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The Stimulative Effects of Anticipated Government Spending Expansions: Evidence from Survey Forecasts*

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Abstract

We employ a maximum forecast error variance VAR identification strategy to examine the effects of anticipated government spending expansions. In our post-1981 U.S. sample, an anticipated expansion in government spending is delayed and persistent. This expansion is associated with increases in consumption and investment, as well as in real wages and hours. It also has an accelerator effect on private capital investment and a delayed stimulative effect on private sector productivity. Moreover, the monetary and tax policies accompanying the anticipated government spending expansion align well with the Fed's dual mandate and with less progressive federal tax reforms, respectively.

JEL Classification: C32, E62, H50
Keywords: Anticipated government spending shocks, Maximum forecast error variance approach, Government spending multipliers, Survey of Professional Forecasters

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1 Introduction

The impact of an increase in government spending on the economy has long been a fundamental question in macroeconomics. Since Blanchard and Perotti's (2002) seminal work, there has been an extensive body of studies addressing this question through vector autoregression (VAR) analysis.[1] Recently, the literature has shifted its focus from surprise shocks to government spending to anticipated or news shocks, thereby exploring the effects of anticipated expansions in government spending. This change in focus arises from the recognition that, due to legislative and implementation lags, economic agents anticipate changes in fiscal policy well in advance—a phenomenon referred to as fiscal foresight. As a result, forward-looking households and firms adjust their behavior, even before the policy changes are actually realized. In this context, anticipated effects are of great relevance to the transmission of fiscal policy shocks.[2]

This paper aims to contribute to the literature on fiscal foresight by implementing a structural VAR (SVAR) identification strategy for anticipated government spending shocks and documenting their macroeconomic impact. To this end, we begin by establishing a measure of news about future government spending. Following Forni and Gambetti (2016), we employ the Survey of Professional Forecasters (SPF) series of real federal government spending to construct a proxy for forecasters' expectations about future government spending. We refer to this constructed series as the SPF news variable, which serves as our measure of news about future government spending. Importantly, we provide evidence that our SPF news variable exhibits significant predictive power for future government spending, and that such predictive content is largely associated with defense spending that is generally interpreted as being exogenous compared to other government spending categories.

We then identify anticipated government spending shocks within a VAR framework that incorporates both the SPF news variable and key macro aggregates, including government spending. Our identification strategy is to identify anticipated government spending shocks as the shocks, restricted to be orthogonal to current government spending, that best explain movements in the SPF news variable during the forecast period from 0 to a finite truncation horizon denoted by *H*. We refer to them as SPF news shocks. Simply put, SPF news shocks are identified by applying the maximum forecast error variance (henceforth, MFEV) methodology of Uhlig (2003) or Barsky and Sims (2011) to our measure of news about future government spending. The appealing aspect of the MFEV approach lies in its

[1] For example, see Mountford and Uhlig (2009), Ramey (2011), Auerbach and Gorodnichenko (2012), Ricco et al. (2016), and Ramey and Zubairy (2018) among others. For an excellent survey, see Ramey (2016).
[2] Examples for empirical and theoretical studies on fiscal foresight include works by Mertens and Ravn (2010, 2011), Fisher and Peters (2010), Leeper et al. (2010, 2013), Leeper et al. (2012), Ricco et al. (2016), and Ellahie and Ricco (2017).

partial identification nature, which does not require one to take a stand on the nature of shocks other than (surprise and news) shocks to government spending. Hence, the MFEV approach is less restrictive than commonly employed recursive identifications as in, for example, Blanchard and Perotti (2002), Ramey (2011, 2016), Forni and Gambetti (2016), and Ellahie and Ricco (2017).

In the post-1981 sample, during which the SPF news variable is available, we investigate the macroeconomic effects of anticipated government spending shocks by implementing our MFEV identification strategy. Before analyzing the impulse responses of macro aggregates to the identified SPF news shock, we formally address the non-fundamentalness issue that arises in SVAR studies related to news about future fundamentals, namely, fiscal foresight in the context of our study - see, for example, Blanchard et al. (2013) and Leeper et al. (2013), among others. We do this by conducting the orthogonality F-test proposed by Forni and Gambetti (2014). The results from this F-test indicate that identified SPF news shocks are not likely to be plagued by the non-fundamentalness problem. Furthermore, we document that identified SPF news shocks are well associated with fiscal and geopolitical events that foresaw significant changes in government spending.

In our analysis of the impulse responses of macro aggregates to a positive SPF news shock, we find that the government spending expansion, induced by the SPF news shock, is both delayed and persistent. Before this government spending expansion is fully phased in, there are substantial increases in GDP, consumption, and investment. This suggests that the short-run boom in output is primarily due to the increase in private spending on both consumption and investment. Delving into the responses of consumption and investment components, we find that significant increases in expenditures on both nondurable goods and services lead to the increase in consumption, while a surge in nonresidential investment is the primary source of the increase in investment. In particular, the surge in nonresidential investment provides support for an accelerator effect of anticipated government spending expansions on private investment, where expected increases in government spending lead private firms to boost their spending on capital goods in advance, preparing to meet the anticipated increase in public demand. With regard to real wages, hours worked and inflation, we find that all rise in response to the SPF news shock.

As Rossi and Zubiary (2011) demonstrate, the impacts of government spending expansions rest on monetary and tax policies. Regarding the monetary policy, we find that the short-term interest rate rises in response to the SPF news shock. This can be in line with the Fed's dual mandate of maximum sustainable employment and price stability. Specifically, the Fed hikes the short-term rate when, as we found earlier, the SPF news shock leads to increases in both output and inflation. Concerning the tax

policy, the response of the tax rate to the SPF news shock exhibits a distinct pattern depending on its measure. While the average tax rate declines substantially following the SPF news shock, the marginal tax rate initially falls and then rises significantly—it is worth noting that irrespective of the tax rate measure used, government debt increases permanently. Although the responses of the average and marginal tax rates are distinct, each is consistent with tax reforms implemented during our post-1981 sample period. These reforms decreased the progressivity of the U.S. federal tax system. Examples include the Economic Recovery Tax Act of 1981 and the Tax Reform Act of 1986 during the Reagan administration, which substantially lowered top marginal tax rates, and the Economic Growth and Tax Relief Reconciliation Act of 2001 during the administration of George W. Bush, which decreased marginal tax rates across the board.

We also estimate the government spending multiplier, associated with the impulse responses of GDP and government spending to the SPF news shock, by taking the integral multiplier approach. At the initial three-year horizons, the multiplier estimate exceeds one, reflecting the strong output expansion driven by increases in both consumption and investment and the delayed expansion in government spending. At subsequent horizons, however, the multiplier estimates become close to unity. This is because, while the anticipated government spending expansion remains significant even in the medium term, the output expansion fades.

