Confidence and the Transmission of Government Spending Shocks*

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Abstract

This paper examines whether confidence is important in the transmission of government spending shocks. In a standard structural VAR, an empirical measure of confidence does not significantly react to spending shocks and output multipliers are around one. In a non-linear VAR, confidence rises following an increase in spending during periods of economic slack and multipliers are much larger. The systematic response of confidence is irrelevant for the output multiplier during normal times, but is critical during recessions. Spending shocks during downturns predict productivity improvements through a persistent increase in government investment relative to consumption, which is reflected in higher confidence.

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"But the hope that monetary and fiscal policies would prevent continued weakness by boosting consumer confidence was derailed by the recent report that consumer confidence in January collapsed to the lowest level since 1992." – Martin Feldstein, Wall Street Journal, February 20, 2008

"Confidence matters independently of fundamentals!" – Roger Farmer, UCLA Today - Faculty and Staff News - 10 Questions: Economist Roger Farmer

1 Introduction

A widespread belief among economists, policy-makers, and members of the news media is that the "confidence" of households and firms is a critical component in the transmission of policy shocks into economic activity. A sampling of quotes from economists and policy-makers with wide-ranging economic and political philosophies attests to this fact (such as the quotes from Martin Feldstein and Roger Farmer above; see Appendix A for additional quotes). We take this proposition to the data for the case of government spending shocks. A large literature studies the effects of these shocks on the real economy, while another literature examines the effects of confidence on aggregate fluctuations.[1] To our knowledge no study bridges these two literatures and explicitly examines the relationship between confidence and the transmission of policy shocks. Says John Cochrane (Cochrane, 2009): "Others say that we should have a fiscal stimulus to 'give people confidence,' even if we have neither theory nor evidence that it will work." This paper is a first attempt at the latter.

Barsky and Sims (2011a) show that *surprise* changes in consumer confidence are associated with long-lasting movements in macroeconomic aggregates. They argue that this relationship between confidence and the economy obtains because empirical measures of confidence are reflective of changes in future economic fundamentals, in particular productivity. In contrast, they argue that *autonomous* fluctuations in confidence unrelated to fundamentals – i.e. what one might call "animal spirits" or "pure sentiment" – are unlikely to be an important source of economic fluctuations. Their analysis is, however, silent on whether the *systematic* behavior of confidence is important in the propagation of other shocks. We address this question in this paper.

Given that there is no off-the-shelf workhorse model for confidence or even a widely accepted channel by which confidence might matter in the transmission of fiscal policy shocks, we use structural vector autoregressions (VAR), which need a minimum of theoretical restrictions, to identify government spending shocks and their effects on the macroeconomy. As David Laibson and coauthors recently wrote, "If a sample of macroeconomists were forced to write down a formal model of animal spirits, most wouldn't know where to start and the rest would produce models that had little in common" (Fuster, Laibson, and Mendel, 2010).

[1] Examples for the first group of papers are Shapiro and Ramey (1998), Blanchard and Perotti (2002), Mountford and Uhlig (2009), Rossi and Zubairy (2011), Auerbach and Gorodnichenko (2011), Ramey (2011), Feyrer and Sacerdote (2011), Nakamura and Steinsson (2011), and Shoag (2011). Examples for the second group of papers are Carroll, Fuhrer, and Wilcox (1994), Matsusaka and Sbordone (1995), Barsky and Sims (2011a), and Barsky and Sims (2011b).

We estimate VARs with a measure of government spending, an empirical measure of consumer confidence from the Michigan Survey of Consumers, and aggregate output. The widely accepted identifying restriction to isolate government spending shocks is that spending shocks impact the economy immediately, whereas government spending only reacts to other shocks with a delay (e.g. Blanchard and Perotti, 2002; Ramey, 2011; Rossi and Zubairy, 2011). This amounts to a recursive identification with government spending ordered first. We implement this assumption throughout the paper, allowing confidence to directly and immediately respond to surprise changes in government spending.

In such a VAR, the impulse response of output to a government spending shock is the sum of two effects. First, there is a *direct* effect, because the government spending shock is allowed to have a contemporaneous effect on output. This effect captures the standard notion of a pure fiscal output multiplier. In addition, there is an *indirect* effect where fiscal policy influences confidence which in turn influences output. It is the hypothetical impulse response which features only the direct effect that we isolate and compare to the actual impulse response in order to answer the question of how important the systematic response of confidence to a spending shock is. We do this decomposition using the methodology proposed in Bernanke, Gertler, and Watson (1998), Sims and Zha (2006), and Kilian and Lewis (2011). It amounts to constructing a hypothetical sequence of some other shock in the system so as to leave the impulse response of confidence to a spending shock zero at all horizons. As a benchmark we use confidence innovations ordered second in a recursive identification for this purpose. We also consider decompositions based on theoretical assumptions about the long run output responses to shocks: in one case shutting down confidence with a shock that has large medium term effects on output; in another constructing hypothetical responses in which the direct effect is isolated using shocks only having a short run effect on output.

In conventional linear specifications we find little evidence to support the notion that confidence is an important part of the transmission of spending shocks into economic activity. Confidence declines slightly on impact in response to a spending shock and rises after a few quarters, though this response is economically small and statistically insignificant. The hypothetical impulse responses of macroeconomic aggregates in which we isolate the direct effect of government spending without the systematic movement of confidence are very similar to the actual responses. These findings are robust to a variety of different specifications, including ones in which we directly control for anticipated changes in government spending (Ramey, 2011). In short, confidence does not appear to be a part of the transmission of government spending shocks in normal times.

Recent theoretical (Christiano, Eichenbaum, and Rebelo, 2011; and Woodford, 2011) and empirical (Auerbach and Gorodnichenko, 2011; and Shoag, 2010) work has emerged arguing that government spending multipliers might be large during periods of economic slack. To capture the idea of government spending shocks having effects that vary with the state of the economy, we also estimate non-linear VAR specifications. Following Auerbach and Gorodnichenko (2011), we allow the parameters of the VAR to vary according to recent output growth. Similar to them, we find that spending multipliers are significantly larger during periods of slack in comparison to expansions. In particular, our estimated spending multipliers are a little higher than 2 during

downturns. Also, we find that confidence significantly rises on impact following a positive spending shock in a recession. During periods of expansion, in contrast, spending multipliers are around one and confidence declines in response to a spending shock, which are similar to the responses from the linear model. These findings suggest that confidence may be an important part of the transmission of spending shocks during periods of economic distress. The hypothetical impulse response of output to a government spending shock in a recession based only on the direct effect of government spending on output is much smaller than the actual one. The estimated hypothetical spending multipliers are much closer to those during an expansion as well as those estimated in the linear model, i.e. around unity.

It is important to stress that the impulse responses of output to a spending shock in a recession is small on impact, and is only large after a number of quarters. Prima facie, this pattern of response seems to be inconsistent with a confidence-induced surge in spending leading to a temporary boost in aggregate demand. Rather, these impulse responses bear a strong resemblance to the slowly-building responses following a "news shock" about future productivity (Beaudry and Portier, 2006; Barsky and Sims, 2011b).

So as to determine whether the systematic response of confidence to a spending shock is indicative of "pure sentiment" – by which we mean fluctuations in confidence unrelated to other fundamentals – or beliefs about longer term fundamentals, as in the "news literature", we alter the basic procedure used to decompose the output response to a spending shock. In particular, we identify a "fundamentals" shock as a shock uncorrelated with government spending shocks that explains a large share of output at a long horizon. We identify a "sentiment" shock as an innovation in confidence orthogonalized with respect to both the government spending and "fundamentals" shocks. We then ask whether the large indirect effect of government spending on output during a period of anemic growth that operates through confidence is mainly due to the fundamental content or the sentiment content in measured confidence. We thus separately create hypothetical impulse response functions where we eliminate, respectively, the indirect effect from fundamentals and sentiment. Without the indirect sentiment effect the output response to a spending shock in a recession is close to the actual response, particularly at longer horizons. In contrast, without the indirect fundamental effect the response to the spending shock is much smaller at all horizons. These results suggest that it is not short-term sentiment that is important in the transmission of government spending shocks during times of economic slack, but rather a channel that is operative at lower frequencies.

We provide additional evidence in support of the notion that confidence matters for the spending transmission mechanism through a medium to longer term channel. In particular, government spending shocks during periods of slack are associated with a slowly-building, longer-term response of a utilization-adjusted measure of total factor productivity (TFP) as well as output. We conclude that confidence matters for the transmission of government spending shocks into output during periods of slack mainly because it is forward-looking and embodies information about future productivity improvements which seem to follow spending shocks during downturns.

The productivity channel is also consistent with our last finding: the composition of government

spending in response to identified spending shocks is different in recessions compared to expansions and normal times. In particular, we show that a spending shock in a recession leads to a persistent increase in the amount of government investment relative to government consumption; this is not nearly as pronounced in an expansion. This relative increase in government investment spending is associated with future productivity increases. The systematic response of confidence appears to largely reflect this policy-induced change.

The remainder of the paper is organized as follows. Section 2 reviews mechanisms for why confidence might matter for the transmission of spending shocks. Section 3 describes the data and our empirical strategy. Section 4 presents our main results. Section 5 discusses why confidence matters for the transmission of spending shocks during recessions. The final section concludes.

2 Why Might Confidence Matter?

An old idea (Keynes, 1936) that has gained recent attention (Ackerlof and Shiller, 2008) is that "animal spirits" in consumer and business confidence are central to understanding economic fluctuations. While intriguing, this idea lacks a widely accepted theoretical structure, and has met with limited empirical success (see Barsky and Sims, 2011a, as well as Luzzetti and Ohanian, 2010). Loosely speaking, the idea is that aggregate sentiment determines aggregate spending, which in turn determines aggregate output and employment. Fiscal or monetary shocks from the government might signal a commitment to aggregate stability, thereby raising sentiment, stimulating demand, and leading to an economic expansion. This idea is related to the "sunspot" framework popularized by Farmer (1998) and others, which holds that there are, at any time, multiple aggregate equilibria. Stimulating sentiment could cause the economy to jump from a "bad" equilibrium to a "good" one.

