Government Spending and Expectations

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Abstract

This paper documents the impact of fiscal policy on the expectations of the consumers and offers an alternative explanation for crowd-in effect of government spending on private consumption. I construct fiscal news variable using survey data to account for the fiscal foresight and show that this variable carries out relevant information about future government spending. I find significant positive response of consumer confidence and consumption to the anticipated government spending (fiscal news) shocks. The further analysis shows that confidence is pivotal in the transmission of fiscal policy on the real variables since the anticipated government spending shock crowds out private consumption when the response of confidence is held fixed. I develop DSGE model with informational frictions to identify the link between fiscal policy and expectations. The agents revise their expectations about future income, consumption and output to a higher level after fiscal news shock if government demand signal is clearer (less noisy) relative to the tax signal. The revised expectations of higher personal and aggregate income and output can be seen as a theoretical counterpart of the increase in consumer confidence found in the empirical part. The higher expected demand relative to the higher expected taxes by the agents associated with the anticipated government spending shock is the key in the more optimistic expectations and improvements in confidence that eventually increases private consumption along with the output in the equilibrium.

Keywords: Fiscal Policy, Sentiment, Consumption, Expectations

JEL Code: E62, E71, H50, D84

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1 Introduction

A classic and long-continued question in macroeconomics is: how does the economy respond to a change in government spending? The large part of the empirical literature answers this question through identification of fiscal shocks and measuring its impact on the real economy. The results generally predict increase in output and hours and mixed results in consumption and real wages, depending on the identification method.\textsuperscript{1} The most puzzling result after all is the increase in consumption that is at odds with neoclassical paradigm and number of authors proposed different explanations to shed some light on this puzzle.\textsuperscript{2}

A different but related literature studies the impact of the changes in the consumer confidence on the economic activity that gained attention following the Great Recession and the recent research find positive response of output and consumption to the innovations in consumer confidence.\textsuperscript{3} In the meantime, the prolonged low economic activity during Great Recession is mostly attributed to the collapse of the consumer confidence and number of economists and policy-makers proposed to use fiscal policy as a tool to restore the confidence in the economy and to combat with the recession.\textsuperscript{4} However, our knowledge how the confidence channel of fiscal spending policy is in effect is very limited since the number of works that explores this channel is very few, both empirically and theoretically.

In this paper, I explore the impact of fiscal policy on the consumer confidence and I provide evidence for the role of confidence, defined as expectations (optimism) of the agents about aggregate and individual state in the near-future, as an important transmission mechanism of fiscal policy on the real economy, particularly on consumption.\textsuperscript{5} I construct the evidence in two steps. First, through the identification of innovations to an empirical proxy for fiscal news (expectations about future government spending) in a structural vector autoregression (SVAR), and second through the lens of a structural dynamic stochastic general equilibrium model (DSGE) with three main features: households’ heterogeneity, imperfect information, and innovations to fiscal news. In the SVAR, fiscal news is proxied by the combination of government spending forecasts from Greenbook Forecasts and Survey of Professional Forecasters, both survey data, and confidence is proxied by the University of Michigan Consumer Sentiment Index. I exploit the timing and design of the survey to identify structural shocks to fiscal news. In the DSGE, movements in consumer confidence are modelled as change in the expectations of the agents about personal and aggregate economic conditions due to the innovations in fiscal news.

An important empirical work that identifies the impact of government spending on consumer confidence is done by Bachmann and Sims (2012). The authors employ nonlinear SVAR and find that

\textsuperscript{1}The identification can be grouped in two methods; SVAR and EVAR, SVAR with expectation variable to account for fiscal foresight. SVAR typically implies a rise in consumption and real wages, whereas EVAR may predict a fall or increase depending on the news variable (see Ramey (2016) for the former and Forni and Gambetti (2016) for the latter)

\textsuperscript{2}The most prominent examples are Ravn et al. (2006), Galí et al. (2007) and Christiano et al. (2011). An exhausting list with detailed explanations is provided in the next subsection.

\textsuperscript{3}Barsky and Sims (2012) is one of the most relevant example in this literature. They disentangle confidence shock as a news shock related to the future fundamentals and a sentiment (pure confidence) shock not related to the fundamentals, so called “animal spirits”.

\textsuperscript{4}For example, Russell Roberts stated on Forbes.com on January 23, 2009 “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.”

\textsuperscript{5}I use consumer confidence and expectations of the agents interchangeably relying on this definition.
unexpected shocks in government spending has positive impact on confidence only during slack times. However, as documented by Ramey (2011) and Forni and Gambetti (2016), a significant part of the government spending is anticipated, called fiscal foresight, and analyses that fail to model foresight will obtain biased estimates (see Leeper et al. (2013) for a discussion). I address fiscal foresight by constructing fiscal news variable, proxy for the anticipated component of fiscal policy, by splicing sum of the next four quarter government spending forecasts from Greenbook and Survey of Professional Forecasters, SPF hereon, that gives me the longest survey data about fiscal policy and I depict that my proxy contains useful information to predict the future government spending.\footnote{Even though Greenbook forecasts can be up to eight quarters, SPF forecasts are published for the next four quarters and this is the reason why my proxy is limited to the next four quarters.}

In addition, SVAR should contain adequate variables not to suffer informational insufficiency.\footnote{In other words, the identified shocks should not be predictable.} To ensure informational sufficiency, I run Bayesian VAR (BVAR) with seven variables and I order fiscal news first and apply Cholesky decomposition to identify the fiscal news shocks.\footnote{I discuss in detail in Section about the information flow and timing assumptions of fiscal news variables to identify the fiscal news shocks.} I show that the identified shocks are exogenous and informationally sufficient and do not pick up the other shocks estimated in the literature. I find positive and significant response of confidence, output and consumption to the fiscal news shock whereas the responses are mild to the surprise shock and turn to negative after several periods. In the last step, I perform counterfactual exercise and compute the response of consumption and output to the fiscal news shock in which the response of confidence to the fiscal news shock is shut down. I find that responses of output and consumption are much smaller in magnitude and the latter turn to negative after the initial period for several quarters as standard RBC models predict. The empirical findings point the confidence as a key component in the transmission of fiscal policy to the real economy, particularly in the short-run, and pick out the confidence as an explanation of the positive response of consumption to the government spending.

But empirical analysis lacks an answer to a fundamental question: what is the mechanism embedded in fiscal policy that fosters the expectations of the agents? To answer this question and shed more light on the inner workings of fiscal policy on the expectations, I construct a simple island model with imperfect communication a la Lorenzoni (2009) with government sector.\footnote{Guimaraes et al. (2016) develop a static model with imperfect information and convex adjustment costs and government spending can stimulate investment when there is coordination failure. Their model requires imperfect substitution among private and public goods so that higher government spending can increase demand for private consumption that would eventually increases investment.\footnote{The starting motivation behind the imperfect information model is that the news about future fiscal policy are quite noisy even though government statistic are published with very high precision. I look at the individual government spending forecasts in SPF data and find large dispersion among the forecasts. I take this result as an evidence to the imperfect information about the fiscal policy announcements.}} The representative agent in each island owns continuum of firms that supply services to the private sector and to the government. The heterogeneous agents receive noisy signals with respect to the fiscal news about future government expenditure and tax obligations that are directed to them but they are imperfectly aware of aggregate fiscal policy announcements. Hence, the agents face a signal extraction problem and they try to anticipate the government demand and taxes payable towarded them using the signals they receive.

The mechanism that improves the expectations of the agents and stimulate the private consumption and output is the following: when the fiscal news shock hits the economy if the idiosyncratic noise in
the government demand signal is sufficiently smaller relative to the noise in the tax signal, the agents expect higher government demand relative to the taxes payable. This increases expectations of permanent income, which in turn causes an increase in desired consumption. The same holds for every island since the decision rule of each island is the same. Overall, the agents in each island is more optimistic about their financials after the government spending shock that translates into aggregate optimism in the economy that is the theoretical counterpart of confidence in the empirical section.

I confront the model with data through the estimation of the key structural parameters by minimizing the distance between the impulse responses generated by the model and those estimated by BVAR. The estimates support the main feature of the model, the large noise in the tax signal and small noise in the government demand signal. However, the estimates also point to the two additional features that are necessary to have an increase in aggregate consumption: highly sticky prices and imprecise information about macro aggregates. Highly sticky prices prevent a price spike that would otherwise decrease quantities consumed and inform agents about macro aggregates. The imprecise information about macro aggregates prevent the agents to infer the true value of the government demand and tax towarded them.

Finally, I run a counterfactual experiment by shutting down the idiosyncratic noises in the government demand and tax signals and generate the model responses with the same estimated parameters and I compare this counterfactual model with the estimated one. The results confirm the main mechanism and the response of consumption turns to negative in the counterfactual model.

The remainder of this introduction is the literature review. The next section describes identification method and empirical results. Section 3 presents the DSGE model. Section 4 concludes.

1.1 Related Literature

Empirical Fiscal Policy

The closest papers to mine from empirical point of view is Ramey (2011), Auerbach and Gorodnichenko (2012), Bachmann and Sims (2012), Forni and Gambetti (2016), Figueres (2015) and Alesina et al. (2015). Ramey (2011) creates military news series after 1939 reading newspapers and embedded news into VAR and finds increase in GDP but decrease in consumption of nondurable plus services. Auerbach and Gorodnichenko (2012) control for the expected government by splicing Greenbook and SPF next quarter government spending forecasts and find larger fiscal multipliers during recessions. Bachmann and Sims (2012) deliver the first work that explores the role of confidence in the transmission of fiscal policy and they find that surprise shocks in government spending increase confidence only during slack times. Forni and Gambetti (2016) construct fiscal news series using sum of government spending forecasts from SPF, incorporate into VAR, apply recursive identification and find increase in output and consumption after positive fiscal news shocks. Figueres (2015) uses forecasts from SPF, in spirit of Forni and Gambetti, 2016, to control for the anticipated component of fiscal policy and find significant impact of both shocks on confidence only during recessions. Finally, Alesina et al. (2015) explore the confidence and fiscal policy channel using exogenous fiscal adjustment plans of OECD countries and find spending-based fiscal adjustment fuels the business confidence, key mechanism behind the lower output losses relative to the tax

\[11\] The government spending forecasts solely for the next quarter may miss the part of the information that agents are subject to since the current quarter fiscal news may contain information not only for the next quarter but also for the next few quarters and these news may be incorporated in the information set of the agents.
adjustments. My paper extends the all the mentioned works by identifying the role of confidence in the transmission of fiscal policy announcements on the real variables, particularly on consumption, through the employment of the longest survey data about the expected government spending.

**Fiscal Policy and Private Consumption**

My paper is linked to the theoretical fiscal policy in which there are different proposals to rationalize the crowd-in effect of government spending on consumption. The deep habit formation in Ravn et al. (2006), in which agents form habits over individual varieties of goods as opposed to over a composite consumption good, gives rise to countercyclical mark-ups and consumption and wages respond procyclically to government-spending shocks. Bouakez and Rebei (2007) develop RBC model with habit forming households and complementary private and public goods that are the key features enabling the positive response of consumption following a government spending shock. Gali et al. (2007) propose sticky-price DSGE model with rule-of-thumb households and find crowd-in effect of government spending if the share of liquidity constrained consumers is not small and mark-ups are countercyclical. Christiano et al. (2011) argue that the government spending multiplier can be much larger than one when the zero lower bound on the nominal interest rate binds. Guimaraes et al. (2016) incorporate fixed costs and noisy idiosyncratic information into a static model and find that an increase in government spending directly incentivizes investment when the desire for investment is low; hence, it affects a firm’s beliefs about others’ investment decisions, which, in turn, provides a further boost to investment. The closest to my paper in this strand is Murphy (2015) and he uses imperfect information framework to deliver increase in aggregate consumption when the owners of firms perceive an increase in their permanent income relative to their future tax liabilities due to persistent idiosyncratic government demand component that is not present in tax liabilities. The key differences between his model and my model are that I add fiscal news process and price stickeness, I introduce persistent component in individual tax liabilities in addition to the individual government demand to enable the role for expectations and to prevent mechanical shifts in perceived permanent income and I confront the model with data.

2 Empirical Analysis

2.1 Proxy for the Future Government Spending

The government spending is anticipated to some degree since the changes in fiscal policy are usually implemented with a lag.\(^{12}\) The agents can react to the anticipated changes in the fiscal policy even before the implementation takes place which eventually lead to the changes in the fundamentals. If the econometrician misses these anticipated changes in his information set, or the agents have larger information set than the econometrician, then Vector Moving Average representation of SVARs can be non-fundamental and estimated impulse-responses can be different than the true ones (see Leeper et al. (2013) for a thorough discussion).