Our work is closely related to Ben Zeev and Pappa (2017). They identify news shocks to defense spending by applying the MFEV methodology to a defense spending series and document that defense news shocks have stimulative impacts on the economy. In contrast to their MFEV identification approach, we apply the MFEV methodology to our SPF news variable, constructed from professional forecasters' forecast series of future federal government spending, and uncover several distinct results. For instance, nonresidential investment falls substantially following Ben Zeev and Pappa's defense news shock, whereas it rises strongly in response to our SPF news shock, suggesting an investment accelerator effect of anticipated expansions in government spending. Furthermore, our SPF news shocks are associated with a delayed increase in total factor productivity and a relatively quick rise in the government investment-consumption ratio. This finding suggests that our SPF news shocks have a delayed stimulative effect on private sector productivity through the increase in government investment.

Our study is also connected to several recent studies that use the SPF forecast series to analyze the effects of anticipated shocks to government spending. Caggiano et al. (2015) construct a measure of news about future government spending by aggregating SPF forecast revisions of the growth rate of real federal government spending. Employing a nonlinear VAR augmented with this news measure and

focusing on government spending multipliers, they find that anticipated shocks yield larger multipliers during deep recessionary periods than during strong expansionary periods. Using the SPF data, Ricco et al. (2016) construct a series of forecast revisions related to the growth rate of government spending and also develop an index of fiscal policy disagreement. In a Threshold VAR framework, they show that anticipated shocks exert more stimulative effects on the economy during times of low fiscal policy disagreement compared to times of high disagreement. Forni and Gambetti (2016) employ a standard VAR augmented with a series of cumulated SPF forecasts of the government spending growth rate to examine the effects of anticipated shocks in an open economy. They focus specifically on the dynamics of the real exchange rate and trade balance.

The remainder of the paper is structured as follows. Section 2 describes the data used in the VAR analysis and the empirical framework. Section 3 presents the empirical results and Section 4 provides the results from further investigations. Section 5 concludes the study.

2 Empirical Framework

In this section, we begin by describing the data used in our VAR analysis of anticipated government spending shocks, introducing our measure of news about future government spending. We next provide evidence on the significant predictive power of our news measure for future government spending. Importantly, its predictive content is largely associated with defense spending, which is less prone to endogeneity issues compared to other categories of government spending. Lastly, we outline our baseline VAR model and present our identification strategy.

2.1 Data

2.1.1 Macro Aggregate Variables

Our empirical study uses a quarterly U.S. dataset that includes macro aggregate series and the Survey of Professional Forecasters (SPF) series of real federal government spending. The dataset spans from 1981:Q3 to 2018:Q4. The starting point of our sample is dictated by the availability of the SPF series of real federal government spending.

The macro aggregate variables employed in our VAR study are grouped into two categories: those from the National Income and Product Accounts (NIPA) and the non-NIPA variables. The NIPA variables include GDP, total (federal plus state and local) government spending, consumption measured by consumption expenditures on nondurable goods and services, investment defined as the sum of

durable consumption and fixed private investment, and each component of consumption and investment. Note that fixed private investment has two sub-categories: nonresidential and residential. Thus, our measure of investment comprises three components: durable consumption, nonresidential investment, and residential investment.

For each NIPA variable, we first obtain its real series by dividing the corresponding nominal series by a common deflator, namely the GDP deflator. Then, following Ramey (2016), we apply the Gordon-Krenn (2010) transformation, dividing each real NIPA series by an estimate of potential real GDP.[3] This estimate is obtained by regressing logged real GDP on a quadratic time trend and taking the exponential of the fitted values. Note that our potential GDP estimation is based on a sample from 1947: Q1 to 2018: Q4 to maximize available real GDP information.

The non-NIPA variables included in the VARs—government debt, the tax rate, the nominal interest rate, hours worked, real wages, and the inflation rate - are defined as in Fernández-Villaverde et al. (2015) and Ramey (2016). Our measure of government debt is defined as the federal debt held by the public as a fraction of GDP. The tax rate is the average tax rate, calculated by dividing federal current receipts by nominal GDP. The nominal interest rate is the three-month Treasury bill rate. Hours are defined as the logarithm of per capita total hours worked, with the total hours worked series from Francis and Ramey (2009) divided by the total population series, including armed forces overseas. Real wages are defined as the logarithm of nominal compensation in the business sector, deflated by the price deflator for private business. Lastly, the inflation rate is the annualized quarterly growth rate of the GDP deflator.

2.1.2 SPF News Variable and its Predictive Content

Our identification strategy for anticipated government spending shocks relies on a measure of news about future government spending. We construct such a measure using the Survey of Professional Forecasters (SPF) series for real federal government spending. For each survey quarter t, the Survey provides the mean forecast of real federal government spending, denoted by $g_t^{spf}(k)$. This forecast pertains to the quarter $t+k$, where k represents forecasters' forecast horizon and $k = 0, 1, 2, 3, 4$, based on the information set available up to the quarter preceding the survey quarter. Following Forni

[3] The Gordon-Krenn transformation of real NIPA variables serves to estimate government spending multipliers directly from the impulse response functions of GDP and government spending, both of which have been subjected to the Gordon-Krenn transformation. Another widely used method in the literature is to estimate multipliers from the impulse response functions of the logarithms of GDP and government spending. Yet, as Owyang et al. (2013) illustrate, this log-transformation-based approach can lead to biases in multiplier estimates. It should be noted that our results concerning the impulse response functions to an anticipated government spending shock, detailed in Section 3.2, remain robust even when employing logged real NIPA variables.

and Gambetti (2016), we use $g_t^{spf}(0)$ and $g_t^{spf}(4)$ to compute the forecasted future growth rate of real federal government spending from t to $t+4$, denoted as $f_t^{g_4}$: that is, $f_t^{g_4} = 100 \times \log\left(g_t^{spf}(4)/g_t^{spf}(0)\right)$.[4] We refer to this computed series f_t^{g4} as the SPF news variable, which serves as our measure of news about future government spending.[5]

We now examine to what extent our SPF news variable, f_t^{g4}, has explanatory power for future government spending. To this end, we consider the following univariate forecasting regression:

$$\Delta G_{t+h} = \alpha_h + b_h^{spf} f_t^{g_4} + \sum_{p=1}^{4} \beta_{h,p}' X_{t-p} + \varepsilon_{t+h} \qquad (1)$$

where $\Delta G_{t+h} = 100 \times (G_{t+h} - G_{t-1})$ is the change in Gordon-Krenn transformed government spending G_t between $t-1$ and $t+h$, with $h \geq 0$ as the forecast horizon in quarters, $f_t^{g_4}$ is the SPF news variable, and ε_{t+h} is forecast errors. In the forecasting regression, $X_{t-p} = \left[\Delta G_{t-p}, \Delta Y_{t-p}, \Delta b_{t-p}, tax_{t-p}, i_{t-p}\right]'$ is a vector representing lags of the following variables: the change in Gordon-Krenn transformed government spending (ΔG_t), the change in Gordon-Krenn transformed GDP (ΔY_t), the change in government debt (Δb_t), the tax rate (tax_t), and the nominal interest rate (i_t).[6] These variables are considered relevant to the determination of changes in government spending—see, for example, Favero and Giavazzi (2007), Leeper et al. (2010), and Ramey (2011), among others. Note that they also feature in our VARs, which will be described in Section 2.2.