Another related possibility includes a role for informational frictions and strategic complementarities in a world in which households fail to perfectly observe aggregate fundamentals and use observed variables like aggregate output to form beliefs about the true fundamentals (see Lorenzoni, 2009). Following a recession there might be induced sluggishness – the true fundamentals might have improved but beliefs about the fundamentals are slow to catch up, hence putting a brake on the recovery. By engaging in expansionary fiscal or monetary policies, the government may be able to convince agents that fundamentals have improved, thereby facilitating recovery.

Recently, Bai, Rios-Rull and Storesletten (2011) have advocated a model of consumer search where the (variable) search effort of consumers is an input of the aggregate production function. In such a context, one might interpret confidence as search effort and thus stimulative fiscal policy as having a positive impact on the willingness to search and shop.

And finally there is the view in Barsky and Sims (2011a) that autonomous innovations to confidence largely reflect news about future fundamentals. This means that fiscal policy – for example through investment in infrastructure, R & D, and education – might change agents' views about these future fundamentals and thus generate important systematic movements in confidence. We provide evidence that is consistent with this view.

3 Data and Methodology

3.1 Data

Quarterly data on real GDP and its components are taken from the BEA. These quantities are expressed in per-capita terms by dividing by the civilian non-institutionalized population aged sixteen and over. The sample period is 1960q1 to 2011q1.

The data source for subjective measures of consumer confidence is the Michigan Survey of Consumers.[2] The survey polls a nationally representative sample of households on a variety of questions concerning personal and aggregate economic conditions. We focus on the Index of Consumer Expectations, which is an average of the indices from three different forward-looking survey questions – one concerning expectations about *aggregate* business conditions over the next year, another concerning expectations about aggregate business conditions over the next *five* years, and the third concerning *personal* financial conditions over the next year. These data are available at a quarterly frequency beginning in the first quarter of 1960.

The left panel of Figure 1 plots the Index of Consumer Expectations across time. Because of averaging of the underlying questions (which are measured as the fraction of respondents with a "good" outlook minus the fraction with a "bad" outlook plus 100) the scale has little meaning, but higher numbers represent more confidence. The shaded gray areas are recessions as dated by the NBER. The series undergoes fairly large swings across time and is clearly procyclical.

3.2 Identifying Government Spending Shocks

Much of the empirical literature on the identification of government spending shocks is or can be cast in a vector autoregression framework. Let g_t be log government spending (consumption plus investment expenditure), and x_t be a $k \times 1$ vector of other time series of interest observed at time t, (e.g. log output). Let $Y_t = [g_t \quad x_t]'$ be $(k+1) \times 1$. The structural VAR can be written (abstracting from the constant term) as:

$$A_0 Y_t = \sum_{j=1}^{p} A_j Y_{t-j} + \varepsilon_t \tag{1}$$

p is the lag length and ε_t is a $(k+1) \times 1$ vector of structural shocks, defined as being uncorrelated with one another. A_0 is the impact matrix. Restrictions must be imposed on A_0 to uniquely recover the structural form. Following Blanchard and Perotti (2002), most of the literature imposes that in the first row of A_0 all elements but $(1,1)$ are zero. Economically, this assumption means that all the variables in x_t react immediately to government spending shocks, whereas government spending does not react on impact to other shocks in the system. Given the delays inherent in the legislative system, this is a natural assumption. The identifying assumption is equivalent to a

[2] In the NBER working paper version of this paper, Bachmann and Sims (2011), we also presented results using business confidence from the Conference Board's CEO Confidence Survey. These results have been omitted from the current draft of the paper. All results are qualitatively similar and are available from the authors upon request.

Choleski factor of the variance-covariance matrix of reduced-form innovations, Ω_u, with g_t ordered first. $u_t = A_0^{-1}\varepsilon_t$, and $\varepsilon_{1,t}$ is the structural government spending shock.

3.3 Isolating the Role of Confidence

To fix ideas, let $x_t = [conf_t \quad y_t]'$, where $conf_t$ is an empirical measure of confidence and y_t is log real GDP. The identifying assumption on the timing effects of government spending is as above. The system can be written as:

$$\begin{pmatrix} 1 & 0 & 0 \\ a_{2,1} & 1 & a_{2,3} \\ a_{3,1} & a_{3,2} & 1 \end{pmatrix} \begin{bmatrix} g_t \\ conf_t \\ y_t \end{bmatrix} = \sum_{j=1}^{p} A_j \begin{bmatrix} g_{t-j} \\ conf_{t-j} \\ y_{t-j} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \end{bmatrix} \tag{2}$$

Let us first look at how confidence *on impact* influences the transmission of spending shocks into the other variables of interest. If confidence reacts to government spending immediately ($a_{2,1} \neq 0$), and output reacts to confidence immediately ($a_{3,2} \neq 0$), then $a_{2,1} \times a_{3,2}$ measures the "confidence" channel of government spending on impact. This is the *indirect* impact effect. In contrast, $a_{3,1}$ is the *direct* impact effect of spending on output.

In addition, confidence can operate as a *propagation* mechanism for spending shocks, whether it has an impact effect or not. For example, if confidence reacts to spending shocks at any horizon, and if the coefficients on lagged confidence are (economically) significant in the output equation, then the dynamic response of confidence to a spending shock will have an effect on the dynamic response of output to a spending shock.

Our objective is to statistically isolate the direct effect (in a dynamic sense) of spending shocks on output from the indirect effect operating through confidence, where this indirect effect consists of both the indirect impact effect and the propagation mechanism discussed above. In particular, we construct a hypothetical impulse response of output to a government spending shock *holding confidence fixed at all forecast horizons*. A comparison of this hypothetical response with the actual impulse response allows us to quantify how important confidence is as a transmission mechanism of government spending shocks.

In order to do so, we need to first impose more structure on A_0. While the timing assumption that government spending does not react within period to confidence or output is sufficient to identify $a_{2,1}$ and $a_{3,1}$, an additional restriction is required to identify $a_{3,2}$ and $a_{2,3}$. We impose that $a_{2,3} = 0$, which amounts to identifying the system under a Choleski decomposition with confidence ordered second and output ordered third. We then interpret $\varepsilon_{2,t}$ as a confidence shock and $\varepsilon_{3,t}$ as a residual output shock. Creating a hypothetical sequence of confidence shocks in such a way as to "zero out" the response of confidence to a spending shock isolates the direct effect of government spending. This procedure can be thought of as answering the following question: while on average the output response to a government spending shock is comprised of the direct effect and the indirect effect (through confidence), and while government spending and confidence shocks are uncorrelated, how would output have responded in a hypothetical situation where confidence

shocks in the same structural economy completely offset the effects of the government spending shock on confidence? This approach is similar to the methodology used by, for example, Bernanke, Gertler, and Watson (1998), Sims and Zha (2006), as well as Kilian and Lewis (2011) to understand the role of the systematic component of monetary policy in the transmission of other shocks.[3]

Once the restriction has been imposed on $a_{2,3}$ and A_0^{-1} has been recovered, the structural form of the system specified above can be written as:

$$Y_t = \sum_{j=1}^{p} A_0^{-1} A_j Y_{t-j} + A_0^{-1} \varepsilon_t \tag{3}$$

We can write this more compactly in companion matrix form as a VAR(1) by defining $Z_t = [Y_t \quad Y_{t-1} \dots Y_{t-p-1}]$:

$$Z_t = \Lambda Z_{t-1} + A_0^{-1} \varepsilon_t, \quad \Lambda = \begin{pmatrix} A_0^{-1}A_1 & A_0^{-1}A_2 & \dots & \dots & A_0^{-1}A_p \\ I & 0 & 0 & \dots & 0 \\ 0 & I & 0 & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & \dots & \dots & I & 0 \end{pmatrix} \tag{4}$$

Let e_i be a selection row vector of dimension $1 \times (k+1)$, with a one in the i^{th} place and zeros elsewhere. Let $A_0^{-1}(q)$ be the q^{th} column of A_0^{-1}. The impulse response of variable i to structural shock q at horizon $h = 1, \dots, H$ is:[4]

$$\Phi_{i,q,h} = e_i \Lambda^{h-1} A_0^{-1}(q) \tag{5}$$

The thought experiment of holding confidence fixed in response to a change in government spending requires setting $\Phi_{2,1,h} = 0$ at each forecast horizon, where 2 is the position indicator for confidence and 1 is the index of the spending shock. We accomplish this by creating a hypothetical sequence of confidence shocks, $\varepsilon_{2,h}$, so as to force this to hold at each relevant horizon. For a unit shock to government spending, on impact this evidently requires that $\varepsilon_{2,t} = a_{2,1}$, or, in matrix notation:

$$A_0^{-1}(2,1) + A_0^{-1}(2,2)\varepsilon_{2,1} = 0 \Rightarrow \varepsilon_{2,1} = -\frac{A_0^{-1}(2,1)}{A_0^{-1}(2,2)} \tag{6}$$

[3]There is an alternative interpretation for our research question of whether confidence matters in the transmission of government spending shocks. While in the baseline approach we *fix the underlying economic environment* and study particular statistical shock combinations that hit this economy, one could also study the output response to a government spending shock in a *different economy*, where we restrict government spending not to move confidence at any horizon. In practice, this amounts to a restricted VAR estimation, setting $a_{2,1} = 0$ (which would impose that confidence not react to spending on impact), and then to restrict the AR coefficients of the system in such a way that confidence does not react to spending shocks at subsequent horizons either. In Appendix C we show that this approach yields very similar results, compared to the baseline methodology. This gives us additional confidence in our findings.