Ramey (2011) and Forni and Gambetti (2010) show that government spending shocks estimated with standard fiscal VARs are predictable by the government spending forecasts, hence the estimated shocks

\(^{12}\)Leeper et al. (2012) calibrate the forecast range of government spending three to four quarters and Mertens and Ravn (2011) find that tax policy changes are subject to six quarter median implementation lag.
are non-fundamental. To overcome the non-fundamentalness problem, I follow the approach developed by Forni and Gambetti (2016) and I endow VAR with proxy of future government spending.\textsuperscript{13}

The proxy is constructed by using the Greenbook, prepared by the FRB staff for FOMC meetings, and SPF (Survey of Professional Forecasts) government spending growth forecasts.\textsuperscript{14} Since the properties of the Greenbook and SPF forecasts are similar, I splice the Greenbook and SPF government spending growth forecasts and construct a continues forecast series running from 1966Q4 to 2018Q1.\textsuperscript{15} The main assumption behind the proxy is that Greenbook and SPF forecasts convey information about the future government spending that is not available in current or lagged variables.\textsuperscript{16}

Assume that \( g_t \) denotes the government spending growth at time \( t \). Then I can define one-period proxy for the future government spending up to \( N \) period as following:

\[
et(h) = E^P_t g_{t+h}, h = 1, 2, \ldots, N
\]  

(1)

where \( E^P_t \) is the information set of the forecaster at time \( t \). This is different than the regular information set \( t \), since the forecasts are made generally in the middle of the quarter and forecaster does not know the realized value of the time \( t \) variable. In addition, I can define cumulative proxy as following\textsuperscript{17}:

\[
et(1, H) = \sum_{h=1}^{H} E^P_t g_{t+h}, H = 1, 2, \ldots, N
\]  

(2)

and in both equations 1 and 2, \( N \) is equal to 4 since this is the furthest forecast horizon in SPF.\textsuperscript{18}

A crucial issue is to determine the horizon of anticipation of fluctuations in the government spending. In other words, which proxy has the largest predictive power of the future government spending. For this reason, I calculate the growth in the government spending between the periods as in each proxy and regress the calculated growth on the related proxy, separately. Since the objective is to assess the predictive power of the proxies to explain the evolution of the government spending, Table 1 displays the adjusted \( R^2 \) and the F-Statistic from these regressions.

\textsuperscript{13}The other approaches proposed in the literature are identifying fiscal spending shocks using narrative military news by Ramey (2011), excess returns to defense contractors by Fisher and Peters (2010), SPF forecasts by Auerbach and Gorodnichenko (2012), Ricco (2015) and Forni and Gambetti (2016).

\textsuperscript{14}I use government spending growth because the forecasts of levels are subject to several changes of the base year in the SPF.

\textsuperscript{15}FOMC meetings are usually 8 or 12 times a year; hence, I take the latest Greenbook forecasts prepared for the meeting of each quarter.

\textsuperscript{16}Appendix A explains in detail how the proxy is used to identify the government spending shocks.

\textsuperscript{17}Definition of cumulative proxy may seem redundant; however, considering the delays in budgeting process or in authorization of spendings, single period proxy may result in mistiming of the news. In other words, the policy that is announced to be implemented in the next period may be delayed and result in lower predictive power of single period proxy. The cumulative proxy may compensate the mistiming due to its longer anticipation horizon. The results from Table 1 support this view.

\textsuperscript{18}The forecast horizons can be different in Greenbook especially until mid 1970s. The list with forecast horizons are given in Appendix B.
The F-statistic is above 10 in all equations indicating the significant forecast ability of the proxies. The predictive power is higher for the cumulative proxies, supporting our intuition of possible mistiming in the implementation of the announced policy. The best predictive power is obtained with the cumulative proxy $e_t(1,4)$; thereof, I continue my analysis using the sum of government spending growth forecasts for the next four quarters.

2.2 Methodology and Data

The empirical model is the following VAR system:

$$X_t = M + B(L)X_{t-1} + u_t$$  \hspace{1cm} (3)

where $X_t$ is a vector of endogenous variables, $M$ is constant, $B(L)$ denote P-order lag polynomials and $u_t$ is the vector of reduced-form residuals having zero-mean. The baseline analysis refer to the vector $X_t$ in the following order; $X_t = (e_t(1,4), conf_t, g_t, d_t, y_t, c_t, i_t)'$ where $e_t(1,4)$ is the proxy for the future government spending, $conf_t$ is the expected consumer sentiment index from survey of consumers published by University of Michigan, $g_t$ is the log of federal government consumption and investment expenditures, $d_t$ is federal debt-to-gdp ratio, $y_t$ is the log of real GDP, $c_t$ is the log of real private consumption (sum of durables,non-durables and services) and $i_t$ is the effective federal funds rate.\(^{19}\) The nominal variables are converted to real values by dividing the implicit GDP deflator provided by the Federal Reserve Bank of St. Louis. The time span is 1966Q4 – 2018Q1.

I estimate the model using Bayesian techniques with diffuse priors with lag-length of three based on Akaike information criterion. Identification is obtained by imposing a Cholesky scheme with the order of the variables as in vector $X_t$. In this approach, the anticipated but unexpected government spending shock, so-called fiscal news shock, is identified as the first Cholesky shock and the surprise government spending shock is identified as the third Cholesky shock in the above VAR system.

The reason of ordering the proxy of future government spending first is due to the information flows in the economy. The forecasts are generally published in the middle of the quarter and the forecasters know

\(^{19}\)The fiscal variables are constructed using the Bureau of Economic Analysis’ NIPA table 3.2

<table>
<thead>
<tr>
<th>$g_{t+1}$</th>
<th>$g_{t+2}$</th>
<th>$g_{t+3}$</th>
<th>$g_{t+4}$</th>
<th>$\sum_{h=1}^{2} g_{t+h}$</th>
<th>$\sum_{h=1}^{3} g_{t+h}$</th>
<th>$\sum_{h=1}^{4} g_{t+h}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R^2$</td>
<td>$F$-Stat</td>
<td>$R^2$</td>
<td>$F$-Stat</td>
<td>$R^2$</td>
<td>$F$-Stat</td>
<td>$R^2$</td>
</tr>
<tr>
<td>0.13</td>
<td>16.4</td>
<td>0.19</td>
<td>31.6</td>
<td>0.11</td>
<td>9.9</td>
<td>0.11</td>
</tr>
<tr>
<td>0.40</td>
<td>33.4</td>
<td>0.44</td>
<td>40.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: OLS estimates of the projection of growth in government spending, $g_{t+j}$ on the proxy $e_t(h)$ defined in equation 1 for each $h = \{1,2,3,4\}$ and cumulative government spending growth $\sum_{h=1}^{H} g_{t+h}$ on the cumulative proxy $e_t(1,H)$ defined in equation 2 for each $H = \{2,3,4\}$. $g_{t+h}$ is the log change of government spending between period $t+h$ and $t+h-1$ and $\sum_{h=1}^{H} g_{t+h}$ is the cumulative log change of government spending between period $t+H$ and $t$. $R^2$ and $F$-Stat corresponds to the adjusted R-squared and the value of F-statistics for each equation, respectively.
only the past values of the variables but not the realized values of the current quarter real variables when the forecasts are published. Therefore, when forecasters form their expectations, their information set includes the past values of the variables but not the current period values. By ordering the expectations of government spending first, the information set of the econometrician and the forecasters are aligned since the identification scheme imposes the restriction that current period real variables do not have impact on the expectations of the future government spending. I analyse the implications of this ordering versus alternative strategies in the robustness section.

2.3 News and Surprise Shocks

![Anticipated and Surprise Spending Shocks](image)

**Figure 1:** Anticipated and Surprise Spending Shocks

*Notes: The top figure shows the identified anticipated government spending shock and bottom figure displays the identified surprise government spending shock after Bayesian estimation of equation 3. All shocks are normalized by their standard deviations.*

The top panel of Figure 1 shows the identified news shocks and bottom panel shows the surprise shocks. The fiscal news shocks display significant variation during key events, whereas the same does not hold for the surprise shocks. For example in top panel, the negative spikes in the beginning of the sample are the result of the Nixon Doctrine that started the withdrawals of the troops from Vietnam and the positive spike in the second quarter of 1971 coincides with Public Law 91-656 which provided 7.9% increase in military pay. The negative spike in the third quarter of 1977 is the cut in defense spending during the presidency of Carter.\(^{20}\)

The aim of incorporating the proxy of future government spending is to resolve the issue of non-fundamentalness. To verify whether this is the case and the shocks do not contain any predictable component, I perform the non-fundamentalness test proposed by Forni and Gambetti (2014). I regress

\(^{20}\)The positive and negative spikes after 1981Q2 are exhaustively discussed in Forni and Gambetti (2016).
the fiscal news and surprise shocks on the lagged values of principal components extracted from large set of macroeconomic variables. Table 2 presents the results in Panel A for fiscal news shock and Panel B for surprise shocks and both shocks pass the orthogonality test.

Table 2: Fundamentalness Test

<table>
<thead>
<tr>
<th>Panel A. Fiscal News Shocks</th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of principal components</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>1 lag</td>
<td>0.92</td>
<td>0.11</td>
<td>0.27</td>
<td>0.41</td>
<td>0.16</td>
<td>0.21</td>
</tr>
<tr>
<td>2 lag</td>
<td>0.88</td>
<td>0.31</td>
<td>0.60</td>
<td>0.70</td>
<td>0.45</td>
<td>0.57</td>
</tr>
<tr>
<td>3 lag</td>
<td>0.97</td>
<td>0.52</td>
<td>0.86</td>
<td>0.86</td>
<td>0.72</td>
<td>0.81</td>
</tr>
<tr>
<td>4 lag</td>
<td>0.98</td>
<td>0.68</td>
<td>0.95</td>
<td>0.96</td>
<td>0.89</td>
<td>0.94</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel B. Surprise Shocks</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of principal components</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>1 lag</td>
<td>0.88</td>
<td>0.77</td>
<td>0.67</td>
<td>0.60</td>
<td>0.54</td>
<td>0.56</td>
</tr>
<tr>
<td>2 lag</td>
<td>0.87</td>
<td>0.88</td>
<td>0.80</td>
<td>0.80</td>
<td>0.86</td>
<td>0.55</td>
</tr>
<tr>
<td>3 lag</td>
<td>0.92</td>
<td>0.97</td>
<td>0.74</td>
<td>0.83</td>
<td>0.84</td>
<td>0.53</td>
</tr>
<tr>
<td>4 lag</td>
<td>0.81</td>
<td>0.86</td>
<td>0.65</td>
<td>0.17</td>
<td>0.13</td>
<td>0.09</td>
</tr>
</tbody>
</table>

Notes: Each entry of the table in panel A (B) reports the p-value of the F-test in a regression of the news (surprise) shock on 1, 2, 3, 4 lags of the first $j$ principal components, $j = 1, ..., 6$

Another desired feature of the identified shock is to isolate the variations in the expected and current government spending due to the exogenous events occurring at period $t$. To check whether this is the case, I document the relationship between the identified shocks and several measures of structural shocks available from the existing literature. I estimate the models

$$s^j_t = \gamma + \beta_i^j z_{it} + u_{jt}$$

where $j = \{\text{anticipated, surprise}\}$ and $z_{it}$ indicates the structural shock $i$. Rejecting the null hypothesis of no correlation ($\beta_i^j = 0$) suggests that the identified government spending shock correlates with the structural shock $i$. I collect the estimated shocks from the literature and the sources are given in Table 3.
Table 3: Exogeneity Test