Using this forecasting regression form, we assess the marginal predictive content of the SPF news variable, conditional on four lags of X_t.[7] In this regard, the regression with only four lags of X_t serves as our benchmark specification. Our predictive power analysis is done for four types of government spending: total (federal plus state and local), federal, and two components of federal government spending, namely defense and nondefense.

[4] As a baseline measure of news about future government spending, Forni and Gambetti (2016) employ the cumulated forecast of real federal government spending growth rates, denoted as $F_t(1,4)$. This is defined by $F_t(1,4) = \sum_{k=1}^{4} x_t(k)$, where $x_t(k) = 400 \times \log\left(g_t^{spf}(k)/g_t^{spf}(k-1)\right)$ represents the forecasted quarterly growth rate of real federal government spending. Consequently, their cumulated forecast series, $F_t(1,4)$, is identical to our SPF news series $f_t^{g_4}$ up to an order of 4.

[5] It is important to note that all of our results remain robust when median forecasts from the Survey are used to construct $f_t^{g_4}$, instead of the mean forecasts. Additionally, our findings are also robust when employing data on individual forecasters from the Survey. For this individual forecaster data, we first calculate the forecasted future growth rate of real federal government spending for each forecaster, and then use either the mean or median of these individual forecasts to construct $f_t^{g_4}$.

[6] In our VAR specification that will be detailed in Section 2.2, the Gordon-Krenn transformed NIPA variables enter the VARs in levels. Correspondingly, the forecasting regression in Equation (1) is specified in terms of changes in Gordon-Krenn transformed government spending and GDP, which means changes in deviations of government spending and GDP from potential GDP. Alternatively, the forecasting regression could be specified in terms of the growth of Gordon-Krenn transformed government spending and GDP or the growth of real per capita government spending and GDP. The results on the predictive power of the SPF news variable hold similarly for all three regression specifications.

[7] Our forecasting regression results are robust to being conditional on 8 or 12 lags of X_t.

Table 1 presents the forecasting regression results for several forecast horizons, namely $h = 0, 4, 8, 16, 24$, in the cases of total (Panel A), federal (Panel B), defense (Panel C), and nondefense (Panel D) government spending. In each panel, Column (1) reports the adjusted R^2, which measures the in-sample goodness of fit, from the regression with only four lags of X_t (the benchmark specification). Column (2) reports the estimation result from the regression that includes both the SPF news variable and four lags of X_t, presenting the estimate of the coefficient on the SPF news variable $\left(b_h^{spf}\right)$, its *t*-statistic obtained from both the Newey-West (NW) and equal-weighted cosine (EWC) heteroscedasticity-autocorrelation-robust (HAR) estimations, and the adjusted R^2. Note that our NW and EWC HAR inference follows the recommendations by Lazarus et al. (2018).[8] To conserve space, we do not report the estimates of coefficients on the four lags of X_t and their *t*-statistics for each regression specification.

We first focus on the forecasting power of the SPF news variable for total and federal government spending. According to the results shown in Panels A and B of Table 1, the SPF news variable is a statistically significant predictor for both total and federal government spending. As shown in Panel A for total government spending, the estimate of the coefficient on the SPF news variable is positive and statistically significant at all forecast horizons. Moreover, the addition of the SPF news variable leads to an increase in the adjusted R^2, relative to the benchmark specification, by about 0.05, 0.17, 0.23, 0.17, and 0.07 at $h = 0, 4, 8, 16, \text{and } 24$, respectively—it is worth noting that the SPF news variable has little nowcasting (i.e., $h = 0$) power for total government spending. As a result, the SPF news variable has significant predictive content, especially at the two-year-ahead forecast horizon. This finding is similarly observed for federal government spending. As illustrated in Panel B, the inclusion of the SPF news variable results in an additional increase in the adjusted R^2 by approximately 0.13, 0.26, 0.31, 0.25, and 0.12 at $h = 0, 4, 8, 16, \text{and } 24$, respectively.

We now turn to the forecasting regression results for two components of federal government spending, namely defense and nondefense. Panels C and D of Table 1 show that the SPF news variable has significant predictive content for defense spending, but not for nondefense spending. As shown in Panel C for defense spending, the estimate of the coefficient on the SPF news variable is statistically significant at all forecast horizons, and its inclusion increases the adjusted R^2 by around 0.12, 0.19, 0.24, 0.18, and 0.09 at $h = 0, 4, 8, 16, \text{and } 24$, respectively, compared to the benchmark regression. In Panel D, concerning nondefense spending, the coefficient estimate for the SPF news variable shows statistical

[8] The referee makes a valuable suggestion for HAR inference, based on the recommendations by Lazarus et al. (2018). Accordingly, when employing the NW HAR inference, we use the rule for the truncation parameter $S = 1.3T^{1/2}$, where T is the sample size, and fixed-b critical values for *t*-statistics, obtained from simulations. When applying the EWC HAR inference, we use the rule for the number of cosine terms $\nu = 0.4T^{2/3}$ and *t*-statistic critical values from the Student *t* distribution.

significance only at the 8 and 16 quarter forecast horizons, with a significance level of 10%. Additionally, the increase in the adjusted R^2 attributed to the SPF news variable is minimal, being 0.00, 0.03, 0.07, 0.05, and 0.02 for $h = 0, 4, 8, 16, \text{and } 24$, respectively. These findings suggest that the predictive content of the SPF news variable is largely related to defense spending that is less likely to suffer from the endogeneity issues than other types of government spending.[9]

In summary of our forecasting power analysis, we find that our SPF news variable carries significant predictive content for future government spending. This informational content is predominantly associated with defense spending, which is viewed as being more exogenous compared to other types of government spending.

2.2 VAR Specification and MFEV Identification Strategy

To identify anticipated government spending shocks, we estimate the following reduced-form VAR model of the *n*-dimensional vector Z_t:

$$Z_t = \mu_t + B(L)Z_{t-1} + u_t \qquad (2)$$

where μ_t denotes a quadratic time trend and $B(L)$ is a fourth-order autoregressive lag polynomial.[10] Our baseline VAR model includes the following eight variables: the SPF news variable, total (federal plus state and local) government spending, GDP, the tax rate, the nominal interest rate, government debt, consumption (consumption expenditures on nondurable goods and services), and investment (durable consumption plus fixed private investment). The tax rate and nominal interest rate are included to control for tax and monetary policies. Government debt is also included, since it can be misleading to set aside the dynamics of debt—see Favero and Giavazzi (2007) and Leeper et al. (2010), among others.[11] All these variables enter the model in their transformed levels described in Section 2.1.

