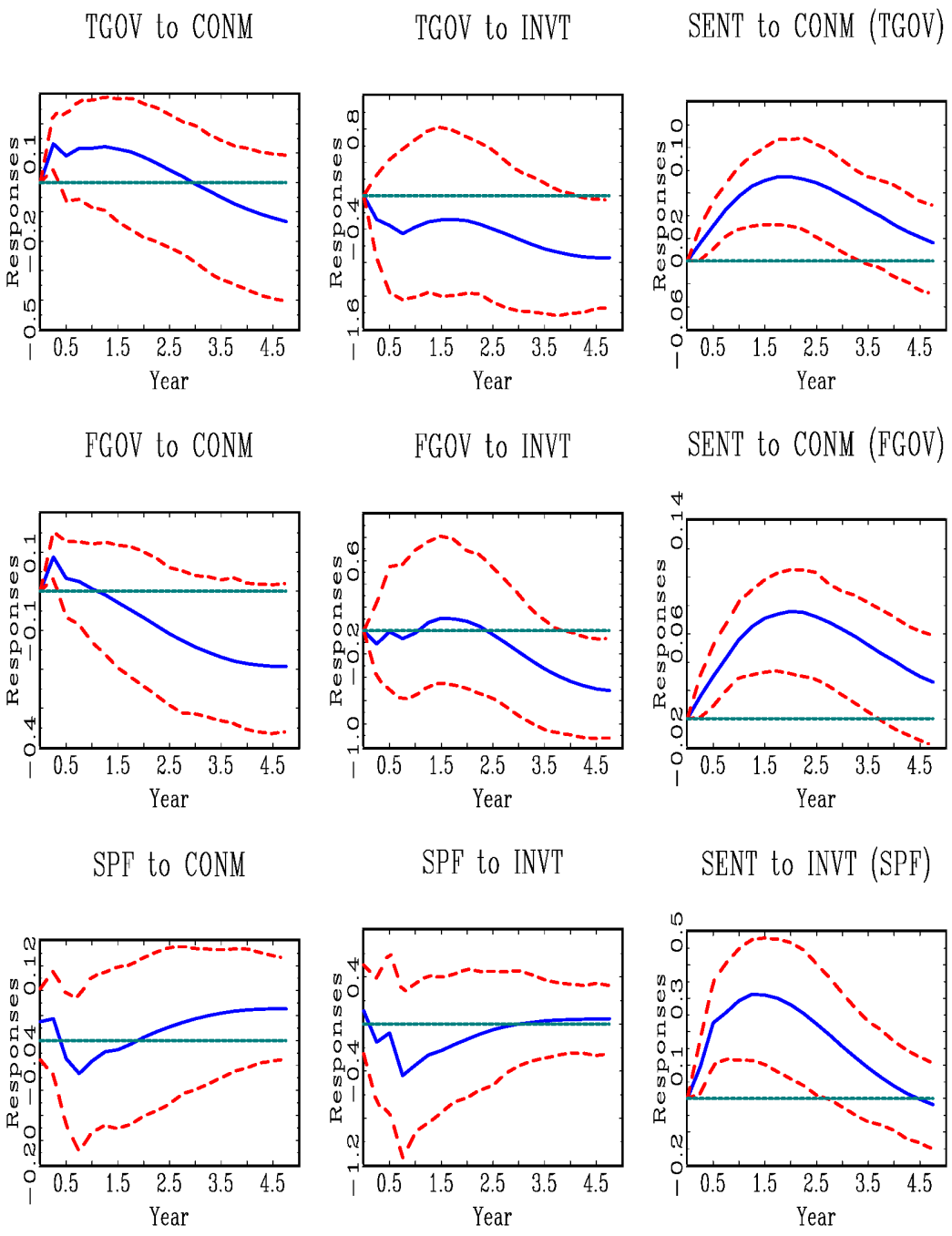
Figure 1. Responses of the Private GDP



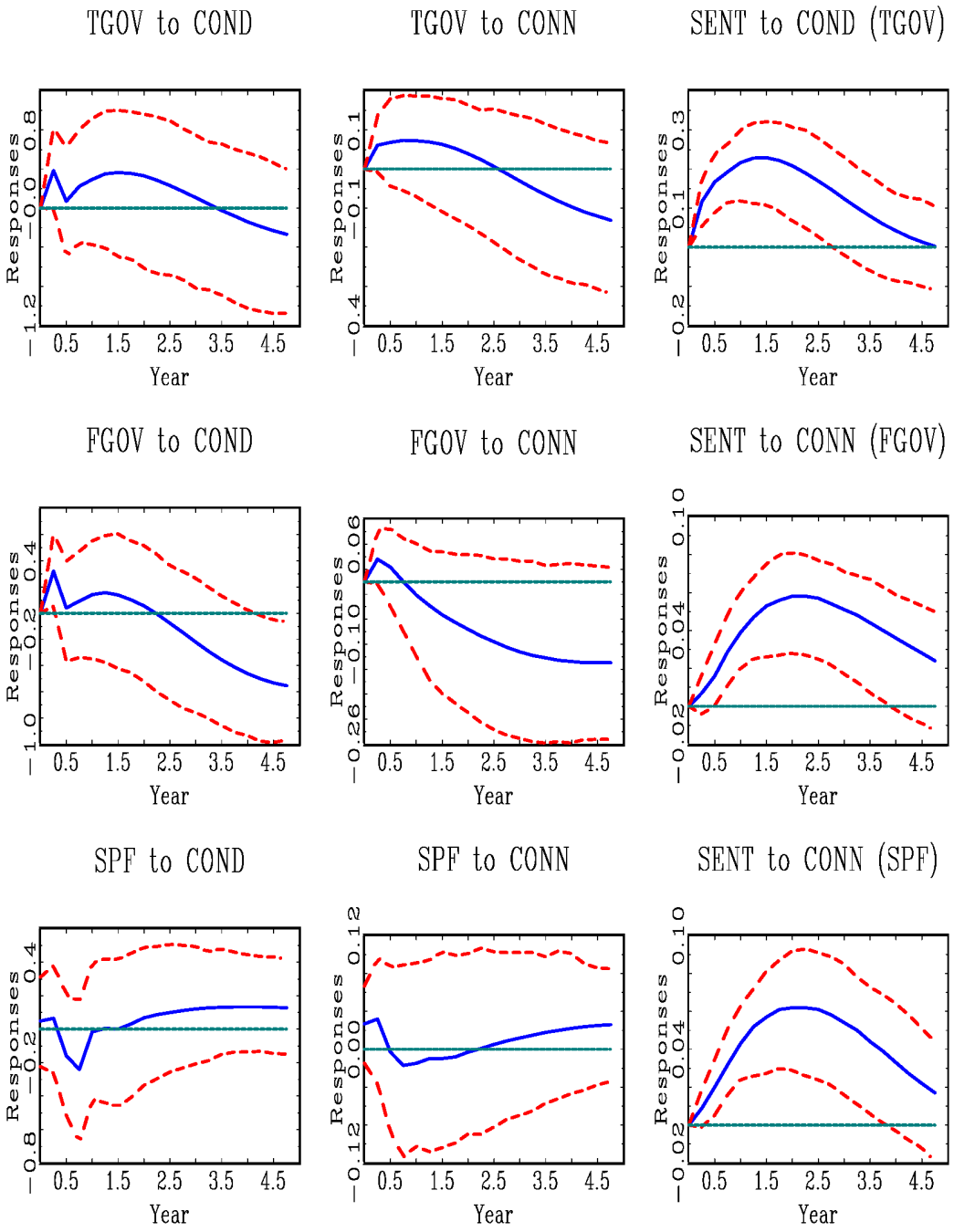
Note: Private GDP is the total GDP minus the total government consumption and gross investment expenditures. All spending variables are in real per capita terms. Solid lines are the impulse-reponse function point estimates from each model. Dashed lines are the 95% confidence band obtained from 500 nonparametric bootstrap simulations from empirical distributions.