[4]This calculation requires augmenting both $A_0^{-1}(q)$ and e_i with $(k+1) \times p$ rows or columns of zeros for the matrix multiplication to work, given the dimension of Z_t, which is $(p+1) \times (k+1)$.

We can calculate the required values of subsequent confidence shocks recursively as:

$$\varepsilon_{2,h} = \frac{\Phi_{2,1,h} + \sum_{j=1}^{h-1} e_2 \Lambda^{h-j} A_0^{-1}(2) \varepsilon_{2,j}}{e_2 A_0^{-1}(2)} \qquad h = 2, \ldots, H \tag{7}$$

Given this sequence, we can compute the modified impulse responses of the variables in the system to the spending shock as:

$$\widetilde{\Phi}_{i,1,h} = \Phi_{i,1,h} + \sum_{j=1}^{h} e_i \Lambda^{h-j} A_0^{-1}(2) \varepsilon_{2,j} \quad i = 1, \ldots, k+1 \tag{8}$$

We will refer to the modified impulse responses, $\widetilde{\Phi}_{i,1,h}$, as the responses to a spending shock "without confidence" or as the "direct effect". That is, these are the impulse responses to a spending shock when the response of confidence is held fixed at zero for all horizons. Comparing these hypothetical responses with the actual average responses, $\Phi_{i,1,h}$, provides a measure of how important the response of confidence is in the transmission of the spending shock.

In Section 5 we consider an alternative approach to statistically isolate the direct of a spending shock. Whereas in the benchmark we draw a hypothetical sequence of confidence shocks ordered second in a recursive identification to offset the systematic response of confidence, there we consider a decomposition in which A_0^{-1} is restricted so as to yield (i) a shock that explains a large fraction of output fluctuations at lower frequencies and (ii) a shock unrelated to (i) which explains short run movements in confidence. We refer to these shocks respectively as "fundamentals" and "sentiment". We can draw a hypothetical sequence of either shock so as to "shut down" the systematic response of confidence, just as one can for the confidence shocks identified from a recursive assumption.

The exercise of using confidence innovations ordered second to construct the hypothetical responses addresses the question of whether confidence matters in the transmission of spending shocks; the exercise of using either "fundamentals" or "sentiment" shocks to construct the hypothetical responses speaks more to the question of why confidence might matter. This latter decomposition is important, as Barsky and Sims (2011a) show that confidence innovations contain information about fundamentals but also have an important component unrelated to fundamentals. This decomposition allows us to speak to which of these two components drive any observed relationship between confidence, government spending, and output.

3.4 Non-Linear Specification

Traditional Keynesian thinking and some recent theoretical work (Christiano, Eichenbaum, and Rebelo, 2011, and Woodford, 2011) both suggest that fiscal policy may be more potent when the economy is experiencing significant slack. So as to allow for this possibility, we also consider a non-linear, state-dependent VAR specification similar to Auerbach and Gorodnichenko (2011). Let z_t be a backward-looking seven quarter moving average of real GDP growth, normalized to have mean zero and re-scaled to have unit variance. Define:

$$f(z_t) = \frac{\exp(-\gamma z_t)}{1 + \exp(-\gamma z_t)}, \qquad \gamma > 0. \tag{9}$$

$f(z_t)$ is thus bounded between 0 and 1, and can be interpreted as the probability of being in a recession given observations on z_t. $f(z_t) \approx 1$ means that z_t is very negative, while $f(z_t) \approx 0$ means that z_t is very positive. We calibrate $\gamma = 1.5$ to match the observed frequencies of US recessions and define "recession" as a period in which $f(z_t)$ is greater than 0.8. This corresponds roughly to $z_t \leq -0.9$. The right panel of Figure 1 plots $f(z_t)$ against time. Clearly periods where $f(z_t)$ are high are strongly associated with NBER dated recessions.

The reduced-form of the non-linear system can be written as:

$$Y_t = \sum_{j=1}^{p} \widetilde{A}_{1,j} Y_{t-j} + \sum_{j=1}^{p} \widetilde{A}_{2,j} Y_{t-j} z_{t-j} + \sum_{j=1}^{p} \widetilde{A}_{3,j} Y_{t-j} z_{t-j}^2 + u_t \tag{10}$$

$$E\left(u_t u_t'\right) = \Omega_t \tag{11}$$

$$\Omega_t = \Omega_e \left(1 - f\left(z_{t-1}\right)\right) + \Omega_r f\left(z_{t-1}\right) \tag{12}$$

In words, Y_t follows an autoregressive process depending on its own lags, its own lags interacted with z_t, and its own lags interacted with z_t^2. These interaction terms allow the AR coefficients to vary smoothly with the state of the economy. In addition, the variance-covariance matrix of reduced form innovations varies with the state of the economy as given by (11) and (12), with the limiting cases ($f(z_{t-1}) = 0$ or $f(z_{t-1}) = 1$) having covariance matrixes of Ω_e and Ω_r, respectively. This means that the impact matrix, $\widetilde{A}_{0,t}^{-1}$, varies with the state of the economy as well, since $\widetilde{A}_{0,t}^{-1} \widetilde{A}_{0,t}^{-1\prime} = \Omega_t$. This specification nests the linear case when $\widetilde{A}_{2,j} = \widetilde{A}_{3,j} = 0 \ \forall j$ and when $\Omega_e = \Omega_r$.

Estimation of the reduced form of the non-linear model is standard. To recover the structural form we pick Ω_e and Ω_r by minimizing the sum of squared deviations of unique elements of the period-by-period variance-covariance matrixes, so as to make equation (12) hold in an average sense. The identifying assumptions on $\widetilde{A}_{0,t}^{-1}$ are identical to the linear specification – in other words, $\widetilde{A}_{0,t}^{-1}$ is just the Choleski factor of Ω_t with government spending ordered first. With confidence ordered second, there is a unique $\widetilde{A}_{0,t}^{-1}$, and the procedure for isolating the role of confidence is conceptually the same as in the linear specification.

Following the recommendation in Koop, Pesaran, and Potter (1996), we construct impulse responses holding the current regime fixed. In other words, we ignore the feedback between the responses and the state, z_{t-1}.[5] We define a "recession" impulse response as one beginning with $z_{t-1} = -0.9$ and an expansion regime as one beginning with $z_{t-1} = 0.9$. These correspond roughly to the upper and lower quintiles of the distribution of z_t.

[5] We also allowed for an endogenous feedback between the impulse responses and the state. This yields similar results.

4 Results

4.1 Linear VARs

The benchmark system features log real government spending, the consumer confidence measure, and log real GDP. We estimate the system in levels with four lags.

The solid lines in Figure 2 plot impulse response to a government spending shock of one dollar. Since government spending and output enter the VAR in logs, the responses are re-scaled by the sample average of output to government spending to put them in dollar terms. As such, the magnitudes of the output response can be interpreted directly as a multiplier, i.e. $\frac{\partial y}{\partial g}$. The shaded gray regions are one standard error confidence bands from Kilian's (1998) bias-corrected bootstrap after bootstrap. Government spending follows a hump-shaped response and is fairly persistent. Output rises a little less than dollar for dollar on impact before reverting back to its pre-shock value. Confidence actually falls on impact before rising slightly a few quarters later. This response, however, is almost never significantly different from zero.

The dashed lines in the figure show the hypothetical impulse responses holding the response of confidence fixed at zero. The direct response of output without the endogenous response of confidence is indeed lower at most horizons, suggesting a positive role of confidence in the transmission of fiscal policy. However, the differences in the impulse responses are economically small and statistically insignificant.

To quantify these findings Table 1 shows a variety of spending multipliers both for the baseline responses and for the hypothetical responses with confidence held fixed. The impact multiplier is defined as the impact response of output to a spending shock divided by the impact size of the spending shock. The max multiplier is defined similarly, but rather than the impact responses it uses the maximum responses (over a 20 quarter horizon). Finally, the cumulative multiplier is the sum of the output response (over a 20 quarter horizon) divided by the sum of the government spending response. The numbers inside brackets are the +/- one standard error confidence bands.

The impact and max multipliers are slightly below unity at 0.84; the same multipliers holding the confidence response fixed are actually slightly higher, though this difference is not statistically significant. The cumulative multipliers are quite a bit lower at 0.17 for the linear model and -0.35 in the hypothetical case in which confidence is held fixed. These numbers are all in the range of most existing estimates, which typically are centered around unity for the max multiplier. Furthermore, they suggest only a very minor role for confidence in the transmission of spending shocks into output.

We conducted a number of additional robustness checks. Perhaps the most important one concerns anticipation effects with respect to government spending shocks. Ramey (2011) emphasizes that VAR shocks to government spending may be predictable, which can render impulse response functions biased. She proposes a measure of anticipated government spending, g_t^a, that is equal to the present discounted value of future spending, based on the reading of news reported in *Business Week* and other newspaper sources. In order to accommodate these anticipation effects, the VAR system to be estimated has to be modified to $Y_t = [g_t^a \quad g_t \quad x_t]'$. The unanticipated government

spending shock is then identified as the innovation in g_t ordered second (i.e. after g_t^a). The output multipliers for the regular and hypothetical cases with confidence held fixed for this specification are shown in the bottom panel of Table 1. These are very nearly the same as in the benchmark system.

In summary, the evidence from the linear VAR specifications suggests that, on average, confidence is not an important part of the transmission of government spending shocks into output. The actual impulse response of output to a government spending shock is very similar to the one that features only the direct effect of spending on output. The spending multipliers are always estimated to be in the neighborhood of one, regardless of whether confidence is allowed to react to the spending shock or not.