<table>
<thead>
<tr>
<th>Shock</th>
<th>Source</th>
<th>Anticipated Shock β</th>
<th>SE</th>
<th>Surprse Shock β</th>
<th>SE</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax</td>
<td>Romer and Romer (2010)</td>
<td>0.054</td>
<td>0.244</td>
<td>0.013</td>
<td>0.129</td>
<td>1967Q2-2006Q4</td>
</tr>
<tr>
<td>Surprise Tax</td>
<td>Mertens and Ravn (2012)</td>
<td>0.282</td>
<td>0.299</td>
<td>−0.069</td>
<td>0.199</td>
<td>1967Q2-2006Q4</td>
</tr>
<tr>
<td>Anticipated Tax</td>
<td>Mertens and Ravn (2012)</td>
<td>0.073</td>
<td>0.052</td>
<td>−0.053</td>
<td>0.106</td>
<td>1967Q2-2006Q4</td>
</tr>
<tr>
<td>Consumer Sentiment</td>
<td>Forni et al. (2017)</td>
<td>−0.025</td>
<td>0.084</td>
<td>0.075</td>
<td>0.082</td>
<td>1967Q2-2011Q1</td>
</tr>
<tr>
<td>Anticipated Monetary</td>
<td>Nakamura and Steinsson (2018)</td>
<td>−1.187</td>
<td>0.927</td>
<td>0.618</td>
<td>0.565</td>
<td>1995Q1-2014Q1</td>
</tr>
<tr>
<td>Surprise Monetary</td>
<td>Nakamura and Steinsson (2018)</td>
<td>−0.614</td>
<td>0.645</td>
<td>0.459</td>
<td>0.462</td>
<td>1995Q1-2014Q1</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>Baker et al. (2016)</td>
<td>0.001</td>
<td>0.002</td>
<td>−0.002</td>
<td>0.002</td>
<td>1967Q2-2018Q1</td>
</tr>
<tr>
<td>TFP</td>
<td>Fernald (2014)</td>
<td>0.018</td>
<td>0.012</td>
<td>0.041**</td>
<td>0.02</td>
<td>1967Q2-2018Q1</td>
</tr>
<tr>
<td>News</td>
<td>Barsky and Sims (2012)</td>
<td>−0.001</td>
<td>0.067</td>
<td>−0.01</td>
<td>0.058</td>
<td>1967Q2-2007Q3</td>
</tr>
<tr>
<td>News</td>
<td>Beaudry and Portier (2014)</td>
<td>−0.019</td>
<td>0.068</td>
<td>−0.06</td>
<td>0.063</td>
<td>1967Q2-2012Q3</td>
</tr>
</tbody>
</table>

Notes: The tests are run by regressing $s_j^t$ on $z_{it}$ (see equation 4), where $s_j^t$ is the identified anticipated and surprise government spending shock and $z_{it}$ is indicated in the rows of the table. White heteroscedasticity-consistent standard errors are reported.

The results reported in Table 3, indicate that the anticipated government spending shocks do not pick up tax, confidence, monetary, uncertainty and economic news shocks and they are uncorrelated with utilization-adjusted TFP series. The last point is important since one could think that fiscal news shock happens when the state of economy starts improving but low and insignificant correlation with TFP series suggest this is not the case. The positive and significant correlation of fiscal news shocks with Ramey Military News is not surprising since both series aim to identify the shocks related to the future government spending.

The picture is more blurred for the surprise government spending shocks since those series are correlated with military news and utilization-adjusted TFP series. Since the aim of the paper is to study the impact of fiscal news shocks, I do not discuss the implications of these findings.

The results from the Tables 2 and 3 provide strong evidence that the identified anticipated government spending shocks are unpredictable and represent exogeneous events orthogonal to the information set of the agents when the expectations are formed; however, even though the identified surprise government spending shocks are unpredictable they are correlated with shocks not related to fiscal policy.

2.4 Impulse Responses

Figure 2 displays the impulse response functions to a shock in expected government spending. The responses are normalized to have the maximum response of government spending equal to one.
The government spending does not change in the period of the fiscal news shock but increases sharply in the next four periods, consistent with the informational content of the fiscal news variable, and starts gradually decreasing after the fourth year. GDP increases slightly on impact and remains positive until it turns to negative at the end of the third year. An interesting result appears in debt-to-gdp ratio, the response is muted for the first few periods but then federal debt gradually accumulates and moves to new level rather than converging to zero. Considering the spike of debt-to-gdp ratio in the sample of the estimation, the response of debt is perfectly consistent and suggests that the higher government spending expenditures are funded by higher debt, not with higher tax receipts.

Figure 2: Impulse Responses to an Anticipated Government Spending Shock

Notes: Solid blue lines with circle marks shows the point estimates of impulse responses to a fiscal news (anticipated government spending) shock from VAR system in equation 3. Solid lines are point estimates (averages across 50,000 draws), dark-blue area is 68% confidence region and light-blue area is 90% confidence region.

The responses of consumer confidence and consumption are the focal point of the paper. The consumer confidence merely changes on impact but spikes in the next period and reaches its peak, stays above zero for two and half year and then goes below zero and never rebounds again. The consumption almost does not move on impact but becomes positive and significant starting with the next period until third year and then reverts back and hits zero level and eventually goes to negative. This positive response of consumption to the higher expected future government spending reinforces the results from the previous literature using SPF forecasts and is in contrast with the neoclassical predictions.

Figure 3 displays the impulse response functions to a shock in surprise government spending. The responses of confidence, consumption and output are quite different relative to the previous figure. The

21 The fiscal multipliers are presented in subsection 2.6 for baseline and counterfactual analysis and in Appendix D for the all robustness checks.
response of consumption is not statistically different than zero initially and goes to negative with second period and output is positive only for the first few periods and also hits below zero level afterwards. The consumer confidence increases after initial period but quickly reverts; however, the responses are never statistically different than zero. The tdebt-to-gdp ratio increases after surprise spending, similar to the responses under fiscal news shock.

The responses displayed in Figures 2 and 3 point to the impact of fiscal policy on the expectations of the consumers and suggest that the policy changes resulting in more optimistic expectations are associated with positive response of consumption and output with effects lasting longer.

2.5 Robustness Checks

The results from the previous section indicate the relevance of fiscal news shock on confidence and consumption; hence, in this and next subsections I only consider the news shocks in my analysis. In this part, I conduct several robustness checks to ensure that the results are not driven by certain assumptions of modelling but valid under alternative specifications. In particular, I consider following checks,\textsuperscript{22}

\textsuperscript{22}For sake of brevity, I plot all the impulse responses under these checks in one figure, Figure 4

![Figure 3: Impulse Responses to a Surprise Government Spending Shock](image-url)

Notes: Solid blue lines with circle marks shows the point estimates of impulse responses to a suprise government spending shock from VAR system in equation 3. Solid lines are point estimates (averages across 50,000 draws), dark-blue area is 68% confidence region and light-blue area is 90% confidence region.
2.5.1 Alternative Orderings of the Variables

In the baseline estimation, I order proxy for future government spending first and consumer confidence second assuming that the other variables in the system do not have contemporaneous impact on these variables since agents do not know the realized values of the real variables when they form expectations about government spending and state of the economy. I relax these assumptions and consider two alternative orderings; first, I order the proxy for future government spending last to allow the all variables in the system to have contemporaneous impact on the fiscal news and second, I order the confidence indicator fourth to remove any contemporaneous impact of the non-fiscal variables in the system on fiscal variables. The impulse responses under these two alternative ordering are shown in Figure4. The responses of confidence, output and consumption are very similar; however, the magnitude of the short-run and long-run response of gdp is smaller, respectively, when the news are ordered last.

2.5.2 Controlling for Expectations

The agents and forecasters may not only observe news related to the government spending but also related to the other variables such as GDP, technology, unemployment and inflation and the current fundamentals of the economy may be affected due to these news, as well. I address this issue in two different ways; first, I include Greenbook and SPF GDP growth forecasts into the system and order first and doing so I enlarge the information set of the agents and second, I regress the proxy onto the forecasts of GDP, unemployment and inflation, which I call purged-news, to clear the impact of non-fiscal news on the proxy and reestimate equation 3. Again, the impulse responses are shown in Figure4 and the results are similar to the baseline case except that the initial responses of confidence is negative after the shock to a purged-news; however, the shape and magnitudes of the estimated responses are very similar after that period. In short, the findings confirm the baseline results and suggest that most of the changes in the expected government spending are related to the fiscal events.

2.5.3 Alternative VAR specifications

I consider two different VAR model; first, I construct small VAR to check whether the estimated baseline model suffers from over-parameterization (whether the estimated model includes more variables than the true data generating process) with variables in following order: proxy for future government spending, consumer confidence, government spending, output and consumption. Second, I include a measure of total factor productivity (TFP) into the baseline specification to ensure that the identified fiscal news shocks are not related to the movements in TFP. For the TFP series, I use the real-time, quarterly series on TFP for the U.S. business sector, adjusted for variations in factor utilization (labor effort and capital’s workweek), constructed by Fernald (2014). The consumer confidence and consumption spike after initial period and holds above zero under both specification; however, the positive impact dies out quicker under small VAR and confidence and consumption hits zero eight and four quarters before relative to the baseline estimation, respectively. Even though the response of confidence and consumption is negative in the long-run when debt and federal funds rate are dropped down, the short-run increase in confidence and consumption after the fiscal news shock is similar to the baseline.

23The TFP series are available from Fernald’s website: http://www.johnfernald.net/TFP
2.5.4 Different Confidence Indicators

The baseline estimation uses the expected consumer sentiment index as an indicator of consumer confidence to reflect the forward-looking nature of the confidence. I reestimate equation 3 using current consumer sentiment index and business conditions expected in the next year to check whether the baseline results are driven by choice of the confidence index. As Figure 4 suggests, this is not the case and baseline results are retained under alternative confidence indicators.\footnote{I do not report the results under business conditions expected in the next year since they are almost identical to the results under current consumer sentiment index.}

2.5.5 Further Robustness Check

The results are robust to a variety of further checks of the baseline model, which include:

(i) a FAVAR (Factor augmented VAR) to further control for the non-fundamentalness and omitted variable bias;

(ii) the estimation of VAR with a proxy for the expected tax receipts (debt-to-gdp ratio) to control for the expectations in the other components of fiscal policy;
(iii) including Ramey news into the baseline VAR to ensure the exogeneity of the anticipated government spending shocks;

(iv) the estimation of VAR using sample starting from 1981Q3 to check whether the results are due to the specific events or policy measures.

(v) the estimation of VAR using per capita real variables to control for the effect of population in the estimation, if any.

The solidity of the baseline results is confirmed also by this battery of robustness checks, which is available in Appendix C.

2.6 The Role of Confidence

The consumer confidence and consumption react positively and significantly to the fiscal news shock, especially in the short-run, under various specifications and the path of the responses of both variables is quite similar suggesting positive link between confidence and consumption. Following Bachmann and Sims (2012), I study the role of the confidence in determining the real effects of a expected government spending shock by performing a counterfactual exercise and estimate the impulse responses conditional to a fixed level of confidence. To do so I implement the approach adopted by Sims and Zha (2006) and I generate a hypothetical sequence of confidence shocks in order to held the response of confidence fixed to zero at each horizon, in such a way that the output and consumption responses reflect the effect of an anticipated government spending shock in a hypothetical situation where confidence is held constant.\footnote{A more detailed explanation about how to compute the hypothetical shocks is done by Bachmann and Sims (2012).}

Figure 5 plots the estimated counterfactual impulse responses when the level confidence is held fix along with the baseline responses. The counterfacutal responses of the output and consumption are smaller for the first ten to eleven periods, and in case of consumption they are remarkably negative and significant in the first four to five periods. The results highlight the importance of confidence in the transmission of fiscal policy shock on real variables; when confidence is fixed higher government spending crowds-out the consumption as predicted by standard RBC theory.
Table 4 presents the fiscal multipliers under baseline and counterfactual scenarios. I calculate the multiplier as ratio of cumulative response of output to the cumulative response of government spending multiplied by the inverse of average government spending to output ratio.\textsuperscript{26}

The baseline one-year and two-year multipliers are 1.88 and 1.48, both statistically significant, and the counterfactual multipliers are much lower when confidence channel is shut down, 0.60 and 0.55 for one and two-year multipliers, respectively. The dramatic difference between baseline and counterfactual multipliers for one-year and two-year horizons reinforces the results from Figure 5 and point to the importance of confidence on the real effects of fiscal news shocks.

\textsuperscript{26}Ramey and Zubairy (2018) warn against this practice by noticing that, in a long US data sample spanning the 1889–2011 period, the output-over-public spending ratio varies from 2 to 24 with a mean of 8. Hence, the choice of a constant value for such ratio may importantly bias the estimation of the multipliers. In my sample, the mean value of such a ratio is 4.97, and it varies from 4.13 to 5.81. Hence, the commonly adopted ex post conversion from the estimated elasticities to dollar values does not appear to be a concern for this exercise.
### Table 4: Fiscal Multipliers

<table>
<thead>
<tr>
<th>Horizon</th>
<th>1-year</th>
<th>2-year</th>
<th>3-year</th>
<th>4-year</th>
<th>5-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>1.88</td>
<td>1.48</td>
<td>0.97</td>
<td>0.64</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td>[0.73, 3.30]</td>
<td>[0.92, 2.12]</td>
<td>[0.56, 1.41]</td>
<td>[0.27, 1.01]</td>
<td>[0.05, 0.75]</td>
</tr>
<tr>
<td>Counterfactual (w/o confidence)</td>
<td>0.60</td>
<td>0.55</td>
<td>0.48</td>
<td>0.39</td>
<td>0.28</td>
</tr>
<tr>
<td></td>
<td>[−0.31, 1.57]</td>
<td>[0.15, 0.96]</td>
<td>[0.21, 0.75]</td>
<td>[0.17, 0.61]</td>
<td>[0.08, 0.50]</td>
</tr>
</tbody>
</table>

Notes: Estimated fiscal multipliers for an anticipated (news) government spending shock. The first row presents the multipliers from baseline estimation and the second row from counterfactual estimation in which confidence is not allowed to respond to the fiscal news shock. The numbers in brackets indicate the 68% confidence intervals from the distribution of multipliers.