When investigating the effects of anticipated government spending shocks on individual components of consumption (or investment), we replace consumption (or investment) in the baseline VAR with each component one at a time, such as nondurable consumption (or nonresidential investment), and then estimate the resulting model. For other variables of interest like hours, real wages, and inflation, we

[9] An extended predictive power analysis for state and local government spending reveals that the SPF news variable lacks explanatory power. Specifically, the estimates of the coefficient on the SPF news variable for $h = 0, 4, 8, 16, \text{and } 24$ are -0.001, 0.005, 0.004, -0.052, and -0.136, respectively, and these estimates are not statistically significant. Furthermore, the changes in the adjusted R^2 relative to the benchmark regression are -0.005, -0.001, -0.002, 0.014, and 0.069 at the same forecast horizons, respectively.

[10] We follow Ramey (2011, 2016) in specifying a quadratic time trend. As such, we do not obscure the implications of our results by adopting a different specification for the trend term. Nevertheless, it is worth noting that our results remain robust when using a VAR specification with a linear time trend.

[11] It is worth noting that our results remain robust when excluding government debt. These results are available upon request.

estimate the baseline VAR with one of these variables in place of investment.

We now introduce our identification strategy for anticipated/news shocks to government spending. As detailed in Section 2.1.2, our SPF news variable serves as a measure of news about future government spending. The predictive power exercises highlighted in Section 2.1.2 demonstrate that the SPF news variable carries significant information about future government spending. Importantly, its informational content is primarily associated with defense spending, which is generally more exogenous than other types of government spending.

Based on these properties of the SPF news variable, we identify anticipated/news shocks to government spending in any VAR model as the shocks, restricted to be orthogonal to current government spending, that best explain movements in the SPF news variable during the forecast period from 0 to a finite truncation horizon denoted by H. We refer to them as SPF news shocks. In other words, we identify anticipated/news shocks to government spending by applying the maximum forecast error variance (MFEV) methodology of Uhlig (2003) or Barsky and Sims (2011) to our SPF news variable.[12] The appealing aspect of the MFEV approach is that it is a partial identification approach that does not require one to take a stand on the nature of shocks other than (surprise and news) shocks to government spending. To conserve space, we skip details on the MFEV approach—refer to Uhlig (2003) and Barsky and Sims (2011). When implementing our MFEV identification strategy, we consider two values of the truncation horizon (H): either 4 or 16 quarters. These values are chosen as being representative of the short and medium horizons, respectively.[13]

3 Empirical Results

In this section, we present our VAR results on SPF news shocks. We begin by examining the validity of the identified SPF news shocks as anticipated structural shocks to government spending. Following this, we discuss the impulse response functions of macro aggregates to an identified SPF news shock to study the macroeconomic effects of anticipated government spending shocks. Lastly, we provide results on the government spending multiplier, estimated using the impulse response functions of GDP and government spending to the SPF news shock.

[12] Our MFEV identification strategy is similar in spirit to Ben Zeev and Pappa's (2017) MFEV approach to the identification of news shocks to defense spending.

[13] Based on our predictive power analysis in Section 2.1.2, the SPF news variable has no nowcasting power for government spending. However, its forecasting strength becomes apparent starting at the 4-quarter forecast horizon. Accordingly, we choose the 4-quarter truncation horizon as representative of the short-run truncation horizon. Additionally, choosing 16, 20, or 24 quarters as the medium truncation horizon produces almost identical results.

3.1 Validation of SPF News Shocks

In this subsection, we examine the validity of the identified SPF news shocks as structural shocks to future government spending. Additionally, we relate these news shocks to historical episodes that foresaw significant changes in government spending.

The structural VAR studies on news about future fundamentals (e.g., fiscal foresight and news about productivity) can be subject to the non-fundamentalness problem—see Blanchard et al. (2013) and Leeper et al. (2013), among others. This problem arises when a VAR model lacks sufficient information to recover economically meaningful structural shocks from reduced-form innovations. Consequently, such a VAR model can yield misleading results. Given the nature of our study, we also confront the non-fundamentalness issue. To address this issue formally, we employ the orthogonality *F*-test proposed by Forni and Gambetti (2014). The essence of this *F*-test is to assess whether the principal components, estimated from a comprehensive dataset encompassing nearly all available macroeconomic information, Granger cause the identified shocks of interest from a VAR model: the VAR model is informationally sufficient to recover the shocks of interest if and only if the null hypothesis of no Granger causality is not rejected.

Using the principal components that Forni and Gambetti (2014) estimate from a large set of U.S. macroeconomic variables, we apply their orthogonality *F*-test to a series of SPF news shocks identified by implementing our MFEV approach in the baseline VAR. In doing the *F*-test, the identified SPF news shocks are regressed on various combinations of the principal components with different numbers of their lags, as in Forni and Gambetti (2016).[14] Table 2 reports the *p*-values of all orthogonality *F*-tests considered; in the table, Panels A and B are the *F*-test results for SPF news shocks that are identified using the truncation horizon (H) of 4 quarters and 16 quarters, respectively. According to the entries in the table that exceed 10%, there is no evidence of information deficiency. Thus, the identified SPF news shocks are not likely to be affected by the non-fundamentalness problem.

To better understand the timing of the identified SPF news shocks, we investigate how their notable spikes and dips align with historical events that foresaw significant changes in government spending. Figure 1 depicts the sequence of SPF news shocks as identified using the MFEV approach in the baseline VAR with the truncation horizon of 4 quarters.[15] This sequence is juxtaposed with fiscal and geopolitical events that foresaw significant changes in U.S. government spending. As illustrated in

[14] Due to the availability of estimates of the principal components, the sample period used in the orthogonality *F*-test spans from 1981:Q3 to 2010:Q4.

[15] It is worth noting that both the truncation horizons of 4 and 16 quarters produce almost identical patterns in the point estimates of SPF news shocks. The correlation between these point estimates from the two truncation horizon values is 0.93.

Figure 1, many of the spikes and dips in the SPF news shock series align with historical events that affected expectations about future government spending without immediately changing the levels of government spending.

One of the most pronounced spikes in the early 1980s corresponds to the announcement of the Strategic Defense Initiative (SDI). In his March 1983 speech, commonly termed the "Star Wars" address, President Reagan appealed to the scientific community, stating, "I call upon the scientific community who gave us nuclear weapons to turn their great talents to the cause of mankind and world peace: to give us the means of rendering these nuclear weapons impotent and obsolete." This announcement signified the introduction of a missile defense system to protect the U.S. against potential Soviet nuclear weapon attacks. Over the subsequent decade, this vision materialized through major initiatives like the Strategic Defense Initiative Organization and the Global Protection Against Limited Strikes.