4.2 Non-Linear VARs

Next we examine results from the non-linear specification detailed in Section 3.4. Figure 3 plots impulse responses. In computing these responses, we set the state for the recessionary regime at $z_{t-1} = -0.9$ and the state for the expansionary regime at $z_{t-1} = 0.9$. The dashed lines are the responses in the expansionary regime while the solid lines are the responses in the recession regime. The dotted lines are the hypothetical impulse responses in the recession state when confidence is held fixed, while the solid lines with dashes are the hypothetical expansion responses when confidence is held fixed. The shaded gray regions are one standard error confidence bands of the responses in the expansion regime.[6]

The responses of output and confidence to a spending shock are quite different across regimes. Whereas in an expansion confidence declines following an unexpected increase in spending, in the recession regime it rises and remains persistently above zero. While the impact responses of output in the two regimes are similar, the dynamic responses are very different. In the expansion regime output quickly reverts towards zero; in the recession regime it grows for a number of quarters, with a peak response of more than two after twenty quarters. It is important to emphasize that the output responses in the two regimes differ the most at longer horizons, not on impact. Comparing Figures 2 and 3, one observes that the expansion responses are very similar to the responses estimated in the linear model. This means that the linear model is a good approximation most of the time, but not in bad states.

The dotted lines in Figure 3 show the hypothetical responses in a recession when confidence is held fixed. The hypothetical response of output under this scenario is fairly similar to its actual response in the expansionary regime as well as the response from the linear model. This finding suggests that the stimulating effect on confidence of a spending shock in a recession may be important in understanding why the output response differs so much across the regimes. The hypothetical response differs the most from the actual recession response at longer horizons, not at high frequencies. On its face, this suggests that the confidence channel may not correspond closely with the idea of a sentiment-induced spending surge, an issue to which we return in the

[6] Appendix B details the non-parametric bootstrap procedure used to construct these confidence bands.

next section. Finally, the hypothetical responses where confidence is held fixed in the expansion regime are very similar to the actual responses.

Table 2 presents the impact, max, and cumulative spending multipliers for the recession and expansion regimes. Comparing the first columns of this table with Table 1, one observes that the spending multipliers in the expansion are very similar to those estimated from the linear model. The multipliers for the recession regime, in contrast, are quite large. In particular, both the max and cumulative multipliers are slightly more than 2. Though the standard errors are large, as there are effectively few observations in the recession regime, these numbers suggest that fiscal policy is considerably more potent when there is slack in the economy. The final column shows output multipliers for the recession regime in the hypothetical case in which the response of confidence is held fixed at zero. These are substantially smaller and are similar to the estimated multipliers in the expansion regime. The bottom panel presents the same multipliers for the non-linear system when we directly control for Ramey's (2011) news variable. These are qualitatively similar to the upper panel, and suggest, if anything, that the multipliers in recessions are somewhat larger than in our benchmark specification.

An advantage of our non-linear empirical specification is that it allows estimated multipliers to vary continuously with the state of the economy. The responses shown up to this point have been for fixed starting values of z_{t-1} – one high and one low – but one can compute impulse responses and multipliers for any value of z_{t-1}. Figure 4 plots some multipliers across time using the historical observations on z_{t-1}. The left panel plots the max output multiplier in the solid line, with the hypothetical multiplier where confidence is held constant as the dashed line. The right panel graphs the historical confidence "multiplier", which is defined as the impact response of confidence to a spending shock. Some notable features stand out. First of all, the output multiplier is elevated in every post-1960 recession, with a bit of a lag relative the end of the recession. The multipliers in recessions are usually around 2, while they are in the neighborhood of one the rest of the periods. The correlation between the historical output multiplier and the cyclical component of output (as measured by the deviation from an HP trend with smoothing parameter of 1600) is significantly negative at -0.59. In the hypothetical case in which confidence is held fixed, in contrast, the output multiplier is essentially constant at one. In the right panel one sees that the confidence multiplier is positive during most recessions and negative in other periods. The correlation between the confidence multiplier and the output multiplier is very high at 0.95. The correlation between the confidence multiplier and cyclical component of output is also significantly negative at -0.64. Finally, it is interesting to note that both confidence and output multipliers were highest during the most recent recession, the most severe of the contractions in the sample.

5 Why and How Does Confidence Matter?

The evidence from the previous section suggests that confidence of households may play an important role in the transmission of government spending shocks into output during times of economic slack. Prime facie, this finding might be viewed as evidence for "animal spirits" type explanations

or as evidence in support of the quotations listed in the Introduction and in Appendix A. However, a closer inspection of Figure 3 reveals that confidence reacts strongest on impact after a government spending shock in a recession, whereas the output response is slowly-building. In a world in which government spending stimulates short-term "animal spirits" we might expect to see a similarly strong impact response of output.

The exercise of constructing hypothetical responses with confidence held fixed requires "shutting down" the response of confidence with some other shock. Up to now, we have simply used confidence innovations ordered second in a recursive decomposition. This exercise suggests that the systematic response of confidence to a government spending shock in recessions can account for most of the differential output response to a spending shock across the two regimes. To the extent to which empirical measures of confidence convey information about the relatively far off future, as in Barsky and Sims (2011a), however, this exercise likely overstates the relevance of confidence per se in the transmission of fiscal shocks. In particular, we would like to isolate the role of "pure" confidence, by which we mean movements in measured confidence unrelated to changes in output at lower frequencies. We will hereafter refer to "pure" confidence as "sentiment".

Because there is only evidence that confidence matters in the recession regime, we focus on the non-linear specification for the remainder of the paper. To that end we consider different restrictions on the impact matrix $\widetilde{A}_{0,t}^{-1}$ for the purpose of constructing the hypothetical responses. We identify what we call a "fundamentals" shock as the structural shock that maximally explains the forecast error variance of output at a twenty quarter horizon.[7] The sentiment shock is the confidence innovation orthogonalized with respect to the government spending and "fundamentals" shocks. The idea is that it reflects pure sentiment, i.e. movements in confidence unrelated to output several years out into the future.

We consider two separate cases. In the first case we create a hypothetical sequence of "sentiment" shocks to hold confidence fixed to identify the indirect effect in response to an increase in government spending. The procedure is conceptually identical to the one laid out in Section 3.3 under the assumption that government spending influences measured confidence only through "sentiment". In the second case we create a hypothetical sequence of "fundamentals" shocks to hold confidence fixed. This identifies the indirect effect if government spending influences measured confidence only through "fundamentals". Figure 5 shows the responses from the benchmark non-linear specification. The solid lines are the responses to a spending shock in a recession, while the dashed lines are the responses in an expansion. The hypothetical responses holding confidence fixed with "fundamentals" shocks are solid lines with dashes through them, while the hypothetical responses fixing confidence with offsetting "sentiment" shocks are shown by the dotted lines.

The main take-away from Figure 5 is that the hypothetical response of output when confidence is held fixed with offsetting "sentiment" shocks is quite similar to the unconstrained response in the recession regime. In contrast, the hypothetical response where confidence is held fixed with

[7] This can be thought of as an approximation to a long run restriction; it is proposed in Francis, Owyang, Roush, and DiCecio (2010), who show that it has superior finite sample properties over conventional long run restrictions. We have experimented with other horizons, like 30 quarters, without much effect on our results.

offsetting fundamental shocks is very similar to the response in the expansion regime.[8] This exercise confirms that the channel through which confidence affects the transmission of spending shocks is not through a sentiment-induced spending surge that lasts only for a while, but rather through some other channel that is mainly operative at lower frequencies.

What is that channel? In Figure 6 we show impulse responses across regimes in the non-linear specification where we include a measure of utilization-adjusted total factor productivity (TFP) in the VAR system.[9] The response of the adjusted TFP series to the spending shock in the recession regime (solid line) looks very similar to the response of output – slowly-building, persistent, and largest at longer horizons. Comparing the magnitude of the TFP response at 20 quarters to that of output, the output response is 1.44 times the size of the TFP response. In a standard neoclassical model with capital accumulation and a labor share of one-third, the long run response of output to a permanent increase in TFP of one percent would be 1.5 percent. Put differently, these results suggest that government spending shocks in the recession regime stimulate productivity in the long run, with the longer horizon output response mostly reflecting this productivity increase.[10]

The dotted lines in Figure 6 show the hypothetical responses without confidence, where the hypothetical responses are constructed using confidence innovations ordered second.[11] Shutting the confidence response down also works to shut down the longer horizon response of adjusted TFP. Our interpretation of this result is similar to that in Barsky and Sims (2011a) – namely, government spending shocks lead to higher future productivity, which is in turn reflected in higher confidence. Confidence itself is not important in the transmission of the spending shock, but rather is informative about what is important – the stimulating effect on productivity.

Why might government spending shocks lead to higher private sector productivity? For example, spending on infrastructure and education may lead to complementarities that stimulate private sector productivity.[12] Baxter and King (1993) show that output multipliers may be very large in a neoclassical model when public capital is productive. In their model, government capital enters the production function directly; increases in government capital would be manifested as changes in private sector TFP under standard growth accounting techniques which ignore government capital. Leeper, Walker, and Yang (2010) develop a similar model but extend it to allow for implementation delays and distorting financing. Quantitatively, they find that multipliers can be large even in the face of distorting financing if public investment is sufficiently productive. They also show that the

[8]The hypothetical responses for the expansion regime are quite similar to the actual responses under either decomposition and are therefore omitted.

[9]This series comes from John Fernald (2009), based on the corrections in Basu, Fernald, and Kimball (2006). The basic idea is that one can proxy for unobserved input variation (in both capital and labor) with observed variation in hours per worker. This produces a measure of TFP that is "purified" of movements owing to unobserved input variation, which was one of the chief criticisms of the early RBC literature that measured technology shocks with simple Solow residuals.

[10]We also conducted this exercise using labor productivity – defined as output per hour in the non-farm business sector – as the measure of productivity. The results are very similar. Labor productivity takes into account the effects of private capital accumulation that is complementary to public capital accumulation.