Figure 2. Responses of Private Acitivity



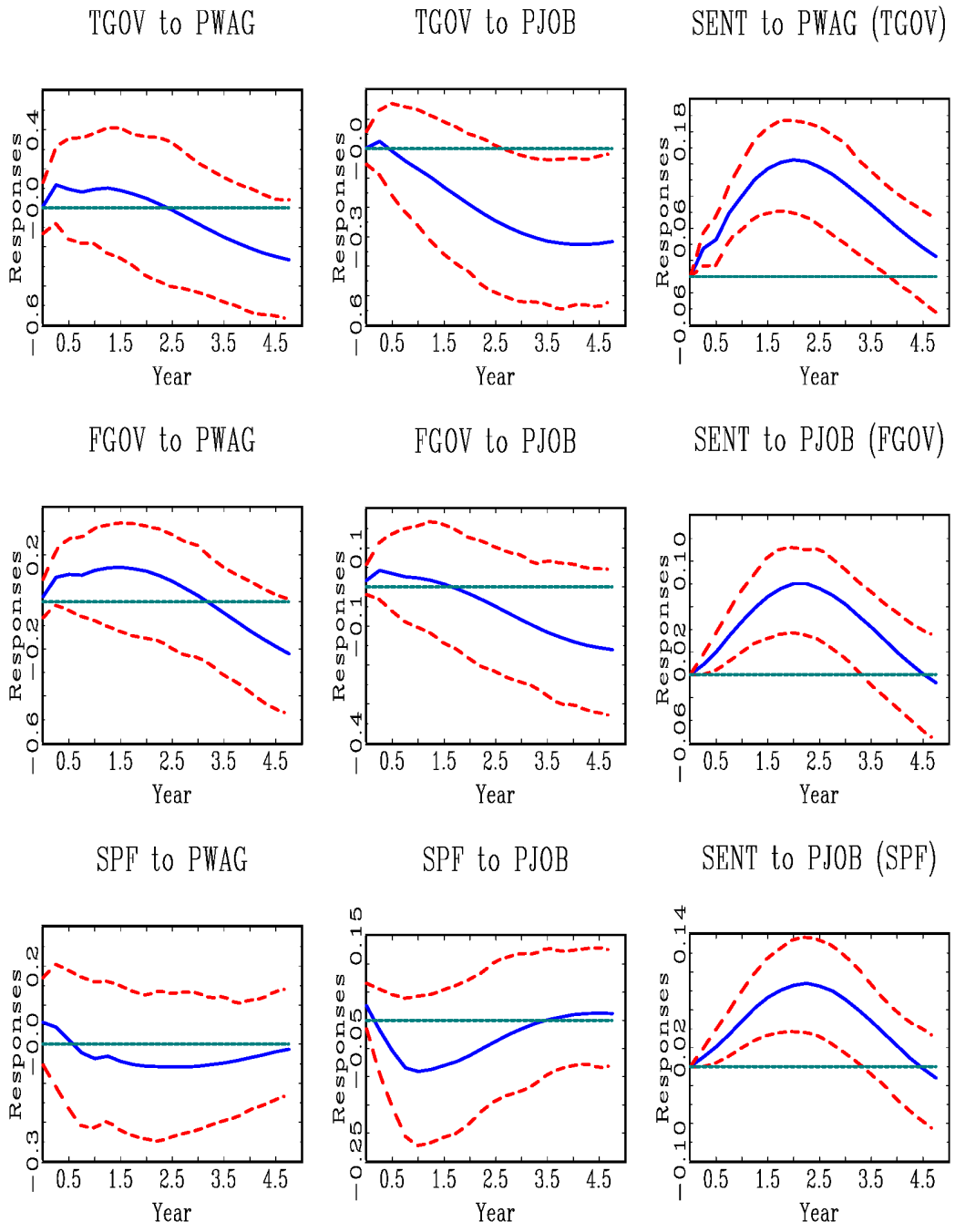
Note: Solid lines are the impulse-reponse function point estimates from each model. Dashed lines are the 95% confidence band obtained from 500 nonparametric bootstrap simulations from empirical distributions.