Building on this, the most prominent spike in the late 2000s is directly associated with the American Recovery and Reinvestment Act (ARRA) of 2009. In February 2009, responding to the severest economic downturn since the Great Depression, the U.S. Congress passed the $787 billion stimulus package. The Congressional Budget Office (2009) highlighted that the ARRA primarily focused on spending increases planned for implementation between fiscal years 2009 and 2014.

Numerous other discernible spikes in the SPF news shock series coincide with US-involved prewar periods. Notably, the series shows an uptick preceding the U.S. invasion of Panama in 1989:Q4 and the commencement of the Gulf War in 1991:Q1, mirroring the rising likelihood of U.S. military engagement as conflicts in these regions intensified. Similarly, in the late 1990s and early 2000s, the series exhibits pronounced spikes related to announcements of U.S. military interventions in areas such as Kosovo, Afghanistan, and the Persian Gulf.

Dips in the SPF news shock series correspond to periods when significant fiscal reforms, intended to curtail budget deficits, were unveiled. Specifically, the series displays a notable decline in 1985-86, coinciding with the signing of the Gramm-Rudman-Hollings Balanced Budget and Emergency Deficit Control Act. Another significant decrease aligns with the enactment of the Balanced Budget and Emergency Deficit Control Reaffirmation Act of 1987. While these declines are less distinct, specific periods around 2011 see the SPF news shock fall, synchronizing with the timeline of the Budget Control Act of 2011, which aimed to achieve at least $1.5 trillion in fiscal deficit reduction over ten years.

In summary, this analysis underscores that the identified SPF news shocks are well associated with fiscal and geopolitical events that foresaw significant changes in U.S. government spending.

3.2 The Macroeconomic Effects of SPF News Shocks

In this subsection, we examine the macroeconomic impact of anticipated government spending shocks by exploring the estimated impulse response functions to an SPF news shock. Figure 2 shows the impulse responses of all eight variables in the baseline VAR to the SPF news shock, identified using the truncation horizon (H) of 4 quarters (or 16 quarters). In the figure, the lines with circles (or the lines with triangles) represent OLS point estimates of the impulse responses, and the shaded areas (or the dash-lined areas) indicate two-standard-error confidence intervals. These confidence intervals are based on 1,000 replications from the residual-based moving block bootstrap with the block length of 20 quarters.[16] The shock is normalized so that the peak response of government spending is equal to one. Figure 3 displays the impulse responses of the individual components of consumption and investment, hours, real wages, and inflation to the SPF news shock, identified using each of the two truncation horizon values.

The impulse responses to the SPF news shock, as depicted in Figures 2 and 3, exhibit quite similar patterns across the two different values of the truncation horizon. Nevertheless, there are subtle differences in response timing and persistence between the impulse responses estimated using the two truncation horizon values. For instance, when using the 16-quarter truncation horizon, both the expansion in government spending and the permanent increase in government debt are more delayed compared to using the 4-quarter truncation horizon. Additionally, the increases in GDP, consumption, and investment appear more persistent. Considering these similarities and nuanced differences in impulse responses across the two truncation horizon values, the ensuing discussions will focus primarily on the impulse responses estimated using the 4-quarter truncation horizon.

3.2.1 Impulse Responses of GDP Components, Hours and Real Wages

As shown in Figure 2, following a positive SPF news shock, government spending rises with a delay, which is a defining feature of the dynamics of government spending in response to anticipated government spending shocks. This pattern of the government spending expansion is more delayed and persistent than what is documented in Ramey (2011) and Ben Zeev and Pappa (2017). The government spending response peaks about 18 quarters following the SPF news shock and remains significantly

[16] The referee points out that the recursive-design or fixed-design wild bootstrap (WB), as suggested by Gonçalves and Kilian (2004, 2007), may not be appropriate for making correct inferences on impulse response functions. This concern is based on the study of Brüggemann et al. (2016), which shows that the WB does not lead to asymptotically valid inference on (functions of) the variance-covariance matrix of a VAR model, whereas the residual-based moving block bootstrap (MBB) does. For this reason, we employ the MBB in our study, as suggested in Brüggemann et al. Furthermore, our results regarding the confidence intervals remain robust when using different block lengths, such as 4, 8, 12, or 16 quarters.

above zero even at the horizon of 24 quarters. In contrast, both aforementioned studies report that government spending peaks around 6 quarters after their respective defense news shocks, with its convergence setting in by the horizon of 16 quarters.[17] Thus, our SPF news shocks have a more persistent impact than the defense news shocks identified by both Ramey and Ben Zeev and Pappa. This disparity in shock persistence is important for understanding the macroeconomic consequences of our SPF news shocks. For instance, highly persistent SPF news shocks are likely to increase investment, in accordance with the predictions of neoclassical models such as Aiyagari et al. (1992) and Baxter and King (1993). Consequently, as detailed below, our SPF news shocks produce distinct dynamics of macro aggregates, compared to findings from earlier studies on anticipated government spending shocks.

In response to a positive SPF news shock, GDP rises instantly, peaking at the horizon of around 4 quarters before gradually converging to its initial level. This strong short-run expansion in output occurs well before the full phase-in of the government spending expansion. Aa a result, the initial boost in output is primarily driven by increases in consumption and investment, as depicted in Figure 2. The figure shows that consumption rises quickly, reaching its peak 2 quarters after the shock. This surge in consumption persists, remaining statistically different from zero for nearly 20 quarters. While not statistically significant, investment also increases with its peak at the horizon of around 5 quarters. According to theoretical studies, the persistence of government spending shocks plays a crucial role in determining the dynamics of investment: more persistent expansions in government spending make the marginal product of capital higher, thereby leading to more investment. Our finding of the increase in investment is in line with this theoretical prediction. All things considered, the responses of consumption and investment in our results suggest that the delayed expansion in government spending, induced by SPF news shocks, crowds in private spending, which accounts for a substantial output expansion in the short run.

We now delve into the sources of the increases in consumption and investment by examining the responses of their respective components, as shown in Figure 3. Following a positive SPF news shock, nondurable consumption rises quickly and remains statistically significant even at the horizon of 24 quarters. Meanwhile, consumption expenditures on services rise gradually with their peak at the horizon of 16 quarters and then return to their initial level. These response patterns indicate that the expansion in consumption over time is attributed to both nondurable consumption and consumption expenditures on services, but the short-run increase in consumption is predominantly driven by nondurable

[17] Ben Zeev and Pappa (2017) concentrate on news shocks related to defense spending, excluding a broader analysis of aggregate government spending. Nonetheless, Ramey (2016) shows that the total government spending response is very similar between Ben Zeev and Pappa's (2017) defense news shocks and Ramey's (2011) defense news shocks.

consumption.