In summary, this subsection documents the key role of the confidence on the crowd-in effect of government spending on consumption and empirical findings point to the confidence as an important transmission channel of fiscal policy. However, one question still remains open: Why consumer confidence increases with higher expected government spending? To answer this question, rather than provide empirical answer, I construct an informational friction model with government that is the subject of next section.

## 3 Model

### 3.1 Setup

This section describes informationally frictional economy that extends the work of Lorenzoni (2009) by introducing noisy signals about government spending and taxes. There are continuum of islands indexed by \( l \in [0, 1] \) and each island \( l \) is inhabited by a representative consumer that owns a continuum of price-setting firms producing differentiated goods indexed by \( m \in [0, 1] \). The consumer from island \( l \) loves variety of goods and consumes the goods produced in a subset of other islands. This subset is denoted by \( B_{l,t} \subset [0, 1] \) that is randomly selected by nature each period. Symmetrically, the firms in island \( l \) are visited by a subset \( F_{l,t} \subset [0, 1] \) of consumers coming from other islands. The random assignment is such that the mass of goods in \( B_{l,t} \) and mass of consumers in \( F_{l,t} \) are constant. There is perfect labor immobility across islands, so the consumer located in island \( l \) provides labor only for the firms in island \( l \).

The firms set the nominal price of their output in each period, and they fully satisfy all demand at that price. Information is common to a consumer and firm within an island but is not shared across islands. Specifically, the agents in island \( l \) observe only local private and public demand for final good, taxes and prices in their own island, the prices of the goods in the consumption basket of the local consumer, and a common noisy signal of aggregate inflation. The agents use this information to predict the values of macro aggregates in the economy. The bond market is the only centralized market. The consumers can trade nominal one-period bonds but cannot fully insure against idiosyncratic shocks.

### 3.1.1 Consumers

The consumer in island \( l \) maximizes

\[
E_0 \sum_{t=0}^{\infty} \beta^t U(C_{l,t}, N_{l,t})
\]
with

\[ U(C_{l,t}, N_{l,t}) = \log C_{l,t} - \frac{N_{l,t}^{1+\chi}}{1 + \chi} \]  

and

\[ C_{l,t} = \left( \int_{\mathcal{B}_{l,t}} \int_{0}^{1} C_{m,j,l,t}^{(\gamma-1)/\gamma} dmdj \right)^{\gamma/(\gamma-1)}, \]  

where \( C_{m,j,l,t} \) is the consumption of the variety \( m \) produced in island \( j \) by the consumer in island \( l \) at time \( t \), \( \chi \) is the inverse Frisch elasticity of labor supply and \( \gamma \) captures the elasticity of substitution among differentiated goods. The budget constraint of the consumer in island \( l \) is given by

\[ Q_t B_{l,t} + 1 + \hat{B}_{l,t} \hat{I}_0 P_{m,j,t} C_{l,t}^{(\gamma-1)/\gamma} \int_{\mathcal{B}_{l,t}} \int_{0}^{1} dmdj = B_{l,t} + W_{l,t} N_{l,t} + \int_{0}^{1} \Pi_{m,l,t} dm + T_{l,t}. \]  

In the above equation, \( B_{l,t+1} \) are holdings of nominal bonds that trade at price \( Q_t \) and zero in net supply, \( W_{l,t} \) is the nominal local wage, \( \Pi_{m,l,t} \) are the profits of firm \( m \) and \( T_{l,t} \) is the island-specific lump-sum tax discussed in detail later. For each island, there are now two relevant price indices. The first is the local producer price index that includes the prices of the all the varieties produced in island \( l \)

\[ P_{l,t} = \left( \int_{0}^{1} P_{m,j,t}^{1-\gamma} dmdj \right)^{1/(1-\gamma)}, \]  

and second the is consumer price index that includes all the varieties consumed in island \( l \)

\[ \overline{P}_{l,t} = \left( \int_{\mathcal{B}_{l,t}} \int_{0}^{1} P_{j,t}^{1-\gamma} dj \right)^{1/(1-\gamma)}. \]  

The maximization of 5 subject to 8 and a no-Ponzi-game condition gives the following optimality conditions

\[ C_{m,j,l,t} = \left( \frac{P_{m,j,t}}{P_{l,t}} \right)^{-\gamma} C_{l,t}, \]  

\[ N_{l,t}^\chi = \frac{W_{l,t}}{P_{l,t} C_{l,t}}, \]  

\[ Q_t = \beta \mathbb{E}_{l,t} \left[ \frac{C_{l,t} P_{l,t}}{C_{l,t+1} P_{l,t+1}} \right]. \]  

The equation 11 gives the demand for good \( m \) produced in island \( j \in \mathcal{B}_{l,t} \) by the consumer in island \( l \). The equations 12 and 13 state the optimal labor supply and no-arbitrage conditions, respectively and \( \mathbb{E}_{l,t} \) denote the expectation of the agents located in island \( l \). Aggregating the demand of all consumers in
\( F_{l,t} \) gives the total private demand for the good produced by firm \( m \) in island \( l \) that is equal to

\[
Y^P_{m,l,t} = \int_{F_{l,t}} \left( \frac{P_{m,l,t}}{P_{j,t}} \right)^{-\gamma} C_{j,t} dj. \tag{14}
\]

The total demand for good \( m \) produced in island \( l \), \( Y^D_{m,l,t} \), consists of demand from the private sector, \( Y^P_{m,l,t} \), and demand from the public sector, \( Y^G_{m,l,t} \), the nature of which is discussed below. The economy-wide price index is defined as

\[
P_t = \left( \int_0^1 P^{1-\gamma}_{l,t} dl \right)^{1/(1-\gamma)}. \tag{15}
\]

### 3.1.2 Government

The government purchases goods from each island at local price and impose lump-sum taxes in each island and maintains balanced budget. Her budget constraint is

\[
\int_0^1 P_{m,l,t} Y^G_{m,l,t} dm dl = \int_0^1 T_{l,t} dl \tag{16}
\]

with \( Y^G_{m,l,t} \) stands for the government’s demand for good \( m \) produced in island \( l \). I assume that government demand for the output good of firm \( m \) in island \( l \) is a function of the good’s price and the aggregate price level such that

\[
Y^G_{m,l,t} = \left( \frac{P_{m,l,t}}{P_t} \right)^{-\gamma} G_t, \tag{17}
\]

where \( G_t \) is the real aggregate government expenditure. Plugging 17 into 16 and aggregating across firms and islands gives

\[
P_t G_t = T_t, \tag{18}
\]

where \( T_t \) is the total tax receipts of the government in this economy.

### 3.1.3 Firms

Firms are price-setters à la Calvo and in each period, on each island, a fraction \( 1 - \theta \) of firms are allowed to reset their price. Let \( P^*_{l,t} \) denotes the optimal price for a firm who can adjust its price in island \( l \) at time \( t \). The total demand for the firm \( m \) in island \( l \) is given by

\[
Y^D_{m,l,t} = P^{-\gamma}_{m,l,t} \left[ \int \frac{P^*_{l,t}}{P^*_{l,t}} C_{j,t} dj + P_t G_t \right] \tag{19}
\]

that is the sum of demand from the private sector and government. The firm uses only labor as an input in the production function and is equal to

\[
Y_{m,l,t} = N_{m,l,t}. \tag{20}
\]
The problem of this firm is to maximize

\[ E_{l,t} \sum_{s=t}^{\infty} \theta^t Q_{l,t+s} (P_{m,l,t+s} Y_{m,l,t+s} - W_{l,t+s} N_{m,l,t+s}) \]  

subject to demand relation given in 19, the technological constraint given in 20 and \( P_{m,l,t+s} = P_{l,t}' \). The solution to the firm’s problem is given by

\[ P_{l,t}' = \gamma \frac{E_{l,t} \sum_{s=t}^{\infty} (\beta \theta)^s U_{c,t+s} W_{l,t+s} Y_{m,l,t+s} + \gamma}{\gamma - 1} \sum_{s=t}^{\infty} (\beta \theta)^s U_{c,t+s} P_{l,t}' Y_{l,t+s}. \]

### 3.1.4 Signals

Each agent observes signals of aggregate states (inflation) and signals of local states (island-specific consumer prices, private and government demand and tax). Agents face a signal inference problem through which they form expectations of aggregate and local states. I assume that the random selection of islands in \( B_{l,t} \) is such that the consumer price index for island \( l \) in log-linear deviations from steady-state is

\[ \bar{p}_{l,t} = p_t + \eta_{l,t}^{CPI}, \]

where \( \eta_{l,t}^{CPI} \) is i.i.d normal with zero mean and variance \( \sigma_{\eta_{l,t}^{CPI}}^2 \) and satisfies \( \int_0^1 \eta_{l,t}^{CPI} dl = 0 \). The log-linearized version of private demand faced by firm \( m \) in island \( l \) in equation 14 is given by

\[ y_{m,l,t}^P = \int_{F_{l,t}} (\gamma \bar{p}_{l,t} + c_{l,t}) \ dj - \gamma p_{m,l,t}. \]

I assume that the random selection of islands in \( F_{l,t} \) is such that the equation 24 takes the form

\[ y_{m,l,t}^P = c_t - \gamma (p_{m,l,t} - p_t) + \eta_{l,t}^P, \]

where \( c_t, p_t \) and \( p_{m,l,t} \) are log-linear deviations of aggregate consumption, price and local price of good \( m \) from steady-state and \( \eta_{l,t}^P \) is i.i.d normal with zero mean and variance \( \sigma_{\eta_{l,t}^P}^2 \) and satisfies \( \int_0^1 \eta_{l,t}^P dl = 0 \). In similar manner, I assume that the government spending in equation 17 takes the form

\[ y_{m,l,t}^G = \epsilon_{t-1} - \gamma (p_{m,l,t} - p_t) + \xi_{l,t}^G + \eta_{l,t}^G, \]

where \( \epsilon_{t-1} \) is fiscal news process (announcements about future government expenditure) details given later, \( \eta_{l,t}^G \) is i.i.d normal with zero mean and variance \( \sigma_{\eta_{l,t}^G}^2 \) and satisfies \( \int_0^1 \eta_{l,t}^G dl = 0 \) and \( \xi_{l,t}^G \) is the persistent component of government demand such that

\[ \xi_{l,t}^G = \rho \xi_{l,t-1}^G + \mu_{l,t}^1, \]

where \( \mu_{l,t}^1 \) is i.i.d normal with zero mean and variance \( \sigma_{\mu_1}^2 \) and satisfies \( \int_0^1 \mu_{l,t}^1 dl = 0 \). The equation 26 prevents the agents to perfectly observe the fiscal news shock and the responses of real variables in empirical section guide me to let the agents to receive signals about the fiscal news with a lag. The consumer in each island pays a lump-sum tax that is a noisy signal of the prices and fiscal news shock in

\[ 27 \]

\[ 28 \]

In the equations that follow, lower-case variables represent the log deviations of the corresponding upper-case variable from their steady-state values unless otherwise specified.