Figure 3. Responses of Consumption: Durable vs. Nondurable Goods



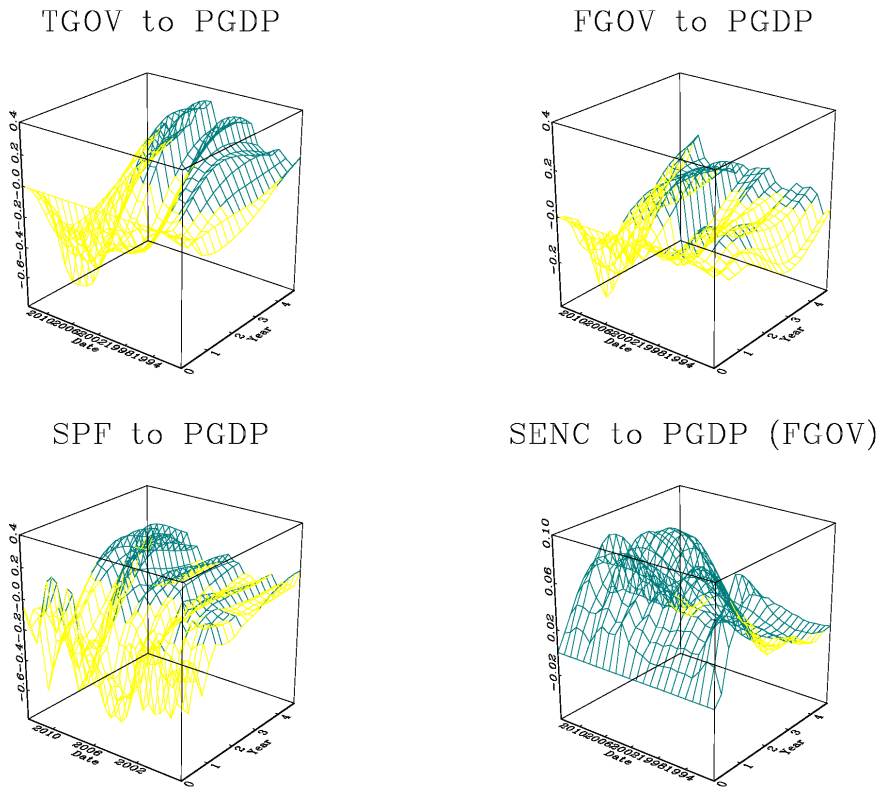
Note: Solid lines are the impulse-reponse function point estimates from each model. Dashed lines are the 95% confidence band obtained from 500 nonparametric bootstrap simulations from empirical distributions.