Regarding the responses of investment components following the SPF news shock, durable consumption rises, peaking at 4 quarters, before gradually converging to its initial level. Nonresidential investment exhibits a strong increase, reaching its peak at 6 quarters, and then returns to zero in subsequent periods. On the other hand, residential investment remains unchanged for the first three years. Of all three components, the response of nonresidential investment to SPF news shocks stands out in terms of both magnitude and statistical significance. It is worth noting that this strong positive response contrasts sharply with the substantial negative response of nonresidential investment to defense news shocks, as identified by both Ramey (2011) and Ben Zeev and Pappa (2017)—further detailed in Ramey (2016). Taken together, the increase in overall investment following the SPF news shock is primarily driven by the surge in nonresidential investment.[18] Importantly, the observed short-run surge in nonresidential investment in our findings might suggest an investment accelerator effect, where anticipated expansions in government spending prompt private firms to increase their spending on capital goods in advance, preparing to meet the expected rise in public demand.

Lastly, we turn to the impulse responses of hours worked and real wages, as shown in Figure 3. Following a positive SPF news shock, hours appear to increase for almost the first 8 quarters, but fall significantly below their initial level in subsequent periods.[19] Real wages rise strongly and persistently, exhibiting a hump-shaped response over all horizons.

In summary, our analysis reveals that anticipated expansions in government spending, induced by SPF news shocks, are associated with increases in consumption, investment, real wages, as well as in output and hours. In particular, the patterns of the responses of consumption and real wages to a government spending shock play a pivotal role in distinguishing between different economic models. Ramey (2011) documents declines in both consumption and real wages in response to her defense news shock, which is consistent with the predictions of neoclassical models. On the other hand, our results align with the predictions of New Keynesian models with some special features, for instance, hand-to-mouth (liquidity-constrained or rule-of-thumb) consumers. The presence of hand-to-mouth consumers

[18] We employed the common GDP deflator to convert nominal NIPA variables into real terms, as detailed in Section 2.1.1. This method does not account for specific price movements in durable consumption, nonresidential investment, and residential investment, especially when contrasted with price changes in other GDP components. However, when we applied individual price deflators to these three components of investment and estimated their impulse responses, our findings regarding the responses of investment and its three components were consistent, irrespective of the deflator used.

[19] Beyond total hours worked, we also examined key labor market variables, including the unemployment rate, job finding and separation rates, and job vacancies. All these variables exhibit a similar pattern to that of total hours worked, with each showing a significant sign change around 8 quarters after the SPF news shock. For instance, the unemployment rate stays below its initial level for the first 8 quarters and subsequently remains significantly above it. We believe that this puzzling pattern in the responses of labor market variables deserves further investigation. A potential explanation for this puzzling response can be sought in Section 4.2, where we document that SPF news shocks are associated with the increase in the government investment-consumption ratio and the increase in private sector productivity. For a more detailed analysis, see Footnote 32 in Section 4.2.

attenuates the negative wealth effect of a government spending expansion, the mechanism explored in Galí et al. (2007). With sticky prices, firms respond to an increase in government spending by raising production rather than prices, thereby causing labor demand to rise. If higher labor demand dominates the increase in work efforts caused by the negative wealth effect, real wages can rise, supporting higher consumption. This channel is well documented in the recent work by Leeper et al. (2017).

3.2.2 Impulse Responses of Inflation, Nominal Interest Rate, Tax Rate and Government Debt

We now explore the effects of SPF news shocks on the inflation rate, the nominal interest rate, the tax rate, and government debt. As shown in Figure 3, following a positive SPF news shock, inflation increases instantly and then converges to its initial level. The increase in inflation is also found in Ramey (2011) and Ben Zeev and Pappa (2017). Turning to the interest rate in Figure 2, it rises quickly and strongly in response to the SPF news shock, exhibiting a hump-shaped response. While this response contrasts with the decline in the short-term rate in Ramey (2011), it is consistent with its strong increase in Ben Zeev and Pappa (2017). One potential rationale for the rise in the short-term rate might be tied to the Federal Reserve's dual mandate of maximum sustainable employment and price stability, which has been established since the early 1980s. As observed earlier, both GDP and inflation rise in response to the SPF news shock. Given its dual mandate, the Fed raises the short-term rate in response to these increases in GDP and inflation. It is noteworthy that our measure of GDP is GDP divided by potential GDP, meaning that a positive response of GDP signifies an increase in the output gap. Consequently, our findings shed light on the coordination between fiscal and monetary policies during our post-1981 sample period. Specifically, policies regarding anticipated government spending expansions have not typically been paired with an accommodative monetary policy. The notable exception is the Great Recession, characterized by large stimulus packages and low interest rates.[20]

Turning to the responses of the tax rate and government debt, as illustrated in Figure 2, we find that SPF news shocks are associated with a substantial decrease in the tax rate and a permanent increase in government debt. Following a positive SPF news shock, the tax rate does not change significantly for almost the first 5 quarters, but then declines substantially in subsequent periods. Meanwhile, government debt barely moves for almost the first 9 quarters, and in subsequent periods rises significantly toward its new long-run level.[21] These results are consonant with the deficit-financed

[20] Our results are robust to the sample period excluding the Great Recession.
[21] The robustness of the result regarding the response of government debt holds even when excluding the post-2008 period. During this period, government debt-measured as federal debt held by the public as a fraction of GDP—rose substantially from

policy scenario that the theoretical literature on government spending typically posits. It is important to note our finding of the decline in the tax rate. This does not necessarily provide strong support for the tax cut policy since our measure of the tax rate is the average tax rate, simply defined as federal current receipts divided by nominal GDP. Its response is likely to reflect the strong GDP expansion induced by SPF news shocks. Thus, we will make a further investigation on the response of taxes in Section 4.1.

In brief, our findings indicate that anticipated expansions in government spending, induced by SPF news shocks, are associated with increases in inflation and the short-term interest rate and the decline in the average tax rate accompanied by a permanent increase in government debt.

3.2.3 Forecast Error Variance Decomposition of Key Macro Aggregates

We turn our attention to the forecast error variance decomposition to examine how much variations of key macro aggregates are accounted for by SPF news shocks. Table 3 reports the share of the forecast error variance (FEV) of each of government spending, GDP, consumption, and investment attributable to SPF news shocks at various horizons. In the table, Panels A and B present the FEV results when SPF news shocks are identified using the truncation horizon of 4 and 16 quarters, respectively. Note that due to the orthogonality restriction on current government spending, the FEV share of government spending on impact is void.

We first focus on the FEV results when the truncation horizon of 4 quarters is used, as shown in Panel A of Table 3. SPF news shocks account for around 30% to 35% of the FEV of government spending over a three-to-five-year medium horizon; for instance, its FEV share is about 35% at 20 quarters. This result is comparable to the findings in Ramey (2016), where the defense news shocks identified by both Ramey (2011) and Ben Zeev and Pappa (2017) explain approximately 46% and 30% of the FEV of government spending over the same medium horizon, respectively. With respect to the FEVs of GDP and consumption, SPF news shocks account for around 6% of GDP variations and about 17% of consumption variations at medium horizons. For investment, however, the contribution of SPF news shocks to its FEV is more limited, with a maximum share of around 3% at 8 quarters.