[11]The identified "fundamentals" shock is very similar to the confidence shock from the recursive identification, so the sentiment-fundamental decomposition as performed above yields very similar results.

[12]See, for example, Aschauer's (1989) seminal contribution. Empirically, Feyrer and Sacerdote (2011) find that multipliers associated with infrastructure spending are in the neighborhood of 2.

pattern of multipliers can be quite different from conventional wisdom in response to increases in government investment – in particular, the multiplier at short horizons may be significantly smaller than the longer run multiplier. This pattern is consistent with our results, where the impact multipliers in the recession regime are about the same as in an expansion, while the longer run multipliers are much larger.

To investigate how government spending shocks across the regimes are differentially geared towards productive versus non-productive spending, we include in the benchmark VAR system the ratio of real government investment to real government consumption. Figure 7 shows the impulse responses. The response of the ratio of public investment to public consumption to an increase in government spending is positive on impact in both regimes, but larger in the recession regime. Furthermore, the response of government investment relative to consumption is significantly more persistent in the recession regime.

This suggests that there is an important difference in the longer term consequences for the composition of government spending following a spending shock in a recession – during recessions government spending shocks are more persistently geared towards investment rather than consumption. This differential mix could explain the much larger output response during a downturn. In the hypothetical case in which the response of confidence is held fixed (using a recursive identification with confidence ordered third, after the government investment to consumption ratio but before output), the responses of both output and the government investment to consumption ratio in the recession regime are much closer to their expansion regime counterparts. This suggests that the key channel through which government spending shocks have a differential effect on output during recessions is that spending shocks in a recession are geared more towards investment, which in turn stimulates private sector productivity, output, and confidence.

Figure 8 presents some historical evidence in support of these claims. It features scatter plots of the percentage growth of adjusted TFP three years after the official NBER recession against, respectively, the average percentage change in real government consumption and real government investment during each NBER-defined recession. Although there are only a few data points, there is clearly a strong positive relationship between government investment in a recession and subsequent productivity growth. In contrast, there is not much of a relationship between real government consumption and subsequent productivity growth. The correlation between growth in government investment during a recession and subsequent TFP growth is 0.77 across the post-1960 recessions, but is only 0.03 for government consumption. These results mean that in US post-war history recessions with higher government investment saw stronger subsequent TFP growth in the recovery. Given our estimates that spending shocks during a recession are more heavily geared towards investment, this evidence provides some credence to the idea that the primary channel through which spending differentially affects output and confidence in a recession is by increasing productivity.

6 Conclusion

This paper tackles the following question: does the transmission of fiscal shocks depend on systematic responses of consumer confidence? In doing so, we shed some new light on how expansionary fiscal policy stimulates the economy, and, to the best of our knowledge, study for the first time the role of systematic movements in confidence for aggregate fluctuations. We find that the endogenous response of conventional measures of confidence explains almost all of the output stimulus in recessions, whereas its role in normal times is minor. Importantly, the positive response of output and productivity to a fiscal stimulus during times of slack is mild on impact, gradual and prolonged. This suggests that fiscal stimulus in recessions is different from fiscal stimulus in normal times in that it boosts long-term productivity. Indeed, we find that fiscal expansions in recessions are more persistently geared towards government investment. It is this long-term productivity boost that is reflected in the important role of the systematic response of conventional confidence measures for recessionary fiscal transmission, not pure sentiment.

Of course, in as much as boosting pure sentiment is itself conducive to productivity enhancing economic activities, like R&D, human capital investment, embodied technological change, etc., our results can also be interpreted as fiscal policy working through a boost in pure sentiment. What is common to both explanations is that the positive role of fiscal policy in recessions works through medium-run effects on productivity, rather than short-run effects on demand. Our results suggest that the composition of government spending matters, especially during downturns. Digging ditches will stimulate neither confidence nor the economy.

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Table 1: Output Multipliers in the Linear Model

	Linear Model	Linear Model w/o Confidence
Impact Multiplier	0.84 [0.82, 1.34]	0.89 [0.86, 1.33]
Max Multiplier	0.84 [0.64, 1.29]	0.89 [0.86, 1.33]
Cumulative Multiplier	0.17 [0.14, 1.14]	-0.35 [-0.41, 0.29]
Controlling for Ramey (2011) News		
Impact Multiplier	0.81 [0.59, 1.07]	0.88 [0.66, 1.13]
Max Multiplier	0.81 [0.57, 1.36]	0.88 [0.66, 1.13]
Cumulative Multiplier	0.20 [-0.83, 1.13]	-0.32 [-0.65, 0.05]

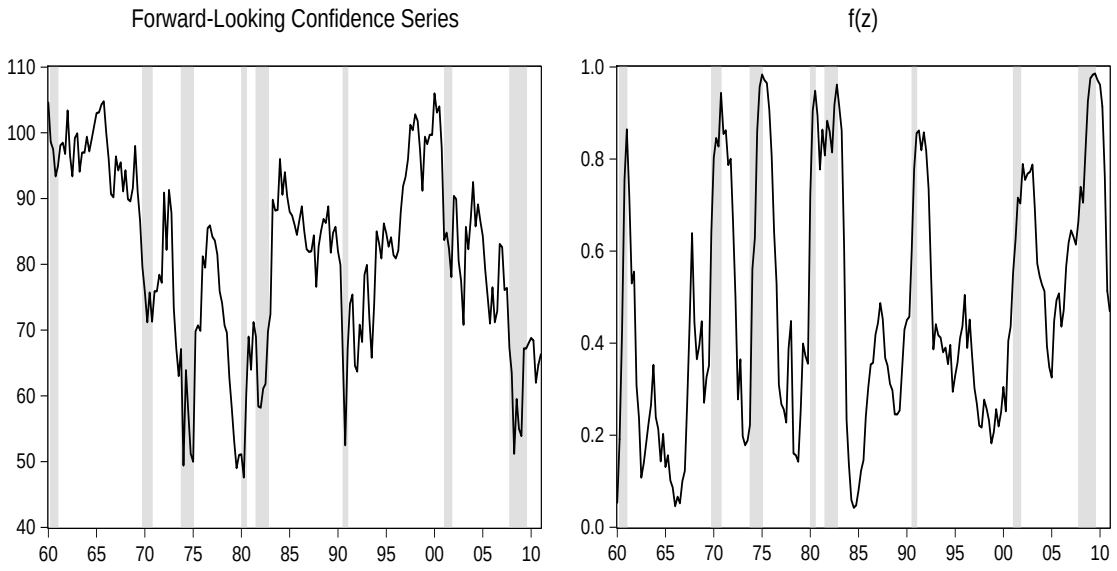
This table shows output multipliers for the benchmark linear Choleski-identified VAR model with government spending, confidence, and output. The impact multiplier is the impact response of output divided by the impact response of government spending to a spending shock. The max multiplier is the maximum response (over a twenty quarter horizon) of output divided by the maximum response of government spending to a spending shock over the same horizon. The cumulative multiplier is the sum of the output response over twenty quarters divided by the sum response of government spending. The estimates in the lower panel are from the benchmark linear VAR model which directly controls for news using Ramey's (2011) variable. The numbers in brackets are the one standard error confidence bands from the Kilian (1998) bootstrap distribution of multipliers.

Table 2: Output Multipliers in the Non-Linear Model

	Expansion	Recession	Recession w/o Confidence
Impact Multiplier	1.04	1.15	1.03
	[0.85, 1.59]	[0.29, 1.17]	[0.36, 1.20]
Max Multiplier	1.04	2.13	1.03
	[0.90, 2.12]	[0.51, 3.88]	[0.40, 3.05]
Sum Multiplier	0.15	2.16	-0.84
	[-0.20, 2.02]	[-1.34, 3.09]	[-1.23, 2.77]
Controlling for Ramey (2011) News			
Impact Multiplier	1.08	0.86	0.87
	[0.75, 1.65]	[0.17, 1.11]	[0.21, 1.09]
Max Multiplier	1.10	3.35	0.87
	[0.87, 2.14]	[0.50, 5.72]	[0.36, 2.69]
Sum Multiplier	0.78	2.67	-0.10
	[-0.36, 2.05]	[-2.03, 4.11]	[-1.04, 2.66]