The equation 26 is not equal to the log-linearized version of the government demand given in Equation 17 plus idiosyncratic components. So, the agents expect fiscal news to become actual spending in the next period. To be consistent, I assume the same for tax processes given in equations 28 and 34. As we will see later, these are necessary for the model responses to match with empirical ones.
the economy
\[ \tau_{l,t} = \theta_{G}(p_t + \varepsilon_{t-1}) + \xi_{l,t} + \eta_{l,t}, \] (28)
where \( \tau_{l,t} = \frac{T_{l,t} - T_l}{T_l} \). Moreover, \( \eta_{l,t} \) is i.i.d normal with zero mean and variance \( \sigma_{\eta}^2 \) and satisfies \( \int_0^1 \eta_{l,t}^2 d\tau = 0 \) and \( \xi_{l,t} \) is the persistent component of lump-sum tax such that
\[ \xi_{l,t} = \rho \xi_{l,t-1} + \mu_{l,t}, \] (29)
where \( \mu_{l,t} \) is i.i.d normal with zero mean and variance \( \sigma_{\mu}^2 \) and satisfies \( \int_0^1 \mu_{l,t}^2 d\tau = 0 \). Following Lorenzoni (2009), the nominal interest rate is given by
\[ i_t = (1 - \rho_i)i^* + \rho_i i_{t-1} + \varphi \tilde{\pi}_t, \] (30)
where \( \rho_i \) and \( \varphi \) are known by all agents and \( \tilde{\pi}_t \) is a signal of realized aggregate inflation
\[ \tilde{\pi}_t = \pi_t + \omega_t, \] (31)
where \( \omega_t \) is an i.i.d. normal shock, with zero mean and variance \( \sigma_{\omega}^2 \). The noisy signal of inflation prevents agents from perfectly inferring aggregate prices from the interest rate.

3.2 Equilibrium

I assume that the log-linear government spending obeys the following AR(1) process
\[ g_t = \rho_g g_{t-1} + \phi \varepsilon_{t-1}, \] (32)
where \( \varepsilon_{t-1} \) is the fiscal news process at time \( t - 1 \) and \( \phi \varepsilon \) is the coefficient of fiscal news on actual government spending. The fiscal news also follows the AR(1) process such that
\[ \varepsilon_t = \rho \varepsilon_{t-1} + u_t, \] (33)
where \( u_t \) is the fiscal news shock that is i.i.d over time with distribution \( N(0, \sigma_u^2) \). The log-linear approximation of the government budget constraint given in 18 is
\[ \tau_t = \theta_{G}(p_t + g_t) \] (34)
where \( \tau_t = \int_0^1 \tau_{l,t} d\tau \) and \( \theta_G \) is the steady-state government spending to gdp ratio in the above equation.

3.2.1 Individual Optimality Conditions

Using the optimality equation given in 13, the Euler equation of the consumer in island \( l \) is
\[ c_{l,t} = \mathbb{E}_{l,t} [c_{l,t+1}] - i_t + \mathbb{E}_{l,t} [\bar{p}_{t,t+1}] - \bar{p}_{l,t}, \] (35)
and the budget constraint in 8 takes the form
\[ \beta b_{l,t+1} = b_{l,t} + p_{l,t} + y_{l,t}^D - \theta C \bar{p}_{l,t} - \theta C c_{l,t} - \tau_{l,t}, \] (36)
where \( b_{l,t} = \frac{B_{l,t} - B_l}{V} \), \( y_{l,t}^D \) is the total demand, details given in below, and \( \theta C \) is steady-state consumption to gdp ratio. The log-linear approximation of the price optimality condition in 22 is equal to
\[ p_{l,t}^* = (1 - \beta \theta) w_{l,t} + \beta \theta \mathbb{E}_{l,t} [p_{l,t+1}^*] \] (37)
and the law of motion for local producer price index is
\[ p_{l,t} = \theta p_{l,t-1} + (1 - \theta) p_{l,t}^*. \] (38)

At this point, I want to introduce demand signals for the total goods produced in island \( l \) from private and public sector given in the following equations\(^{29}\)
\[ d_{l,t}^P = \epsilon_t + \gamma p_t + \eta_{l,t}^P \] (39)
\[ d_{l,t}^G = \epsilon_{t-1} + \gamma p_t + \xi_{l,t}^G + \eta_{l,t}^G. \] (40)

The agents observe and distinguish demand for their product from the private sector and from the government sector. Then, we can rewrite the equations 24 and 25 as a function of observables, the local price firms choose and the demand signals given in the above equations that are function of unobservables. The total demand for the goods produced in island \( l \) is the sum of private and public demand
\[ y_{D, l,t} = \theta C y_{P, l,t} + \theta C y_{G, l,t}. \] (41)

Defining total demand signal as
\[ d_{l,t} = \theta C d_{l,t}^P + \theta C d_{l,t}^G \] (42)
allows to express the final demand as a function of local price and total demand signal
\[ y_{D, l,t} = d_{l,t} - \gamma p_{l,t}. \] (43)

Using the log linear approximations of the equations 12 and 20 plus the equations 38 and 43, one can rewrite the equation 37 as following
\[ p_{l,t} - p_{l,t-1} = \lambda \left( \tilde{p}_{l,t} + c_t - p_{l,t} \right) + \lambda \chi \left( d_{l,t} - \gamma p_{l,t} \right) + \beta E_{l,t} \left[ p_{l,t+1} - p_{l,t} \right]. \] (44)

The expectation term on the very right hand side of the equation 44 is island-specific and each island has different information set. Hence, one cannot simply iterate the expectations and aggregate them across islands.

### 3.2.2 Learning and Aggregation

The economy’s aggregate dynamics can be described using notation similar to that in Lorenzoni (2009). The variables \( z_{l,t} = \left( g_t, \tilde{\epsilon}_t, \tilde{\epsilon}_{t-1}, c_t, p_t, i_t, \xi_{l,t}^G, \xi_{l,t}^F \right) \) describe the dynamics of aggregate macro variables and idiosyncratic but persistent demand and tax processes. The state of the economy is captured by the infinite dimensional vector \( Z_{l,t} = (z_{l,t}, z_{l,t-1}, ...) \). I am looking for a linear equilibrium where the law of motion for
\[ Z_{l,t} = A Z_{l,t-1} + B u_{l,t}. \] (45)

\(^{29}\)Since the marginal cost of the firms in island \( l \) are same, they are symmetric and we can aggregate the firms in same island and drop the index \( m \).
with $u_{l,t} = (u_t, \omega_t, \mu_{l,t}^1, \mu_{l,t}^2)'$ and the rows of A and B conform to the laws of motion for $g_t, i_t, \xi^G_{l,t}, \xi^T_{l,t}$. To solve for a rational expectations equilibrium, I conjecture that $p_{l,t}$ and $c_{l,t}$ follow the rules

$$p_{l,t} = q_b b_{l,t} + q_p p_{l,t-1} - q_r \tau_{l,t} + q_d d_{l,t} + q_z E_{l,t} [Z_t] \tag{46}$$

$$c_{l,t} = -p_{l,t} + m_b b_{l,t} + m_p p_{l,t-1} - m_r \tau_{l,t} + m_d d_{l,t} + m_z E_{l,t} [Z_t]. \tag{47}$$

The equation 46 represents the optimal pricing policy of the firms in island $l$ (aggregated across firms) and the equation 47 represents the optimal consumption policy of the representative consumer in island $l$. The agents use the Kalman filter to form expectations about the state variables

$$E_{l,t} [Z_{l,t}] = E_{l,t-1} [Z_{l,t}] + C (s_{l,t} - E_{l,t-1} [s_{l,t}]), \tag{48}$$

where $s_{l,t}$ is the vector of signals observed by the agents in island $l$

$$s_{l,t} = (\overline{p}_{l,t}, d^P_{l,t}, d^G_{l,t}, \tau_{l,t})', \tag{49}$$

and $C$ is the matrix of Kalman gains. There exists a matrix $\Xi$ such that average expectations of the aggregate state variables are a linear function of the states themselves:

$$\Xi Z_t = \int_0^1 E_{l,t} [Z_{l,t}] \, dl. \tag{50}$$

A rational expectations equilibrium consists of matrices $A, B, C, \Xi$ and vectors $q_b, q_p, q_r, q_d, q_z$ and $m_b, m_p, m_r, m_d, m_z$ that are consistent with agents' optimization, Bayesian updating, and with market clearing in the goods, labor, and private bonds markets. The computation method used to solve for the equilibrium is an adaptation of Lorenzoni (2009) and the details are in Appendix E.

### 3.3 Taking Model to Data

I now discuss the methodology for evaluating the model in the light of the empirical findings. I divide the parameter space into two sets; calibrated and estimated.

#### 3.3.1 Calibration

The first set includes calibrated parameters based on the data sample means and other studies. I choose value of 0.99 for discount factor, $\beta$, that is standard in the business cycle literature. I pick macro estimate Frisch elasticity from Chetty et al. (2013) that gives $\chi$ equal to 0.3.\footnote{Frisch elasticity is equal to 3.31 in Table 2 of Chetty et al. (2013). That gives $\chi = 1/3.31 \approx 0.3$} The average government spending to GDP ratio is equal to 0.19 for the sample period. I adopt the values from Lorenzoni (2009) for elasticity of substitution among goods, $\gamma = 7.5$, persistency of monetary policy rule, $\rho_i = 0.9$, response of monetary policy to inflation, $\phi = 1.5$, standard deviations of noise in inflation, $\sigma_w = 0.0015$, CPI signal, $\sigma_{CPI} = 0.02$, and private demand signal, $\sigma_{P} = 0.11$, since these parameters have same interpretation both in Lorenzoni (2009)’s model and my model. Finally, I pick standard deviation of fiscal news shock from empirical section that gives $\sigma_u = 0.0461$. Table 5 summarizes the calibrated parameters.
Parameter | Value | Source
---|---|---
$\beta$ | Discount factor | 0.99 | Standard value
$\chi$ | Inverse Frisch elasticity | 0.3 | Chetty et al. (2013)
$\gamma$ | Elasticity of substitution | 7.5 | Sample mean
$\theta_G$ | Steady-state government spending/output ratio | 0.19 | Sample mean
$\Delta \rho^2$ | Persistency of monetary policy rule | 0.9 | Lorenzoni (2009)
$\phi$ | Response of monetary policy rule to inflation | 1.5 | Lorenzoni (2009)
$\sigma_\omega$ | Std. dev. of noise in inflation | 0.0015 | Lorenzoni (2009)
$\sigma_{\eta CPI}$ | Std. dev. of noise in CPI signal | 0.02 | Lorenzoni (2009)
$\sigma_{\eta p}$ | Std. dev. of noise in private demand signal | 0.11 | Lorenzoni (2009)
$\sigma_\eta$ | Std. dev. of fiscal news shock | 0.0461 | Own calculation

Table 5: Calibrated Parameters

### 3.3.2 Estimation

The second set includes the parameters that I estimate by minimizing a measure of distance between empirical impulse responses and the model responses. The parameters to be estimated are related to the fiscal side of the model except Calvo parameter $\theta$. The fiscal policy announcements are not inflationary as documented by Dupor and Li (2015) and considering that the main motivation of the model is to show the response of real variables to fiscal news shocks, I opt to estimate parameter $\theta$ rather than calibrating with standard values in business cycle literature.

I select $(\varepsilon_t, g_t, i_t, c_t, y_t)$ as variables of interest because these variables are both present in the model and in empirical VAR. Denote the estimated parameter vector with $\Theta$ and the model responses to the fiscal news shock with $\Psi(\Theta)$. Let $\hat{\Psi}$ be the $n \times 1$ vector of empirical estimates of the VAR impulse responses to the fiscal news shock. The estimate of $\Theta$, vector of parameters, solves

$$
\min_{\Theta} \left( \Psi(\Theta) - \hat{\Psi} \right)^T \Omega \left( \Psi(\Theta) - \hat{\Psi} \right)
$$

(51)

where $\Omega$ is a $n \times n$ weighting matrix. Since this is a Wald hypothesis testing under the null that the VAR model is true and that the model fits the data, the optimal weighting matrix would equal to $\Omega = \Lambda^{-1}$, the diagonal matrix with inverse of the sample variances of the VAR impulse responses. Given that the aim of the model is to document the impact of fiscal news shock on consumption and output, I specify $\Omega = \Upsilon \Phi \Lambda^{-1}$, where $\Phi$ is a $n \times n$ matrix that puts four times larger weight to the responses of $c$ and $y$ and $\Upsilon$ is a $n \times n$ matrix that puts smaller weights to the responses over time. This way I fit the model to the moments of high interest and at the same time I get consistent but inefficient estimates.

Table 6 displays the estimates of the parameters in $\Theta$. The results strongly supports much clear government demand signal relative to the tax signal; the standard error of the idiosyncratic noise in the public demand signal is $\sigma_{\eta_c} = 0.01$ whereas the standard error of the idiosyncratic noise in the tax signal

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31 I choose first eleven periods of the responses to match; hence, $n = 11$. 

24
is $\sigma_{\eta^G} = 2.00$.\footnote{These values are the lower bound for $\sigma_{\eta^G}$ and higher bound for $\sigma_{\eta^T}$} I impose symmetry in the estimation of the standard error of the noises in the persistent component of government demand and tax signals and I obtain $\sigma_{\mu_1} = \sigma_{\mu_2} = 0.0252$.