When compared to the FEV shares attributed to the SPF news shocks identified using the 4-quarter truncation horizon, the SPF news shocks identified using the 16-quarter truncation horizon explain larger FEVs for all four variables at medium horizons. Specifically, the FEV share of government spending at 20 quarters increases from approximately 35% to 42%. Meanwhile, the FEV shares of GDP, consumption, and investment nearly double at three-to-five-year medium horizons. Interestingly, the

36% in 2008:Q1 to 77% in 2018:Q4.

FEV shares of government spending, output, and investment attributable to SPF news shocks identified with the 16-quarter truncation horizon closely match those attributable to Ben Zeev and Pappa's (2017) defense news shocks. These defense news shocks are identified employing the MFEV methodology over a five-year truncation horizon. However, even accounting for these larger FEV shares, our results still suggest that SPF news shocks are unlikely to be a major source of business cycle fluctuations.

3.3 Government Spending Multipliers

The size of the government spending multiplier is at the crux of the policy and academic debate about the efficacy of fiscal stimulus. In this section, we estimate government spending multipliers associated with SPF news shocks by taking the integral multiplier approach.[22] In our VAR specification, the integral multiplier at a given horizon h is calculated as the ratio of the sum of the responses of GDP over the h horizon to the sum of the responses of government spending over the h horizon:

$$\text{Integral multiplier } (h) = \frac{\sum_{j=0}^{h} IRF_Y(j)}{\sum_{j=0}^{h} IRF_G(j)}, \qquad (3)$$

where $IRF_Y(j)$ and $IRF_G(j)$ are the estimated impulse responses of GDP and government spending in the baseline VAR at horizon j, respectively. Note that the Gordon-Krenn (2010) transformed NIPA variables enter the VAR model in levels, so that the impulse responses of GDP and government spending are measured in level changes, not in percentage changes.

Table 4 reports estimates of integral multipliers at various horizons in quarters, when SPF news shocks are identified using either a 4-quarter or a 16-quarter truncation horizon. It is important to note that, due to our identification assumption, the impact response of government spending is set to zero. As a result, the impact multiplier is not available. According to point estimates of multipliers in the table, SPF news shocks produce somewhat large multipliers at the first three-year horizons. In the case of the truncation horizon of 4 quarters, the multipliers at 4, 8, and 12 quarters are 6.85, 3.97, and 2.54, respectively. This is because GDP rises immediately with its peak at 4 quarters in response to the SPF news shock, whereas government spending starts rising with a delay of around 4 quarters and gradually reaches its peak at 18 quarters after the shock. The corresponding multipliers are even bigger in the case of the truncation horizon of 16 quarters—the multipliers at 4, 8 and 12 quarters are 12.26, 6.47, and 3.73, respectively.[23] This is because the government spending expansion induced by SPF news shocks

[22] Another prominent way of estimating multipliers is to calculate the ratio of the peak response of output to the impact response of government spending, often referred to as impact multipliers. Ramey (2016), however, illustrates how impact multipliers can be biased.

[23] The reported standard errors suggest that the point estimates lack the precision necessary to reject the null hypothesis of a

is more delayed in the case of the truncation horizon of 16 quarters, while the increase in GDP over the first three-year horizon is closely comparable across the two values of the truncation horizon, as shown in Figure 2.

At subsequent horizons, however, the multiplier becomes smaller. For instance, in the case of the truncation horizon of 4 quarters, the multipliers at 16, 20, and 24 quarters are 1.89, 1.55, and 1.32, respectively. This decline occurs since the convergence of GDP begins around 16 quarters after the SPF news shock, while the response of government spending remains quite persistent, even over the 24-quarter horizon. Consequently, the estimates of multipliers at medium horizons become close to unit.

The magnitude of our estimated multipliers associated with SPF news shocks exceeds those presented in earlier studies. For example, Ramey (2016) documents that the multipliers associated with her defense news shocks are below unity across all five-year horizons, except for the 4-quarter horizon. The relatively low estimates in her study arise from a notable decline in private consumption and investment following her defense news shock.[24] Hence, a surge in private spending is crucial for multipliers to surpass unity.

4 Further Investigations

4.1 Alternative Measures of the Tax Rate

In this section, we further investigate the impulse response of the tax rate to better grasp the tax policy associated with SPF news shocks. As shown in Figure 2 and detailed in Section 3.2.2, the average tax rate (denoted as baseline ATR)—defined as federal current receipts divided by nominal GDP—declines significantly following a positive SPF news shock. Yet, this decline does not inherently endorse the tax cut policy, especially since this tax rate can, by its definition, move alongside GDP. Thus, by using different measures of the tax rate, we aim to provide a deeper insight into the tax policy associated with SPF news shocks.

As a measure of the marginal tax rate, we use Barro and Redlick's (2011) average marginal tax rate (denoted as BR's AMTR). As alternative measures of the average tax rate, we consider Fernández-Villaverde, Guerrón-Quintana, Kuester and Rubio-Ramírez's (2015) average tax rates (denoted as

multiplier being equal to one at the 90 percent confidence level.

[24] For comparative purposes, we estimated the impulse responses to Ramey's (2011) defense news shock by using two approaches within our empirical framework: the VAR recursive identification and the Jordà (2005) local projection. These estimated impulse responses are available upon request. In computing integral multipliers associated with Ramey's defense news shocks identified within our VAR framework, we found that our multiplier estimates are quite similar in magnitude to those reported in Ramey (2016, Table 4 in Section 4.1.3), which were obtained using an instrumental variables estimation.

FGKR's ATRs) on personal income, labor income, capital income, and consumption at all levels of government (federal, state, and local). These FGKR's ATRs are constructed using the national income and product accounts data. Note that due to the availability of the BR's AMTR series, the sample period used in this section spans from 1981:Q3 to 2013:Q4. At a quarterly frequency and in levels, the correlations between the baseline ATR and FGKR's ATRs on personal income, labor income, and capital income are 0.90, 0.90, and 0.74, respectively. In comparison, the correlations between the baseline ATR and FGKR's ATR on consumption, as well as BR's AMTR, are 0.47 and 0.35, respectively. These results indicate that the baseline ATR is strongly correlated with FGKR's ATRs on personal income, labor income, and capital income, but has a somewhat weaker correlation with FGKR's ATR on consumption and BR's AMTR.