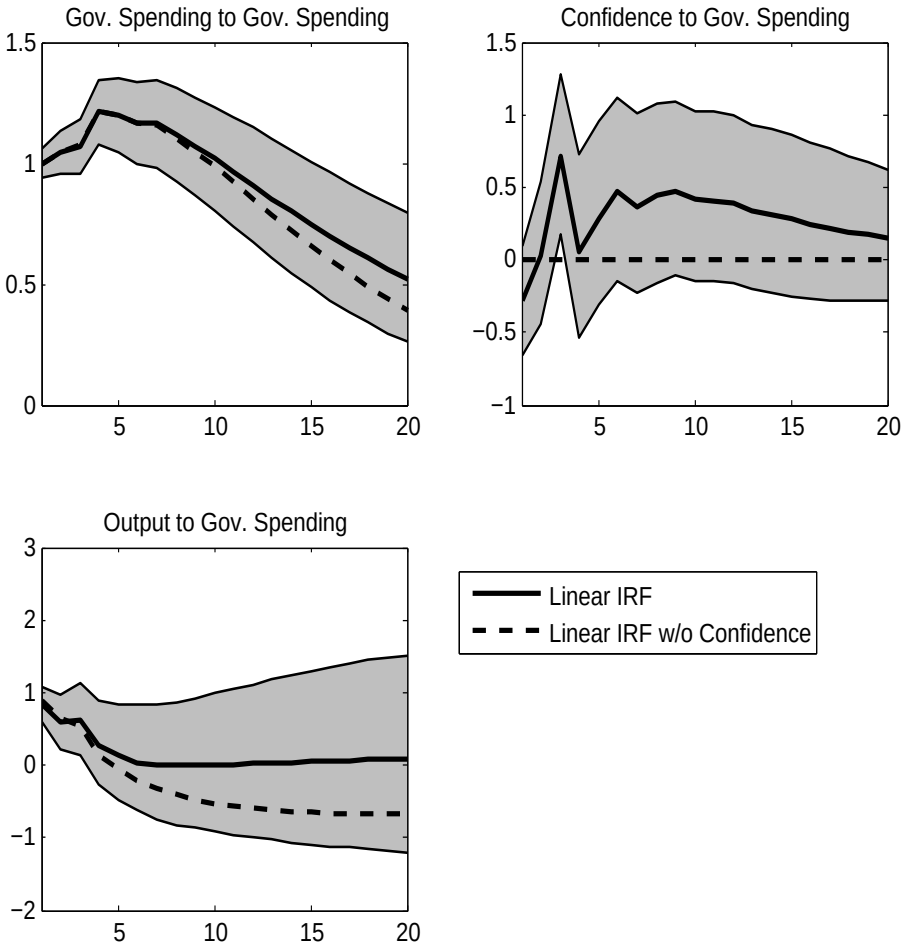
This table shows output multipliers for the benchmark non-linear Choleski-identifid VAR model with government spending, confidence, and output. The recession case sets $z_{t-1} = -0.9$ and the expansion case sets $z_{t-1} = 0.9$. The impact multiplier is the impact response of output divided by the impact response of government spending to a spending shock. The max multiplier is the maximum response (over a twenty quarter horizon) of output divided by the maximum response of government spending to a spending shock over the same horizon. The cumulative multiplier is the sum of the output response over twenty quarters divided by the sum response of government spending. The estimates in the lower panel are from the benchmark non-linear VAR model which directly controls for news using Ramey's (2011) variable. The numbers in brackets are the one standard error confidence bands from the bootstrap distribution of multipliers (see Appendix B).

Figure 1: Consumer Confidence and $f(z_t)$



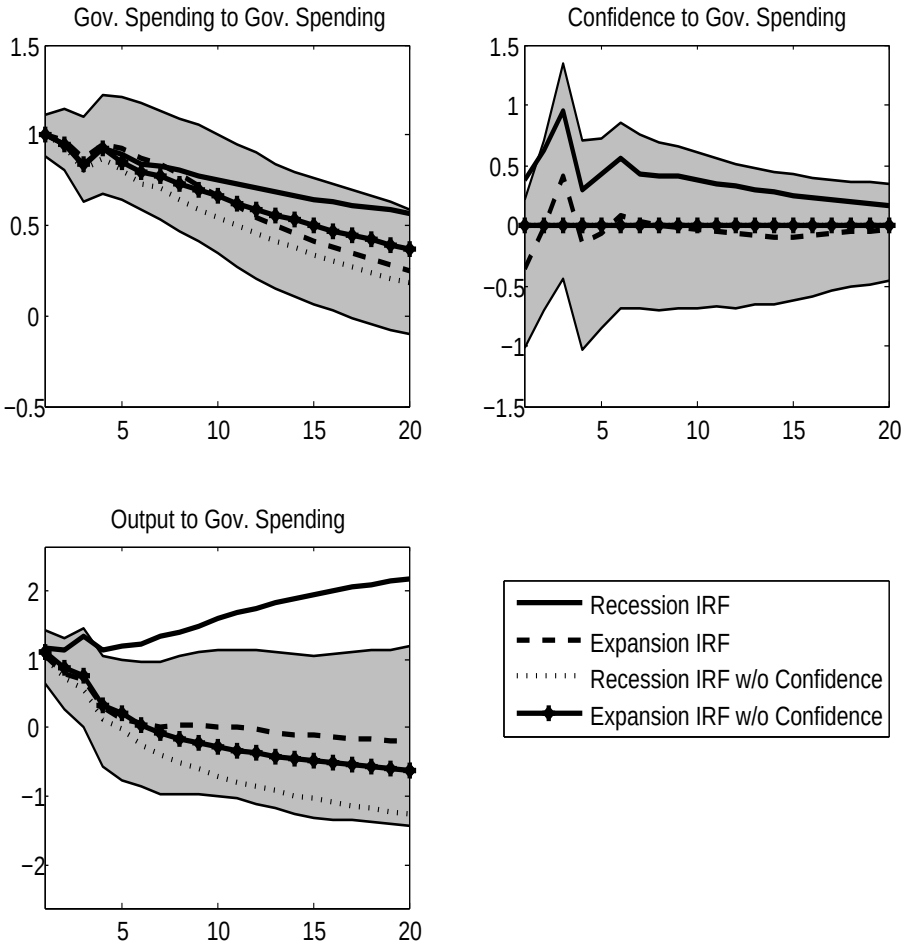
This figure plots the Index of Consumer Expectations from the Michigan Survey of Consumers. The right panel plots the cyclical indicator $f(z_t) = \frac{\exp(-\gamma z_t)}{1+\exp(-\gamma z_t)}, \gamma = 1.5$, where z_t is defined as the seven quarter moving average of real GDP growth. The shaded gray areas are recessions as defined by the NBER.

Figure 2: Government Spending and Confidence: Linear Model



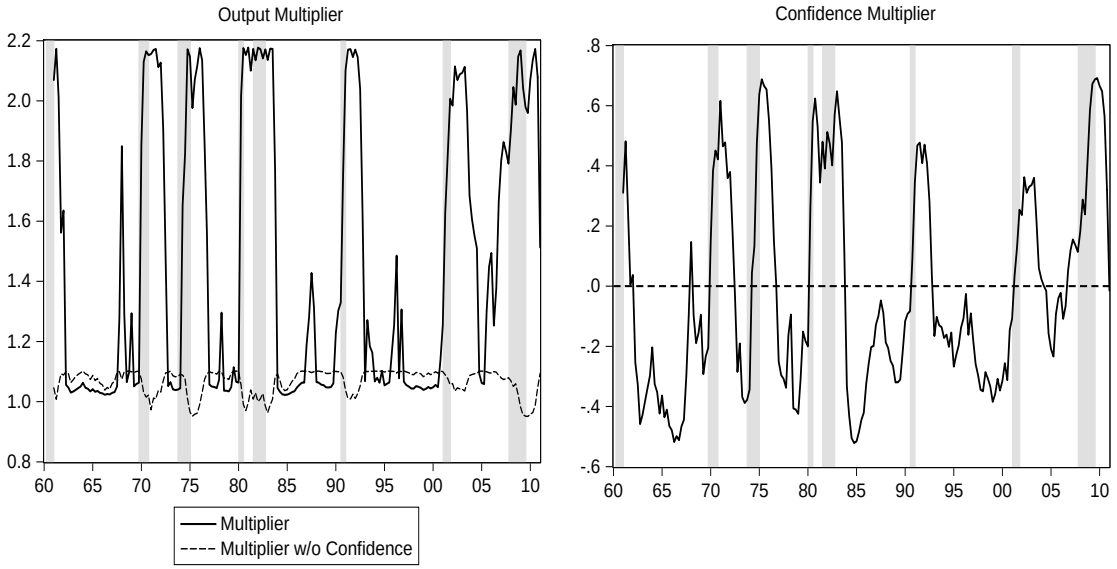
This figure shows impulse responses to a government spending shock in the benchmark Choleski-identified linear VAR model with government spending, confidence, and output. The solid lines are the actual impulse responses. The shaded gray areas are one standard error confidence bands around the actual impulse responses, using the bias-corrected bootstrap after bootstrap of Kilian (1998). The dashed lines are the impulse responses when confidence is held fixed.

Figure 3: Government Spending and Confidence: Recessions vs. Expansions



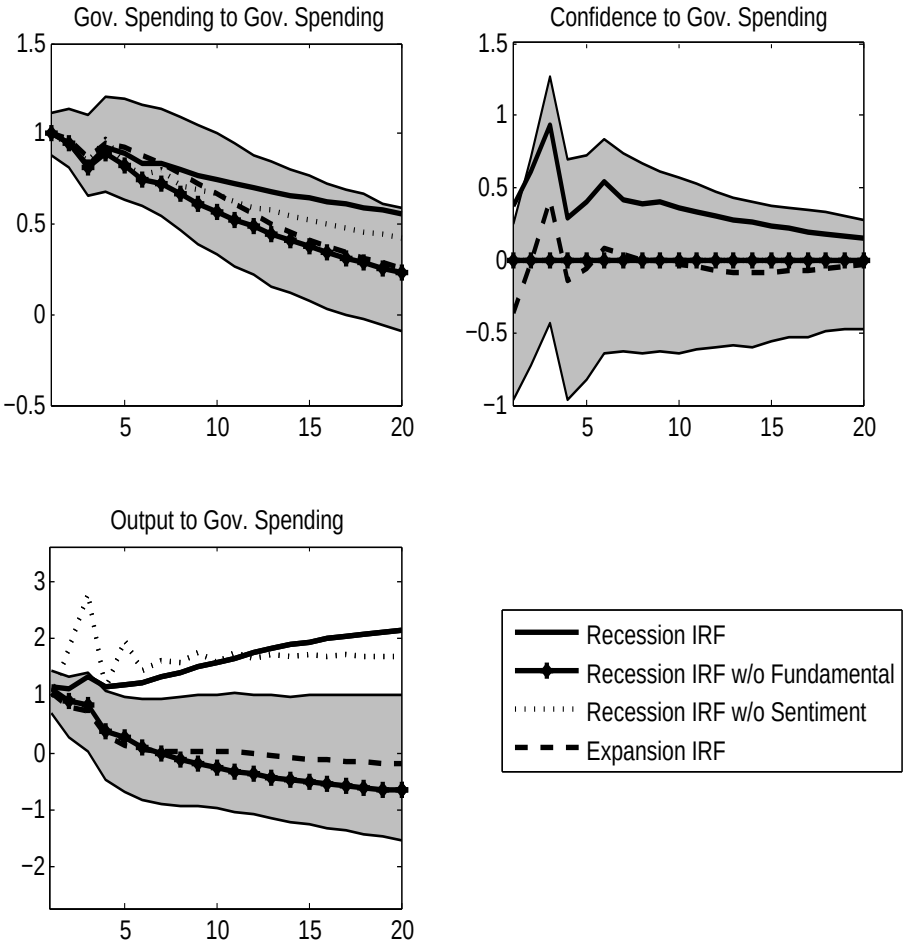
This figure shows impulse responses to a government spending shock during a recession (solid line) and expansion (dashed line), estimated from the benchmark non-linear Choleski-identified VAR model with government spending, confidence, and output. The dotted line shows the recession impulse responses holding confidence fixed, while the solid line with dashes through it shows expansion responses holding confidence fixed. The shaded gray areas are one standard error confidence bands for the expansion responses from the bootstrap procedure described in Appendix B.