The government spending is more persistent than the fiscal news, $\rho_g = 0.99$ and $\rho_c = 0.8199$, respectively, and the fiscal news becomes actual government spending slowly over time since $\phi_c = 0.0149$. The probability of fixed price is very high relative to the literature, $\theta = 0.98$, and the main rationale is that government demand shocks may not be inflationary as other demand shocks and may not cause frequent changes on prices. The literature on how varies the impact of different demand shocks on prices is limited and can be an interesting avenue for further research.

Unfortunately, the key parameters, $\sigma_{\eta^G}$, $\sigma_{\eta^T}$, $\sigma_{\mu_1}$ and $\sigma_{\mu_2}$, are not statistically significant. The estimates are robust to the specification of $\Phi$; however, the standard errors are generally large for these parameters. The possible explanation is that the estimation needs more data series to recover reliable estimates on these parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Std. Err.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\theta$</td>
<td>Probability of fixed price</td>
<td>0.98</td>
</tr>
<tr>
<td>$\rho$</td>
<td>Persistency of government spending</td>
<td>0.99</td>
</tr>
<tr>
<td>$\rho_c$</td>
<td>Persistency of fiscal news</td>
<td>0.82</td>
</tr>
<tr>
<td>$\phi_c$</td>
<td>Elasticity of gov. spending to fiscal news</td>
<td>0.02</td>
</tr>
<tr>
<td>$\rho_x$</td>
<td>AR parameter in persistent gov. demand and tax</td>
<td>0.99</td>
</tr>
<tr>
<td>$\sigma_{\mu_1,2}$</td>
<td>Std. dev. of persistent gov. demand and tax</td>
<td>0.03</td>
</tr>
<tr>
<td>$\sigma_{\eta^G}$</td>
<td>Std. dev. of noise in gov. demand signal</td>
<td>0.01</td>
</tr>
<tr>
<td>$\sigma_{\eta^T}$</td>
<td>Std. dev. of noise in tax signal</td>
<td>2.00</td>
</tr>
</tbody>
</table>

Table 6: Estimated Parameters

3.3.3 Model Dynamics

The impulse response functions of the estimated model and VAR to a unit fiscal news shock are represented by the solid red and blue lines in Figure 6, respectively. A number of results deserve closer attention. First, the model does well at accounting for the dynamic response of the U.S. economy to a fiscal news shock in the short-run. The model responses lie within the one-standard-deviation confidence interval computed from the VAR estimates. The model responses of consumption and output are similar to the empirical ones in the first few quarters. Second, the model does well in accounting for the crowd in effect of government spending on private consumption. In the model one period after the fiscal news shock hit the economy, the consumption spikes as in data that is due to the stronger demand signal relative to the tax signal. The response of consumption in the model and in VAR moves together in the first three quarters; however, afterwards they disintegrates. A possible explanation could be that the model lacks consumption habit that makes the VAR responses smoother relative to the model responses and there are other news in the third and fourth periods that move the consumption up again that we observe in data.
but the model lacks.\textsuperscript{33}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure6.png}
\caption{The Responses to Fiscal News Shock, Model versus VAR}
\textit{Notes: Red solid lines represent the estimated model and blue solid line represents the VAR with 68\% confidence intervals.}
\end{figure}

The dispersed information in the model with clear government demand and noisy tax signals results in higher expected demand and income in each island that leads to larger consumption as a result of expected improvement in wealth. In other words, fiscal policy announcements can alter the expectations of the agents in positive or negative way depending on the information structure. The imperfect information is the key factor that produces this novel mechanism. To test this mechanism I conduct two exercises; first, I measure the responses of the variables under perfect information by shutting down all the idiosyncratic shocks and feed the model with the remaining parameters from Tables 5 and 6 and second, I repeat the same exercises but this time I fix the idiosyncratic noises in government demand and tax signals to a small number such that $\sigma_{\mu}^{1,2} = \sigma_{\eta}^{G} = \sigma_{\eta}^{T} = 0.001$ to have the same information content in both signals and keep the remaining parameters in their estimated value.

Figure 7 presents the responses of the variables of interest under VAR, baseline estimation and two scenarios discussed above. The difference in the response of consumption to the fiscal news shock is remarkable. Under perfect information, the fiscal new shock crowds out consumption due to the negative wealth effect as in standard business cycles models.\textsuperscript{34} Considering imperfect information but same

\textsuperscript{33}I estimate model with alternative government demand and tax signals with additional lagged fiscal news and the responses fit better. The results are shown in Appendix F.

\textsuperscript{34}I check that the impulse responses of same exercise up to 100 periods and all variables return to their initial values. Since, government spending is very persistent and prices are almost rigid, it takes very long time the variables to return their
idiosyncratic noise in government demand and tax signals, the consumption does not change on impact and decreases afterwards. These two exercises confirm that the small noise in the government demand but the large noise in the tax signal is the key mechanism of the model that generates positive response of consumption to the fiscal news shock and the estimation shows this mechanism is present in the data. This is the novel result the paper brings into the fiscal policy literature because the expectations rise as a key transmission channel of the fiscal policy since it improves the expectations of the agents about their future income due to the higher perceived demand relative to the perceived tax obligations as a consequence of the imperfect information.

![Graphs showing responses to fiscal news shock](image)

Figure 7: The Responses to Fiscal News Shock, Imperfect Information Model versus Perfect Information Model

Notes: Red line represents imperfect information model, blue line represents empirical VAR, green line represents perfect information model and yellow line represents fixed idiosyncratic noise model.

The role of expectations on the response of consumption can be better seen in Figure 8. Here, I only consider baseline scenario and the one with imperfect information but fixed idiosyncratic noises in government demand and tax signals. The solid lines denote realized and the dashed lines denote aggregated time \( t \) expectations of \( t + 1, \int E_{t,t} [x_{t+1}] \) for \( x = n, y, c \), for the corresponding scenario. The positive wealth effect due to higher perceived demand relative to the tax obligations at island level translates into positive aggregate expectations about future consumption. This is the expectation channel on the response of the realized consumption. Moreover, the highly sticky prices lead to minimal decrease in real interest rate so that realized consumption can remain positive for few quarters. Hence, combination of initial values which not visible Figure 7. The results are available upon request.
positive wealth effect and highly sticky prices are the required ingredients to have the observed protracted response of consumption in data.

An interesting prediction of the model is that the expected next period output is always smaller than the realized output even though it is positive. The reason is that the agents underestimate the aggregate fiscal news process and realized government spending. In real world, the government spending data is generally published with very high precision and constant underestimation of realized public spending seems counterfactual. The model does not contain signal about realized government spending and this is why the expectations of the agents never converge to the true value.

4 Conclusion

The last decade witnessed the surge of interest to understand the impact of consumer confidence on real variables. In the meantime, confidence is proposed as an important transmission mechanism of fiscal policy by a number of economists and policy-makers. This paper is both an empirical and theoretical attempt to explore the potential confidence channel of discretionary fiscal measures on the economy, particularly on consumption. To do so, I exploit proxy for fiscal policy announcements using Greenbook and SPF forecasts in a medium-size Bayesian VAR model to identify the anticipated and surprise government spending shocks in an empirical setting and develop an island model with information frictions and...
government to understand the role of fiscal policy on the expectations of the agents about the state of the economy in the near future.

The empirical results suggest that confidence, consumption and output react positively to the anticipated government spending shocks, especially in the short-run. The same responses are not observed for the surprise spending shocks. The counterfactual analysis shows that the response of consumption to the anticipated government spending shock becomes negative when the response of confidence fixed to the same shock and reveals the key role played by the confidence in the transmission of fiscal news shocks on the real variables.

The island model with imperfect communication a la Lorenzoni (2009) incorporated with government sector is the first step in documenting the confidence channel of government spending in the business cycles literature. The frictions in communication prevent agents from reaching exactly the same expectations about economic activity and the agents use noisy signals to infer the government demand and taxes towarded to their island. The main mechanism in the model is that the sufficiently lower noise in the island-specific government demand signal relative to the tax signal leads to higher expected output, income and positive wealth effect at island-level. This can be seen as more optimistic expectations about local and aggregate economic activity that are driven by the anticipated government spending shocks.

Particularly, revised expectations of the higher level of economic activity that occur simultaneously among the agents after anticipated government spending shock is the theoretical counterpart of observed increase in consumer confidence after fiscal spending announcements. The revised beliefs of higher expected demand after aggregate government spending shock fuels the confidence in the economy and increases the output and private consumption. From policy perspective, empirical and theoretical findings suggest that a clearer and credible forward guidance about the fiscal measures can enhance the effect of the policies through it’s impact on confidence.

A promising avenue for future research could be to determine the situations when the fiscal policy announcements send clear signals about demand-side. This might be particularly in recession or high economic uncertainty times or when the fiscal policy is well-designed so it can convince the agents about it’s impact on the demand-side. Another interesting extension could be to introduce habit formation and see whether still highly rigid prices are necessary to have observed responses of consumption in data.

References


APPENDIX

A. Identification of Government Spending Shocks

This part is borrowed from Forni and Gambetti (2016). Assume the following simple government spending growth process:

\[ g_t = \phi(L)\varepsilon_t + \theta(L)u_t \]  \hspace{1cm} (A.1)

where \( \varepsilon_t \) is the anticipated shock, \( u_t \) is the surprise shock and \( \phi(L) = \sum_{k=s}^{\infty} \phi_k L^k \) and \( \theta(L) = \sum_{k=0}^{\infty} \theta_k L^k \) are the polynomials and \( \phi_k \) and \( \theta_k \) are the coefficients of the anticipated and surprise shocks. Taking into account the implementation lags, \( \phi_0 \) is set to zero and time \( t \) news shocks do not have impact on the time \( t \) government spending. Now denote \( P_t \) as the information set of the agents/professional forecasters with the following assumptions:

\[ \mathbb{E}^P_t \varepsilon_{t-i} = \varepsilon_{t-i}, i \geq 0 \]  \hspace{1cm} (A.2)

\[ \mathbb{E}^P_t u_{t+h} = \mathbb{E}^P_t \varepsilon_{t+h+1} = 0, h \geq 0 \]  \hspace{1cm} (A.3)

where \( \mathbb{E}^P_t \) is the expectations formed at \( t \) conditional on the information set \( P_t \). The equations A.2 and A.3 state that the forecasters observe the anticipated shocks occurred up to time \( t \); however, they do not observe the surprise shocks at time \( t \) since this information is not available when they form their expectations. Now define the information set of the econometrician that spans all anticipated and surprise shocks and denote with \( I_t \). Then, the following equations hold:

\[ \mathbb{E}^I_t \varepsilon_{t-i} = \varepsilon_{t-i}, i \geq 0 \]  \hspace{1cm} (A.4)

\[ \mathbb{E}^I_t u_t = u_t \]  \hspace{1cm} (A.5)

\[ \mathbb{E}^I_t u_{t+h} = \mathbb{E}^I_t \varepsilon_{t+h} = 0, h > 0 \]  \hspace{1cm} (A.6)

The equations A.2-A.6 state that \( P_t \) spans \( I_{t-1} \) and \( I_t \) spans \( P_t \). Now, let’s iterate the equation A.1 for the next \( h \) periods and take time \( t \) expectations conditional on \( P_t \):

\[ \mathbb{E}^P_t g_{t+h} = \sum_{k=s-1}^{\infty} \phi_{h+k} \varepsilon_{t-k} + \sum_{k=1}^{\infty} \theta_{h+k} u_{t-k} \]  \hspace{1cm} (A.7)

If \( h = s \), the news shock \( \varepsilon_t \) can be identified as the residual after projecting the expected government spending on the one period lagged information set \( I_{t-1} \). However, the single period expectation does not identify the news shock if \( h \neq s \). Now, consider the sum of the expectations up to \( H \) period and assume \( H \geq s \):

\[ \sum_{h=1}^{H} \mathbb{E}^P_t g_{t+h} = \sum_{k=s}^{H} \phi_k \varepsilon_t + \sum_{k=s}^{\infty} \sum_{j=k-1}^{H+k-1} \phi_{j+k} \varepsilon_{t-j} + \sum_{k=1}^{\infty} \sum_{j=k}^{H+k-1} \theta_j u_{t-k} \]  \hspace{1cm} (A.8)

and news shock \( \varepsilon_t \) can be identified as the residual after projecting the sum of the \( H \) period expected government spending on the one period lagged information set \( I_{t-1} \).
### B. The Greenbook Forecasts

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Table B.1: The horizon of expected government spending from Greenbook forecasts
C. Further Robustness Checks

C1. Factor-augmented VAR (FAVAR)

The baseline VAR is a medium-size model with a set of key macroeconomic variables to capture the all possible dynamic relationships crucial to isolate the impact of current and expected government spending. However, even though the baseline model supplies rich specification and passes the non-fundamentalness test, still it might suffer from an omitted-variable problem, which may bias the results of the baseline scenario. To address this possible issue, I estimate factor-augmented VAR (FAVAR) by extracting factors from a large data set and adding these factors into my VAR. In particular, I consider a data set composed of 109 time-series and extract common factors applying principal component method. Following Bernanke et al. (2005), I extract two common factors and enlarge my data vector with these factors such that:

\[ X_t = (f_1^t, f_2^t, e_t(1, 4), \text{conf}_t, g_t, t_t, d_t, y_t, c_t, r_t)' \]

where \( f_1^t \) and \( f_2^t \) are the two factors that explain the largest share of variance of the series in the large data set. The impulse responses from FAVAR are presented in Figure C.1 and the shape of the responses are very similar to the baseline estimation even though the magnitudes are different.