Figure 4. Responses of Private Jobs and Wages



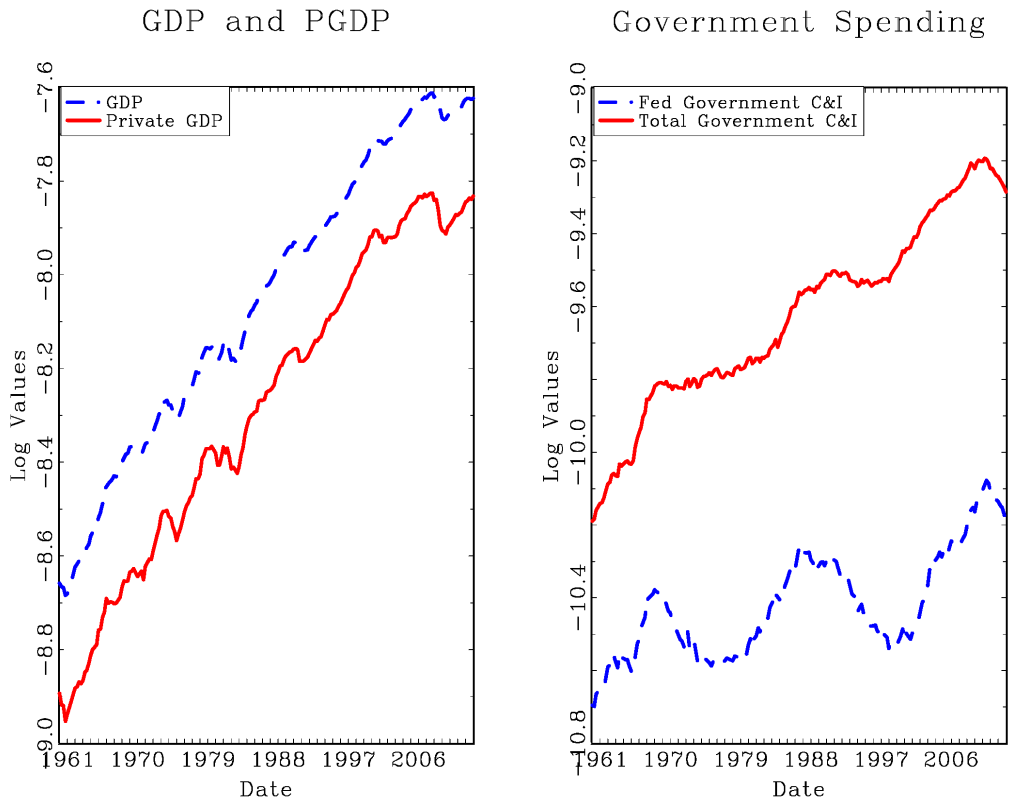
Note: Solid lines are the impulse-reponse function point estimates from each model. Dashed lines are the 95% confidence band obtained from 500 nonparametric bootstrap simulations from empirical distributions.