Figure 4: Output Multiplier and Confidence Responses Across Time



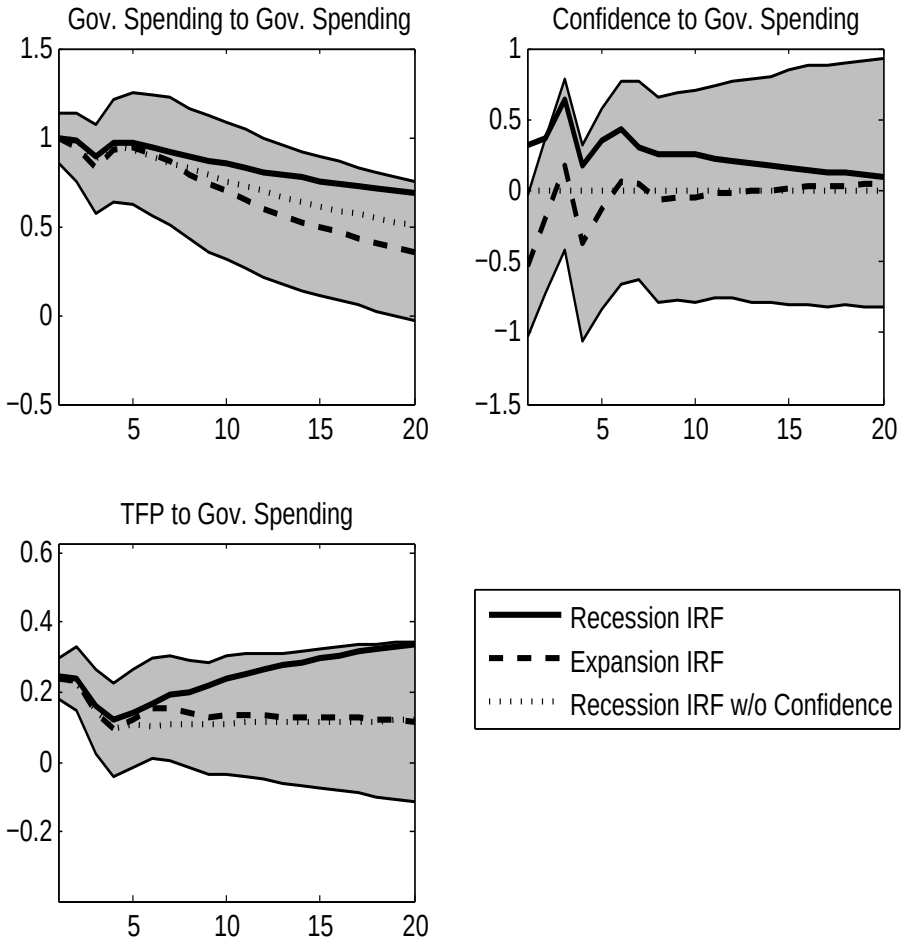
The left panel plots the government spending multiplier from the estimation of the benchmark non-linear Cholesky-identified VAR model across time. The multiplier is defined as the "max" multiplier: the maximum response of output over a 20 quarter horizon divided by the maximum change in government spending. The dashed line is the hypothetical multiplier when confidence is held fixed. The right panel plots the impact response of confidence. The shaded gray regions are recessions as defined by the NBER.

Figure 5: Government Spending and Confidence: Expansions and Recession
"Fundamentals"-"Sentiment" Decomposition



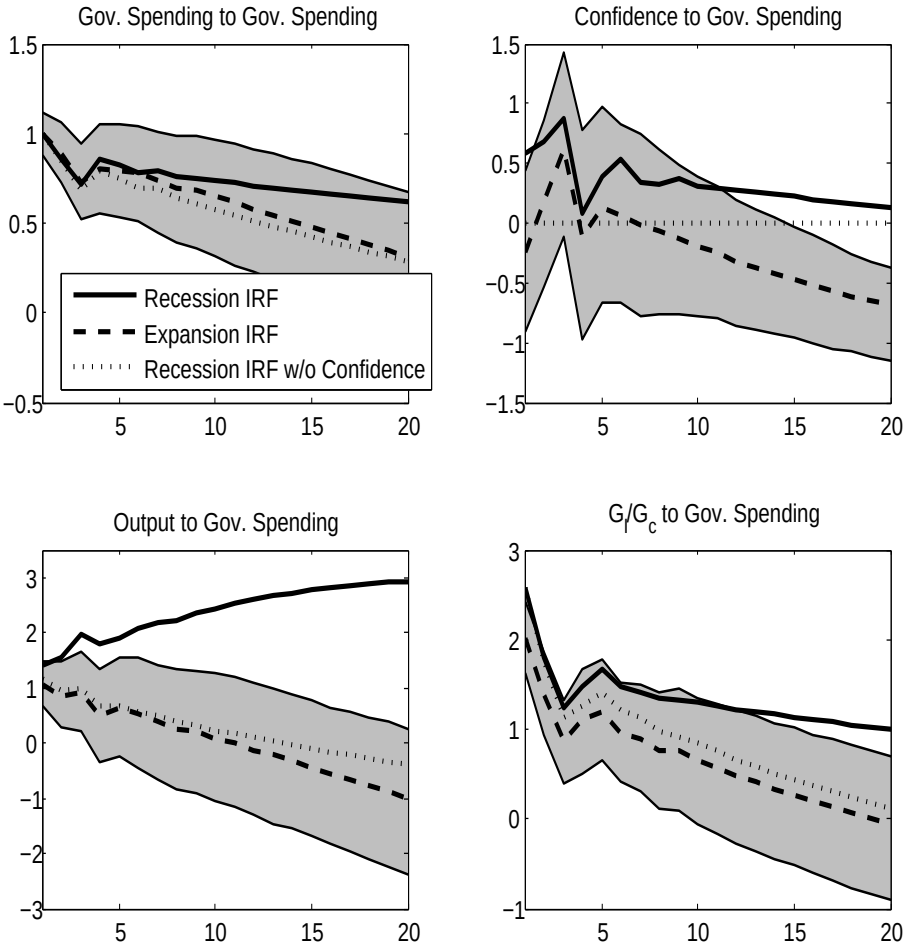
This figure shows the actual responses to a government spending shock during a recession (solid line) and expansion (dashed line) from the estimation of a non-linear VAR model with government spending, confidence, and output, where we identify what we call a "fundamentals" shock as the structural shock that maximally explains the forecast error variance of output at a twenty quarter horizon. The "sentiment" shock is the confidence innovation orthogonalized with respect to the government spending and "fundamentals" shocks. The dotted lines are the hypothetical responses holding confidence fixed with offsetting "sentiment" shocks, whereas the solid lines with bars are the hypothetical responses holding confidence fixed with offsetting "fundamentals" shocks. The shaded gray regions are one standard error confidence bands for the expansion responses from the bootstrap procedure described in Appendix B.

Figure 6: Government Spending, Confidence, and TFP



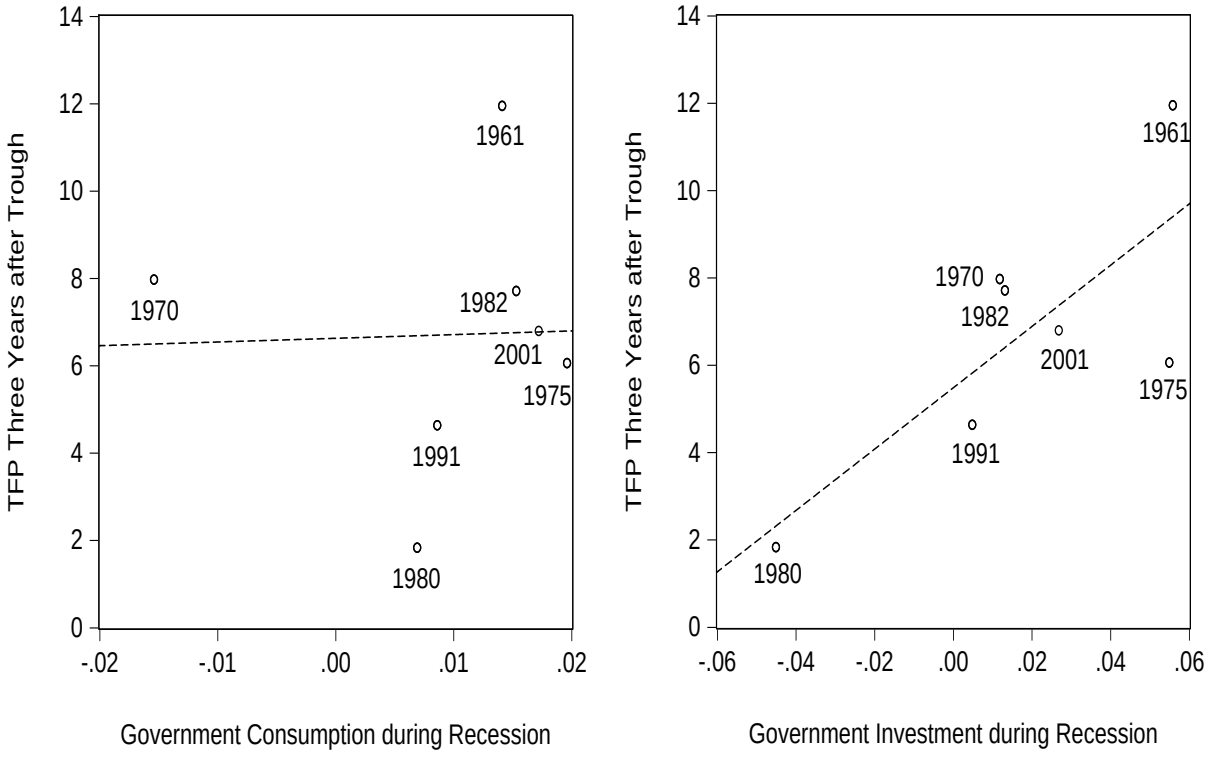
This figure shows the actual responses to a government spending shock during a recession (solid line) and expansion (dashed line) from a non-linear Choleski-identified VAR model using Fernald's (2009) quarterly utilization-adjusted measure of TFP ordered third instead of output. The dotted lines are the hypothetical responses holding confidence fixed. The shaded gray regions are one standard error confidence bands for the expansion responses from the bootstrap procedure described in Appendix B.