C2. Expected Tax Receipts

There are two main policy tools in the fiscal policy; spending and tax. Hence, the agents in the economy may not only observe the news related to the future spending but also the news related to the future tax policy. If the news for spending and tax policy occur at the same time and one does not control for the expected changes in tax policy, then the estimated effect of fiscal spending news might be confounded. The aim of this exercise is to check whether the baseline results are biased due to the news related to the tax policy. To do so, I construct forecasts of tax revenue-to-gdp ratio using Greenbook forecast with the same horizon forecast of government spending and embed these forecasts into baseline vector such that:

\[ X_t = (e_t(1, 4), \text{conf}_t, g_t, e_{\tau t}(1, 4), t_t, d_t, y_t, c_t, r_t)' \]

where \( e_{\tau t}(1, 4) \) is the tax revenue-to-gdp forecasts. Since Greenbook forecasts are available up to the last quarter of the year 2012, I estimate Bayesian VAR with lag-length of three and time span 1966Q4 – 2012Q4. Figure C.1 shows the responses under Tax News and the results are larger in magnitude relative to the baseline case; however, the path of the responses are similar and they do not suggest that the baseline estimations are confounded.

C3. Ramey News Variable

Even though the fiscal news shocks pass the exogeneity test, the identified shocks were found to be correlated with Ramey Military News variable. To check whether the results in baseline case are driven by the unique informational content of my proxy of future government spending and not driven by it’s correlation with another fiscal news variable, I add Ramey news variable into my baseline vector and order it first. I exhibit the results in Figure C.1 with Ramey News ordered first and the estimation produces almost identical responses relative to the baseline case. These findings offer additional evidence that the proxy contains unique information related to the future government spending and this unique content drives the baseline results.
C4. Subsample

The first fifteen years of the sample exhibits large variation in the fiscal news shock and the events in these time period might have large impact on the results. To check whether this is the case, I reestimate my baseline VAR using sample from 1981Q3 to 2018Q1. The reasons of selecting this period is that first, this is the sample contains only SPF forecasts so it is possible to test the effect of different survey data and second, as shown in Figure 1, this is the period of shocks with less variation. The results are in Figure C.1 under title Subsample and the responses are similar to the baseline estimates even though the first few quarters produce smaller effects.

C5. Per Capita Real Variables

The baseline estimation uses aggregate real variables in VAR since the aim is to measure the aggregate responses. However, population increased more than 50% in the US in the last 50 years and to control for any impact of larger population in the sample period, per capita real variables are used in this robustness check. The real GDP, consumption and federal government spending are divided into U.S. civilian noninstitutional population series of FRED to obtain per capita real variables. The results are almost same as in baseline estimation.

Figure C.1: Impulse Responses to an Anticipated Government Spending Shock under further robustness checks

Notes: Solid blue lines are baseline, point orange lines with circles are FAVAR, dash-dot green lines are forecasts of tax revenue-to-gdp ratio included and ordered fourth, point magenta lines are confidence ordered fourth, dashed cyan lines are subsample from 1981Q3 to 2018Q1, and dash-dot gray lines are Ramey news variable ordered first estimates of impulse responses to a fiscal news (anticipated government spending) shock from Bayesian VAR. The shaded area is 68% confidence interval of baseline estimation.
### D. Fiscal Multipliers

<table>
<thead>
<tr>
<th>Horizon</th>
<th>1-year</th>
<th>2-year</th>
<th>3-year</th>
<th>4-year</th>
<th>5-year</th>
</tr>
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<tbody>
<tr>
<td>Baseline</td>
<td>1.88</td>
<td>1.48</td>
<td>0.97</td>
<td>0.64</td>
<td>0.40</td>
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<td></td>
<td>[0.73, 3.30]</td>
<td>[0.92, 2.12]</td>
<td>[0.56, 1.41]</td>
<td>[0.27, 1.01]</td>
<td>[0.05, 0.75]</td>
</tr>
<tr>
<td>Fiscal News Last</td>
<td>2.01</td>
<td>1.20</td>
<td>0.81</td>
<td>0.53</td>
<td>0.32</td>
</tr>
<tr>
<td></td>
<td>[1.36, 2.80]</td>
<td>[0.80, 1.64]</td>
<td>[0.46, 1.18]</td>
<td>[0.19, 0.87]</td>
<td>[−0.01, 0.65]</td>
</tr>
<tr>
<td>Sentiment 4th</td>
<td>1.74</td>
<td>1.30</td>
<td>0.86</td>
<td>0.57</td>
<td>0.35</td>
</tr>
<tr>
<td></td>
<td>[0.68, 3.02]</td>
<td>[0.80, 1.87]</td>
<td>[0.50, 1.26]</td>
<td>[0.24, 0.91]</td>
<td>[0.03, 0.67]</td>
</tr>
<tr>
<td>GDP News</td>
<td>2.06</td>
<td>1.44</td>
<td>0.98</td>
<td>0.67</td>
<td>0.44</td>
</tr>
<tr>
<td></td>
<td>[1.14, 3.24]</td>
<td>[0.95, 2.00]</td>
<td>[0.60, 1.39]</td>
<td>[0.31, 1.03]</td>
<td>[0.09, 0.79]</td>
</tr>
<tr>
<td>Purged News</td>
<td>1.83</td>
<td>1.45</td>
<td>1.03</td>
<td>0.73</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>[1.04, 2.86]</td>
<td>[0.99, 1.98]</td>
<td>[0.67, 1.43]</td>
<td>[0.39, 1.08]</td>
<td>[0.17, 0.84]</td>
</tr>
<tr>
<td>Small VAR</td>
<td>2.14</td>
<td>1.05</td>
<td>0.56</td>
<td>0.33</td>
<td>0.19</td>
</tr>
<tr>
<td></td>
<td>[1.01, 3.60]</td>
<td>[0.61, 1.55]</td>
<td>[0.25, 0.89]</td>
<td>[0.06, 0.61]</td>
<td>[−0.07, 0.46]</td>
</tr>
<tr>
<td>TFP First</td>
<td>0.75</td>
<td>1.21</td>
<td>0.76</td>
<td>0.46</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>[−1.05, 2.47]</td>
<td>[0.50, 2.06]</td>
<td>[0.29, 1.28]</td>
<td>[0.06, 0.88]</td>
<td>[−0.12, 0.64]</td>
</tr>
<tr>
<td>Other Confidence</td>
<td>2.19</td>
<td>1.99</td>
<td>1.45</td>
<td>1.06</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>[0.95, 3.79]</td>
<td>[1.35, 2.76]</td>
<td>[0.98, 1.98]</td>
<td>[0.65, 1.51]</td>
<td>[0.41, 1.22]</td>
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<tr>
<td>FAVAR</td>
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<td>0.98</td>
<td>0.75</td>
<td>0.59</td>
</tr>
<tr>
<td></td>
<td>[0.47, 2.39]</td>
<td>[0.49, 1.87]</td>
<td>[0.22, 1.62]</td>
<td>[−0.03, 1.48]</td>
<td>[−0.22, 1.42]</td>
</tr>
<tr>
<td>Tax News</td>
<td>0.11</td>
<td>3.04</td>
<td>3.09</td>
<td>2.57</td>
<td>2.08</td>
</tr>
<tr>
<td></td>
<td>[−2.93, 3.25]</td>
<td>[0.96, 5.55]</td>
<td>[1.58, 4.97]</td>
<td>[1.35, 4.03]</td>
<td>[1.02, 3.32]</td>
</tr>
<tr>
<td>Ramey News</td>
<td>1.50</td>
<td>3.53</td>
<td>3.06</td>
<td>2.11</td>
<td>1.41</td>
</tr>
<tr>
<td></td>
<td>[−2.33, 5.22]</td>
<td>[0.73, 6.59]</td>
<td>[1.06, 5.33]</td>
<td>[0.27, 3.96]</td>
<td>[−0.45, 3.15]</td>
</tr>
<tr>
<td>Per Capita</td>
<td>1.65</td>
<td>1.09</td>
<td>0.67</td>
<td>0.38</td>
<td>0.16</td>
</tr>
<tr>
<td></td>
<td>[0.69, 2.82]</td>
<td>[0.61, 1.61]</td>
<td>[0.30, 1.05]</td>
<td>[0.05, 0.72]</td>
<td>[−0.16, 0.48]</td>
</tr>
<tr>
<td>Subsample</td>
<td>0.69</td>
<td>2.32</td>
<td>1.61</td>
<td>1.07</td>
<td>0.71</td>
</tr>
<tr>
<td></td>
<td>[−1.8, 3.01]</td>
<td>[1.44, 3.52]</td>
<td>[1.12, 2.19]</td>
<td>[0.73, 1.45]</td>
<td>[0.44, 1.01]</td>
</tr>
</tbody>
</table>

**Notes:** Estimated fiscal multipliers for an anticipated (news) government spending shock. The first row presents the multipliers from baseline estimation and from second row to the last row represent the multipliers estimated with specifications in the following order: fiscal news ordered last, sentiment ordered fourth, forecasts of future gdp growth ordered first, purged news replaced with baseline proxy, small VAR where tax, debt and 3-month T-bill rate are dropped, utilization-adjusted TFP series are ordered first, current consumer sentiment index is used as a confidence indicator, Factor-augmented VAR with two factors, forecasts of tax revenue-to-gdp ratio included, Ramey News variable ordered first and sample from 1981Q3 to 2018Q1. The numbers in brackets indicate the 68% confidence intervals from the distribution of multipliers.
E. The Solution Method

The transition equation in 45 can be represented as following:

\[
\begin{pmatrix}
    g_t \\
    \xi_{t-1} \\
    c_t \\
    p_t \\
    i_t \\
    \xi_{t,t} \\
    Z_{t,t}
\end{pmatrix}
= \begin{pmatrix}
    \rho \phi_e & 0 & 0 & 0 & 0 & 0 & 0 \\
    0 & \rho \xi & 0 & 0 & 0 & 0 & 0 \\
    0 & 0 & \rho \xi & 0 & 0 & 0 & 0 \\
    A_c & A_p & 0 & 0 & 0 & 0 & 0 \\
    0 & 0 & 0 & 0 & 0 & 0 & 0 \\
    0 & 0 & 0 & 0 & 0 & 0 & 0 \\
    A
\end{pmatrix}
\begin{pmatrix}
    \xi_{t-1} \\
    c_{t-1} \\
    p_{t-1} \\
    i_{t-1} \\
    \xi_{t-1,t-1} \\
    Z_{t-1,t-1}
\end{pmatrix}
+ \begin{pmatrix}
    0 & 0 & 0 & 0 & 0 & 0 & 0 \\
    0 & 0 & 0 & 0 & 0 & 0 & 0 \\
    0 & 0 & 0 & 0 & 0 & 0 & 0 \\
    0 & 0 & 0 & 0 & 0 & 0 & 0 \\
    0 & 0 & 0 & 0 & 0 & 0 & 0 \\
    0 & 0 & 0 & 0 & 0 & 0 & 0 \\
\end{pmatrix}
\begin{pmatrix}
    1 \\
    0 \\
    0 \\
    0 \\
    0 \\
    0
\end{pmatrix}
\]

(A.9)

where \(A_c, A_p, B_c\) and \(B_p\) will be determined in equilibrium.