Figure 5. Robustness Check Analysis: 30-Year Rolling Window Scheme



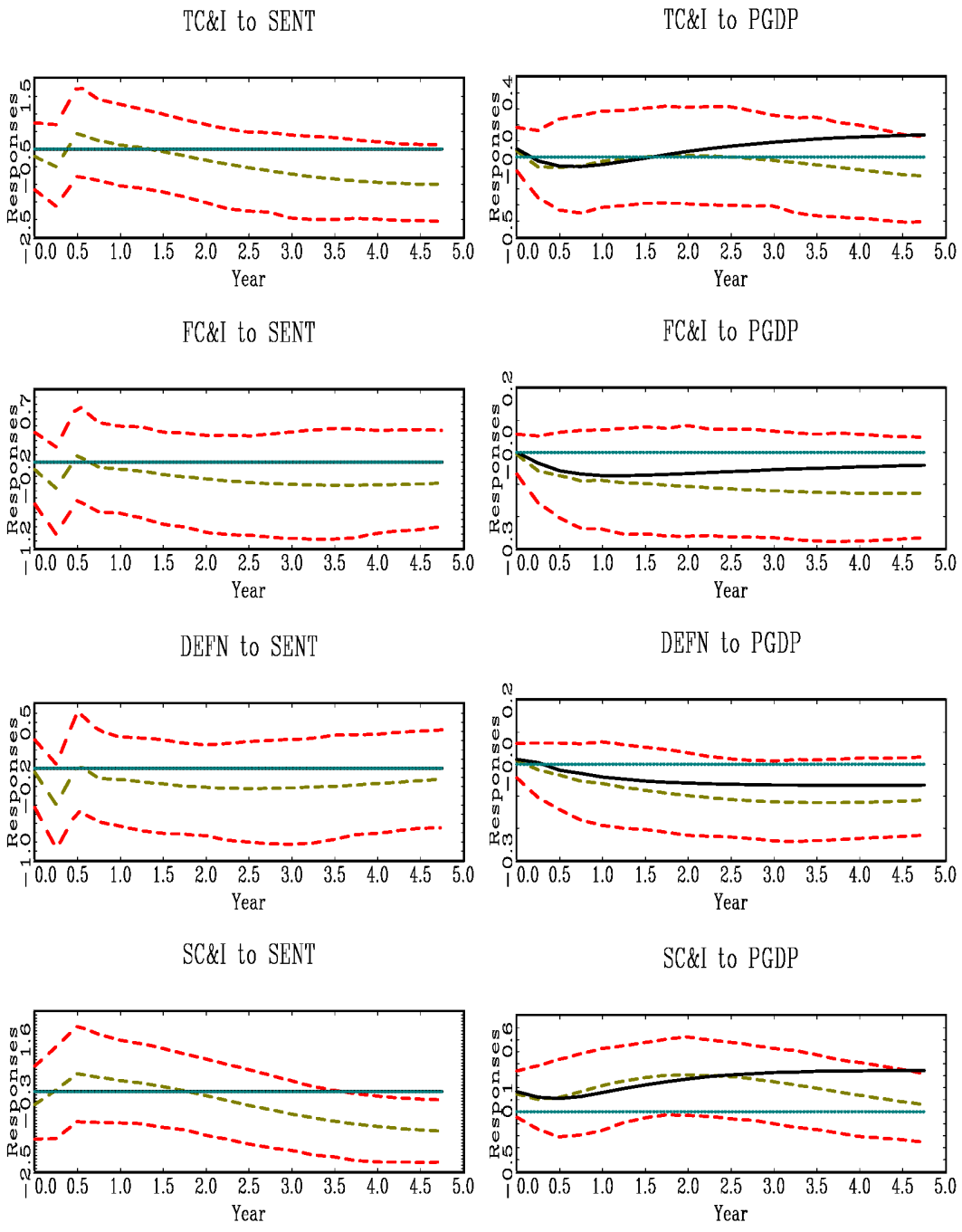
Note: We estimate and report surface graphs of the impulse response function with a 30-year fixed size rolling window scheme. That is, we begin the estimation with a sample period from 1960Q1 to 1989Q4, the last estimation is implemented with a sample period from 1983Q3 to 2013Q2. Lighter areas denote negative responses, whereas darker areas are positive responses.