Figure 7: Government Spending, Confidence, and Components of Government Spending



This figure shows the actual responses to a government spending shock during a recession (solid line) and expansion (dashed line) in a non-linear Choleski-identified VAR model including the log ratio of real government investment to real government consumption expenditures, where the ratio is ordered after government spending but before confidence and output. The dotted lines are the hypothetical responses holding confidence fixed. The shaded gray regions are one standard error confidence bands for the expansion responses from the bootstrap procedure described in Appendix B.

Figure 8: Government Spending Components and Productivity Growth



In the left panel this figure plots the percentage deviation of the Fernald (2009) utilization-adjusted TFP measure three years out from the NBER-trough of each recession against the average percentage change of real government consumption during a recession relative to its peak value. The right panel does the same for real government investment. Consistent with our VAR procedure, we start with the 1961 recession. The dashed lines in both panels are the best-fitting regression lines.

A Quotes

"We must be certain that programs to solve the current financial and economic crisis are large enough, and targeted broadly enough, to impact public confidence." – Robert Shiller, Wall Street Journal, January 27, 2009

"Yale's Bob Shiller argues that confidence is the key to getting the economy back on track. I think a lot of economists would agree with that . . . The sad truth is that we economists don't know very much about what drives the animal spirits of economic participants. Until we figure it out, it is best to be suspicious of any policy whose benefits are supposed to work through the amorphous channel of 'confidence.'" – N. Gregory Mankiw, Blog, January 27, 2009

"Enacting such a conditional stimulus would have two desirable effects. First, it would immediately boost the confidence of households and businesses since they would know that a significant slowdown would be met immediately by a substantial fiscal stimulus." – Martin Feldstein, Testimony to the Committee on the Budget, U.S. House of Representatives, December 5, 2007

"But the economy is not stagnant because of a lack of spending. The economy is stagnant because of a lack of confidence in the future. Government spending on bridges, roads and new schools will stimulate the construction industry. But without confidence, the benefits will not spread to the rest of the economy." – Russell Roberts, Forbes.com, January 23, 2009

"The stimulus was too small, and it will fade out next year, while high unemployment is undermining both consumer and business confidence." – Paul Krugman, New York Times, November 23, 2009

"Economic activity in the United States turned up in the second half of 2009, supported by an improvement in financial conditions, stimulus from monetary and fiscal policies, and a recovery in foreign economies. These factors, along with increased business and household confidence, appear likely to boost spending and sustain the economic expansion." – Ben Bernanke, Monetary Policy Report to the Congress, February 24, 2010

"Confidence today will be enhanced if we put measures in place that assure that the coming expansion will be more sustainable and fair in the distribution of benefits than its predecessor." – Larry Summers, Responding to an Historic Economic Crisis: The Obama Program Brookings Institution, March 13, 2009

"President Obama's top priority has been to stop the vicious cycle of economic and financial collapse, stem the historic rate of job loss, restore confidence and put the economy on a path to recover." – Larry Summers, memo to Members of Congress Re: Status Report on Rescuing and Rebuilding the American Economy, August 4, 2009

"The subsequent global sell-off in equity markets suggested that governments would need to take action with more immediate impact to restore confidence in the markets." – James Bullard, The

B Bootstrap

This section details the block bootstrap procedure used to generate confidence bands for the non-linear VAR model.

The bootstrap procedure in the linear models is a parametric bootstrap. First, we re-sample the VAR residuals, u_t, with replacement, and use the resulting series along with the estimates of the As to re-construct hypothetical time series of Y_t. Then we re-estimate the VAR on each hypothetical time series, construct impulse responses, and measure the confidence bands by the percentiles of the bootstrap distribution of impulse responses.

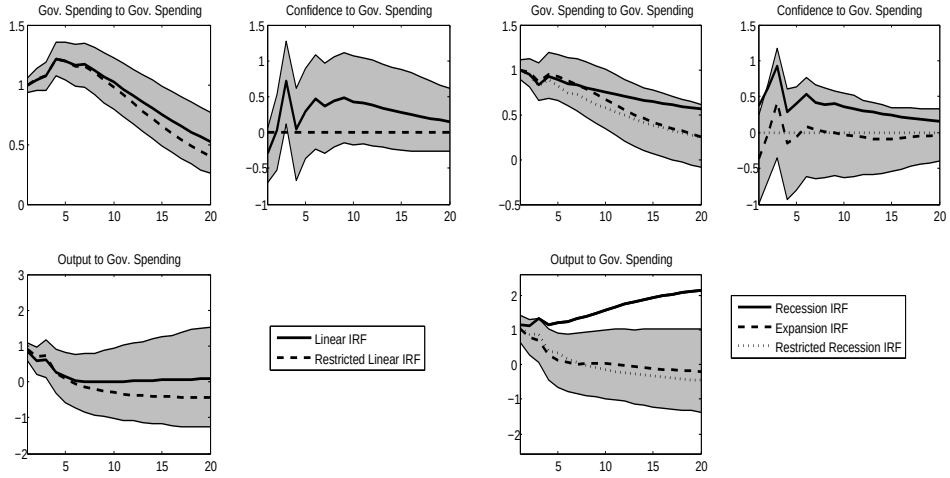
The state-dependent nature of the non-linear VAR models makes this procedure inappropriate. In particular, the variance-covariance matrix of residuals depends on lagged values of output, which forms the basis of z_t and hence $f(z_t)$. A simple parametric bootstrap would fail to take account of this correlation. We therefore employ a non-parametric block bootstrap procedure. Rather than re-sampling residuals with replacement, we instead re-sample the actual data series. We first transform the trending series (output, government spending, etc.) to be stationary by first differencing (the confidence series is clearly stationary). We then draw blocks of 20 observations of the data series with replacement to construct a bootstrap sample. Drawing blocks is necessary to account for the time dependence of the data; our results are fairly consistent across different block sizes. We then re-transform the data to be in levels (cumulative summing of the growth rates). Then for each bootstrap sample, we take the observed time series for output and re-construct a measure of z_t and $f(z_t)$ exactly as in the data. Then we estimate (10)-(12) on the re-sampled data and compute impulse responses across regimes. The confidence bands are then the percentiles of the distribution of estimated responses.

C An Alternative Approach to Isolating the Role of Confidence

In the main part of the paper, we fix the underlying economic environment and isolate the role of confidence in the transmission of policy shocks by decomposing the observed average effect of government spending on output into its direct effect and its indirect effect through confidence. An alternative interpretation of the question "Does Confidence Matter in the Transmission of Government Spending Shocks?" would be to restrict the coefficients of the underlying VAR in such a way as to force the response of confidence to a spending shock to be zero, and then compare the restricted impulse responses with the unrestricted ones. There is a subtle difference to the baseline approach: there we fix the underlying economic environment and study particular hypothetical shock combinations that hit this economy; here we postulate a different (restricted) economic structure, i.e. confidence is *structurally* not allowed to respond to government spending and output shocks, and re-estimate. Then we compare how different the unrestricted and the restricted economy behave after a surprise increase in government spending.

In terms of the linear model, a necessary condition for confidence to not react to a spending shock at any horizon is $a_{2,1} = 0$, so that it not react on impact. This plus restricting the AR coefficients on lagged output and spending in the confidence equation to zero will be *sufficient* for imposing that confidence not react to a spending shock at any horizon. We implement these restrictions by estimating the benchmark system using seemingly unrelated regressions, with the additional restriction that confidence not react to a spending shock on impact. This is straightforward to implement in both the linear and non-linear models. The impulse responses for the benchmark system, which are shown below, are both for the linear case (left panel) and recessions (right panel).

Figure A-1: Government Spending and Confidence: Restricted Models



This figure shows impulse responses to a government spending shock. The left panel shows responses for the linear system, where the solid lines are the actual impulse responses. The dashed lines are the impulse responses in the system estimated via seemingly unrelated regressions, where confidence cannot respond to the spending shock by construction. The right panel shows responses for the non-linear system, with the solid line the responses during a recession, the dashed lines the responses during an expansion, and the dotted lines the responses from the restricted system estimated via seemingly unrelated regressions. In both figures, the shaded gray areas are one standard error confidence bands around the linear responses in the left panel and around the expansion responses in the right panel, using the bias-corrected Bootstrap of Kilian (1998) in the left panel and the bootstrap procedure described in Appendix B in the right panel.

These are very similar to what obtains in the benchmark results in the paper; see, for example, Figures 2 and 3.