E1. Optimal Decision Rules

Iterating equation 47 one period ahead and plugging into the Euler equation gives

\[
c_t = E_{t,t} [mb_{l,t+1} + mp_{l,t} - m_t \pi_{t+1} + m_d d_{l,t+1} + m_z E_{l,t} [Z_{t+1}]] - i_t - \bar{p}_{l,t}.
\]

Using individual budget constraint in 36 and one period ahead total demand and tax signal in 42, one can rewrite the above equation as following

\[
c_t = E_{t,t} \left[ \frac{mb}{\beta} (b_{l,t} + (1 - \gamma) p_{l,t} + d_{l,t} - \theta_C \bar{p}_{l,t} - \theta_C c_{l,t} - \pi_{l,t}) + m_p p_{l,t} - m_t \theta_G (\xi_{t,t} + \pi_{t+1} + \xi_{l,t+1}^G + \mu_{l,t+1}^1) + m_d (\theta_C c_{l+1} + \theta_G \xi_{l,t} + p_{l+1} + \xi_{l,t+1}^G + \mu_{l,t+1}^1) + m_z E_{l,t} [Z_{t+1}] \right] - i_t - \bar{p}_{l,t}.
\]

The \(t+1\) variables in the above equation can be expressed as function of \(Z_{l,t}\) and \(E_{l,t} \mu_{l,t+1}^G = E_{l,t} \mu_{l,t+1}^\rho = 0\). After rearranging, the above equation takes the form

\[
\Psi c_{l,t} = - \bar{p}_{l,t} + \frac{1}{\Psi} \left( \frac{mb}{\beta} + \Phi q_b \right) b_{l,t} + \frac{1}{\Psi} \left( \frac{md}{\beta} + \Phi q_d \right) d_{l,t} - \frac{1}{\Psi} \left( \frac{m_t}{\beta} + \Phi q_r \right) \pi_{l,t} + \frac{1}{\Psi} \Phi q_{p} p_{l,t-1}
\]

\[
+ \frac{1}{\Psi} \left( -e_i + (-m_t + m_d) \theta_G e_x + \Phi q_z + \left[ \frac{(-m_t \theta_G + m_d \gamma) e_p + b_d \theta_G e_c \xi_{l,t} + m_d \theta_C e_c - m_t \theta_C e_x + b_z A}{m_d \theta_C e_c - m_t \theta_C e_x + b_z} \right] E_{t,t} Z_{l,t} \right)
\]  

where \(\Psi = \frac{\beta + m_p \theta_C}{\beta}\), \(\Phi = \frac{mb}{\beta} (1 - \gamma) + b_p\) and \(e\) is unitary vector that selects corresponding variable from \(Z_{l,t}\). Matching equations 47 and A.10 gives

\[
m_p = \frac{1}{\Psi} \Phi q_p,
\]

\[
m_b = \frac{1}{\Psi} \left( \frac{mb}{\beta} + \Phi q_b \right),
\]

\[
m_r = \frac{1}{\Psi} \left( \frac{m_r}{\beta} + \Phi q_r \right),
\]

37
\[ m_d = \frac{1}{\psi} \left( \frac{m_d}{\beta} + \Phi q_d \right), \]

\[ m_z = \frac{1}{\psi} \left( -e_i + (-m_r + m_d) \theta_G e_g + \Phi q_z + \left[ (-m_r \theta_G + m_d \gamma) e_p + m_d \theta G e_c - m_r \theta G e_{e_{t}} + b_d \theta G e_{\xi_G} + b_z \right] A \right). \]

Plugging equation 44 into the equation 46 and rearranging gives

\[ \Lambda p_{l,t} = p_{l,t-1} + \lambda \left( \bar{p}_{l,t} + c_{l,t} \right) + \lambda \chi d_{l,t} + \beta E_{l,t} \left[ q_b b_{l,t+1} + q_b p_{l,t} - q_r \tau_{l,t+1} + q_d d_{l,t+1} + q_z E_{l,t} \left[ Z_{l,t+1} \right] \right]. \]

Following the same steps taken for consumption, one can rewrite the above equation as following

\[ \mathcal{Y} p_{l,t} = p_{l,t-1} + q_b b_{l,t} + (\lambda \chi + q_b) d_{l,t} + \Omega (m_b b_{l,t} + m_p p_{l,t-1} - m_r \tau_{l,t} + m_d d_{l,t} + m_z E_{l,t} \left[ Z_t \right]) \]

\[ + \beta \left\{ (-q_r + q_d) \theta G e_g + \left[ (-q_r \theta G + q_d \gamma) e_p + q_d \theta G e_c - q_r \theta G e_{e_{t}} + q_d \theta G e_{\xi_G} + q_z \right] A \right\} E_{l,t} Z_{l,t}, \]

(A.11)

where \( \mathcal{Y} = \Lambda - (1 - \gamma) q_b - \beta q_b \) and \( \Omega = \lambda - \theta C q_b \) with \( e \) is unitary vector that selects corresponding variable from \( Z_{l,t} \). Matching equations 46 and A.11 gives

\[ q_p = \frac{1 + \Omega b_p}{Y}, \]

\[ q_b = \frac{q_p}{1 + \Omega b_p} \left( q_b + \Omega b_b \right), \]

\[ q_r = \frac{q_p}{1 + \Omega b_p} \left( \Omega b_r \right), \]

\[ q_d = \frac{q_p}{1 + \Omega b_p} \left( \lambda \chi + q_b \right), \]

\[ q_z = \frac{q_p}{1 + \Omega b_p} \left[ \Omega b_z + \beta \left( (-q_r + q_d) \theta G e_g + \left[ (-q_r \theta G + q_d \gamma) e_p + q_d \theta G e_c - q_r \theta G e_{e_{t}} + q_d \theta G e_{\xi_G} + q_z \right] A \right) \right]. \]

**E2. Individual Inference**

The vector of signals \( s_{l,t} \) (observation equation) for island \( l \) can be written as function of states and idiosyncratic noises

\[ \left( \begin{array}{c}
\bar{p}_{l,t} \\
d_{l,t}^P \\
d_{l,t}^G \\
\tau_{l,t} \\
i_{l,t}
\end{array} \right) = \left( \begin{array}{c}
e_e \\
e_p \\
e_{e-1} + \gamma e_p \\
\theta_G \left( e_{e-1} + e_p \right) + e_G \\
e_i
\end{array} \right) \left( \begin{array}{c}
g_t \\
\varepsilon_t \\
\varepsilon_{t-1} \\
c_t \\
p_t \\
i_t \\
\xi_{l,t}^e \\
\xi_{l,t}^G \\
i_{l,t}
\end{array} \right) \left( \begin{array}{c}
1 \\
0 \\
1 \\
0 \\
1 \\
0 \\
1 \\
0 \\
1
\end{array} \right) \left( \begin{array}{c}
\eta_{l,t}^{CP} \\
\eta_{l,t}^P \\
\eta_{l,t}^G \\
\eta_{l,t}^\tau \\
u_{l,t}^2
\end{array} \right), \]

(A.12)

where \( e \) is unitary vector that selects corresponding variable from \( Z_{l,t} \). The prediction rule for the agent in island \( l \) using Bayesian updating is equal to

\[ E_{l,t} Z_{l,t} = E_{l,t-1} Z_{l,t-1} + C \left( s_{l,t} - E_{l,t-1} s_{l,t-1} \right) \]

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and C is the Kalman gain matrix. Define variance-covariance matrix for the residuals in equation A.9

\[
\Sigma = \begin{bmatrix}
\sigma_u^2 & 0 & 0 & 0 \\
0 & \sigma_z^2 & 0 & 0 \\
0 & 0 & \sigma_{\mu_1}^2 & 0 \\
0 & 0 & 0 & \sigma_{\mu_2}^2
\end{bmatrix}
\]

and in equation A.12

\[
V = \begin{bmatrix}
\sigma_{\eta_{CP}}^2 & 0 & 0 & 0 \\
0 & \sigma_{\eta_P}^2 & 0 & 0 \\
0 & 0 & \sigma_{\eta_G}^2 & 0 \\
0 & 0 & 0 & \sigma_{\eta_r}^2
\end{bmatrix},
\]

then Kalman gain matrix is given by

\[
C = PF' \left( FPF' + GVG' \right)^{-1},
\]

where \( P = E_{l,t-1} \left[ Z_{l,t}Z_{l,t}' \right] \) and must satisfy

\[
P = A (P - CF) A' + B\Sigma B'.
\]

**E2. Fixed Point**

The average first-order expectations regarding the state \( Z_{l,t} \) can be expressed as a function of \( Z_{l,t} \) itself as

\[
\int E_{l,t} \left[ Z_{l,t} \right] = \Xi Z_{l,t}.
\]

Using the Bayesian updating rule and aggregating across islands gives

\[
\int E_{l,t} \left[ Z_{l,t} \right] = (I - CF) A E_{l,t-1} Z_{l,t-1} + CF Z_{l,t},
\]

for all \( Z_{l,t} \). Aggregating the individual decision rules in 46 and 47 gives

\[
p_t = q_p p_{t-1} - q_r \tau_t + q_d d_t + q_z \Xi Z_{l,t},
\]

\[
c_t = -\bar{p}_t + m_p p_{t-1} - m_r \tau_t + m_d d_t + m_z \Xi Z_{l,t}.
\]

Expressing everything in terms of the state \( Z_{l,t} \), the equilibrium coefficients must satisfy

\[
[- (1 + m_r \theta_G - m_d \gamma) e_p + m_p e_{p-1} + (m_d - m_q) \theta_G e_{e-1} + m_d \theta_G e_c + m_z \Xi] Z_{l,t} = 0
\]

\[
[(q_d \gamma - q_r \theta_G) e_p + q_p e_{p-1} + (q_d - q_t) \theta_G e_{e-1} + q_d \theta_G e_c + q_z \Xi] Z_{l,t} = 0,
\]

for all \( Z_{l,t} \). The equations A.17 and A.18 are used to update the evolution of the state variables until the impulse responses of \( c_t \) and \( p_t \) to the aggregate shocks converge under the old and updated values of A and B. In the numerical computation, I restrict the values of \( A_c, A_p, B_c \) and \( B_p \) so that they do not respond to the local state variables \( \xi_{l,t}^G \) and \( \xi_{l,t}^r \).
F. The Alternative Model

In this alternative model, I only modify the government demand and tax signals in 26 and 28 in following way

\[
y_{m,l,t}^G = \varepsilon_{t-1} + \varepsilon_{t-4} + \varrho \varepsilon_{t-5} - \gamma (p_{m,l,t} - p_t) + \xi_{l,t}^G + \eta_{l,t}^G, \tag{A.19}
\]

\[
\tau_{l,t} = \theta G (p_t + \varepsilon_{t-1} + \varepsilon_{t-4} + \varrho \varepsilon_{t-5}) + \xi^T_{l,t} + \eta^T_{l,t}, \tag{A.20}
\]

where \( \varepsilon_{t-4} \) and \( \varepsilon_{t-5} \) are fiscal news at time \( t - 4 \) and \( t - 5 \), respectively and parameter \( \varrho \) determines the share of fiscal news at time \( t - 5 \) on government demand and tax signals. The reason of adding those two additional terms is to capture the second shift in output and consumption in empirical results. I reestimate the model with these signal structures and same calibrated parameter values and the estimation gives similar parameter values but tighter standard errors. However, the standard errors of idiosyncratic shocks are still not significant.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Std. Err.</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \theta )</td>
<td>0.98</td>
<td>0.15</td>
</tr>
<tr>
<td>( \rho )</td>
<td>0.99</td>
<td>0.05</td>
</tr>
<tr>
<td>( \rho_\varepsilon )</td>
<td>0.82</td>
<td>0.01</td>
</tr>
<tr>
<td>( \phi_\varepsilon )</td>
<td>0.02</td>
<td>0.01</td>
</tr>
<tr>
<td>( \rho_\xi )</td>
<td>0.99</td>
<td>0.14</td>
</tr>
<tr>
<td>( \sigma_{\mu_{1,2}} )</td>
<td>0.03</td>
<td>0.17</td>
</tr>
<tr>
<td>( \phi )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \sigma_{\eta^G} )</td>
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<td>0.21</td>
</tr>
<tr>
<td>( \sigma_{\eta^T} )</td>
<td>2.00</td>
<td>263.29</td>
</tr>
</tbody>
</table>

Table D.2: Estimated Parameters of Alternative Model

The Figure C.2 shows the responses of empirical and alternative model and the responses show better fit of the alternative model to the data. This results point to the fact that fiscal news process is more complex than standard AR(1) process and there are some shocks that the agents become aware of with few lags.
Figure C.2: The Responses to Fiscal News Shock, Alternative Model versus VAR

Notes: Red solid lines represent the estimated alternative model and blue solid line represents the VAR with 68% confidence intervals.