Figure 6. Trend in GDP and Government Spending



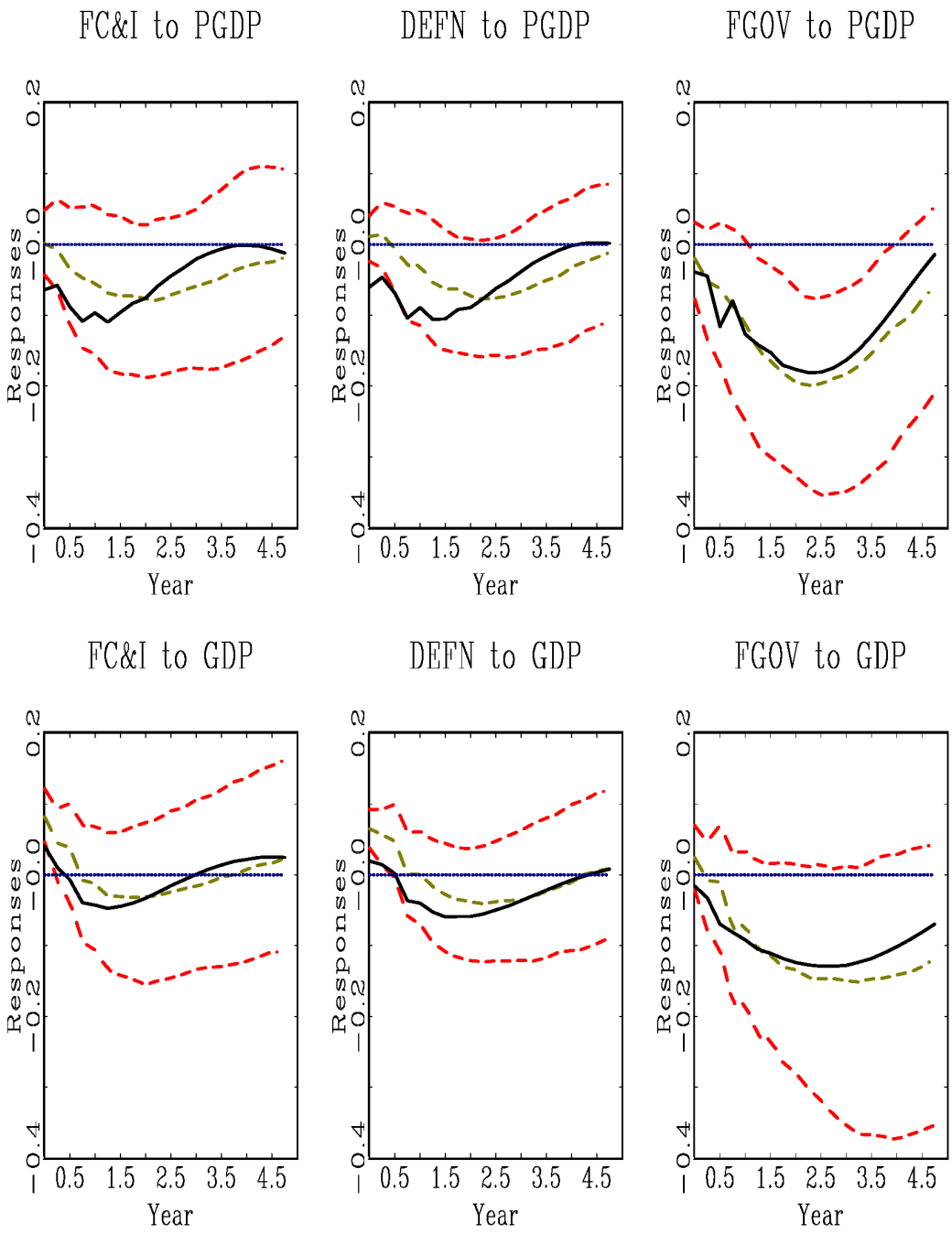
Notes: All spending values are in real per capita terms and log-transformed.

Figure 7. Counterfactual Simulation Exercises with Alternative Identification Scheme



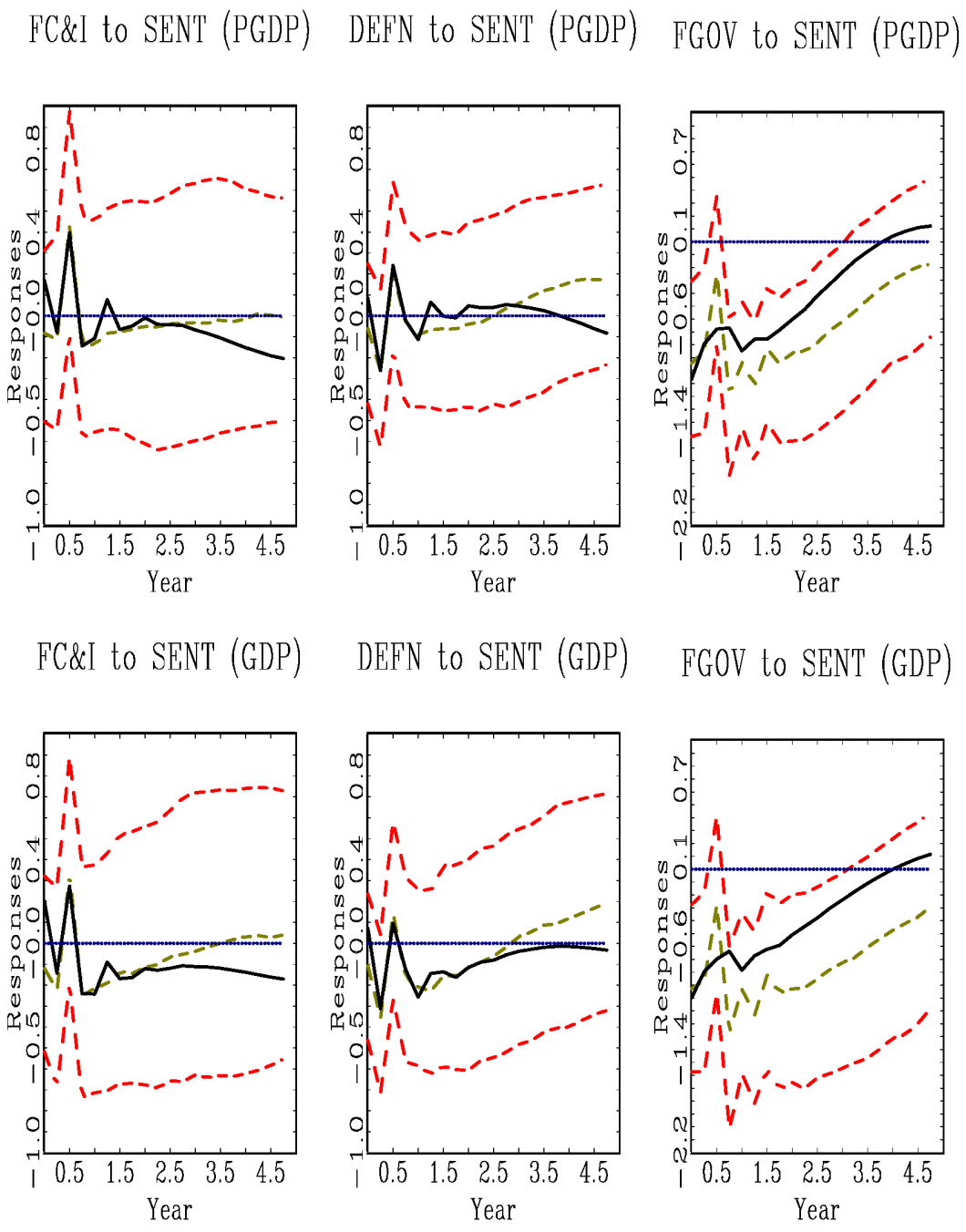
Note: Reported estimates are from tri-variate VAR models with the fiscal variable, the sentiment variable, and the private GDP, following the ordering used in Bachman and Sims (2012).. The solid lines are hypothetical response functions with additional sentiment shocks that hold sentiment unchanged for all forecast horizons. Dashed lines are the impulse-response function point estimate from unconstrained models accompanied by its 95% confidence bands.

Figure 8. Nonlinear Responses of GDP



Note: Reported estimates are from tri-variate VAR models with the fiscal variable, the sentiment variable, and the private/total GDP, following the ordering used in Bachman and Sims (2012). The solid lines are response function estimates in the recession regime, while dashed lines are 15.87 percentiles, 50 percentiles, and 84.13 percentiles of the response function in the boom regime, which constitutes the one standard deviation confidence band, generated by 500 nonparametric bootstrap simulations.

Figure 9. Nonlinear Responses of Sentiment



Note: Reported estimates are from tri-variate VAR models with the fiscal variable, the sentiment variable, and the private/total GDP, following the ordering used in Bachman and Sims (2012). The solid lines are response function estimates in the recession regime, while dashed lines are 15.87 percentiles, 50 percentiles, and 84.13 percentiles of the response function in the boom regime, which constitutes the one standard deviation confidence band, generated by 500 nonparametric bootstrap simulations.