Figure 4 displays the impulse responses of six distinct tax rate measures to a positive SPF news shock.[25] The figure indicates that while all five average tax rates decline in response to the SPF news shock, BR's AMTR initially drops and then rises significantly. We first discuss the responses of the average tax rates in detail. Given the definition of the baseline ATR, its decline is likely driven by the GDP expansion induced by SPF news shocks. In contrast, FGKR's ATRs are less likely to exhibit a mechanical decline in response to the SPF news shock. For instance, let us consider FGKR's ATR on personal income, denoted as τ^p. This rate is defined as $\tau^p = PIT/(WSA + PRI + CI)$, where the numerator (*PIT*) represents federal, state, and local taxes on personal income and the denominator consists of wage and salary accruals (*WSA*), proprietor's income (*PRI*), and capital income (*CI*). Furthermore, capital income (*CI=RI+CP+NI*) is the sum of rental income (*RI*), corporate profits (*CP*), and interest income (*NI*). During the output expansion induced by SPF news shocks, an increase in the numerator of τ^p might outweigh a corresponding rise in its denominator, or vice versa. Consequently, there is not a clear reason to expect FGKR's ATR on personal income (τ^p) to either decrease or increase in response to the SPF news shock. This is also true of other FGKR's ATRs on labor income, capital income, and consumption. Given the consistent declining responses across all five average tax rate measures, the decline in the baseline ATR is unlikely to be simply a mechanical result of the strong expansion in GDP induced by SPF news shocks.

In her study, Ramey (2016) uses the baseline ATR as a measure of the tax rate and shows that both the baseline ATR and GDP increase strongly following her defense news shocks.[26] Generally, the

[25] To obtain the impulse responses of BR's AMTR and the four FGKR's ATRs to an SPF news shock, we replace the baseline ATR in the baseline VAR model with each of these five tax rates one at a time, and estimate the resulting VAR model.
[26] As documented in the online appendix, we identified Ramey (2011)'s defense news shocks within our VAR framework and showed that the baseline ATR increases immediately and strongly in response to her defense news shock.

baseline ATR rises because higher GDP pushes more households into higher tax brackets, more progressive tax legislation is implemented, or both come into play. Both Ramey's defense news shocks and our SPF news shocks induce immediate and substantial increases in GDP, pushing more households into higher tax brackets and consequently raising tax revenues. Accounting for this consistent effect across the two news shocks, tax legislation emerges as crucial in differentiating the baseline ATR responses between these two shocks. This viewpoint finds support in the work of Ferriere and Navarro (2018), who explore the relationship between U.S. tax reforms and the progressivity of the U.S. federal tax system.

Ferriere and Navarro develop a measure of U.S. federal tax progressivity. They find that most variations in this measure are directly associated with tax reforms and political events, rather than economic conditions. Importantly, U.S. tax reforms were significantly more progressive prior to the early 1980s. Many of these progressive reforms were linked to major military events. For instance, very high top marginal tax rates were introduced during the 1950s and 1960s to finance the Korean and Vietnam Wars. In contrast, the post-early 1980s era, notably during the Reagan administration, witnessed major tax cuts. The Economic Recovery Tax Act of 1981 and the Tax Reform Act of 1986 drastically reduced top marginal tax rates, first from 70% down to 50% and then further down to 28%. These reductions resulted in a significant decrease in the overall progressivity of the U.S. federal tax system.

In the post-1990 era, two legislative acts aimed to bolster tax progressivity: the Omnibus Budget Reconciliation Act (OBRA) of 1990 under George H.W. Bush and the 1993 OBRA during Clinton's tenure. These two acts raised top marginal tax rates and introduced two higher tax brackets, respectively. When viewed historically, however, their impact on tax progressivity was modest. In stark contrast, tax reforms under George W. Bush in 2001 and 2003, as well as those during Obama's tenure in 2009 and 2010, reduced tax progressivity. Notably, the onset of the Iraq War in 2003 did not lead to significant tax reforms. This marked the first instance in U.S. history where a major military expenditure was permanently financed by increasing deficits.

Building upon the comprehensive analysis by Ferriere and Navarro (2018) regarding U.S. tax reforms and progressivity, we establish clear relationships between the progressive nature of tax reforms and both Ramey's defense news shocks and our SPF news shocks. Specifically, Ramey's defense news shocks, which are predominantly relevant before the 1980s, are associated with significant increases in tax progressivity, primarily to finance major military events. In contrast, our SPF news shocks, identified from the post-1981 sample, are tied to pronounced declines or only modest increases in tax

progressivity. To further illustrate this point, as outlined in Section 3.1, the two most salient peaks in our series of identified SPF news shocks align with the proclamation of the Strategic Defense Initiative in 1983 and the American Recovery and Reinvestment Act of 2009. These events correspond to tax reforms during the Reagan and Obama tenures, respectively, both of which contributed to a diminishing tax progressivity. These relationships are supportive of the observed response of the baseline average tax rate (ATR): it rises in response to Ramey's defense news shocks but exhibits a decline following our SPF news shocks. Thus, the consistent decrease observed across all our average tax rate measures following the SPF news shock likely reflects post-1981 tax policies aiming to reduce the overall progressivity of the U.S. federal tax system.

We now turn to the response of Barro and Redlick's average marginal tax rate (BR's AMTR) to the SPF news shock. As shown in Figure 4, BR's AMTR exhibits a notable initial decline, followed by a significant rise.[27] This response pattern can be rationalized as follows: BR's AMTR decreases in response to the SPF news shock due to the prevalence of less progressive tax reforms implemented during the post-1980 period. However, its significant increase is observed a year after the shock, a phenomenon attributable to the GDP surge induced by the shock, which consequently pushes more households into higher tax brackets.

In summary, while the responses of all five average tax rate measures to the SPF news shock differ markedly from the response of the marginal tax rate measure, they all align with the tax reforms predominant in our post-1981 sample period that reduced the overall progressivity of the U.S. federal tax system.

4.2 Other Types of News

In this section, we conduct robustness checks to see whether SPF news shocks to government spending are related to other types of news. To do this, we first replace the investment variable in our baseline VAR with Ramey's (2011) defense news variable, which is well-known to have a predictive content for changes in government spending caused by large military events, and then identify SPF news shocks in the resulting VAR. In Figure 5, we present the impulse response of Ramey's defense news variable to an SPF news shock. Alongside this, the figure also displays the impulse responses of consumer confidence, stock prices, total factor productivity (TFP), and the ratio of government gross investment to government consumption expenditures to an SPF news shock, which will be discussed soon.[28] In the

[27] It is noteworthy that, as documented in Ramey (2011), BR's AMTR exhibits an immediate and strong increase in response to her defense news shock, peaking at 4 quarters after the shock.
[28] Each of these impulse responses is estimated in our baseline VAR with the corresponding variable in place of investment.

figure, the response of Ramey's defense news variable to the SPF news shock is statistically insignificant at all horizons. This finding suggests that the information content of our SPF news shocks is distinct from that of Ramey's defense news variable.

Although the SPF news variable is constructed using professional forecasters' forecasts of government spending, it may generally contain information about future economic conditions other than solely government spending. For instance, it could encompass news about future technological developments and demographic trends. Consequently, identified SPF news shocks could be confounded by other types of news shocks. To further examine this potential confounding, we explore the responses of consumer confidence and stock prices to the SPF news shock. Both stock prices and consumer confidence are viewed as good indicators for capturing changes in economic agents' expectations about future fundamentals—see Beaudry and Portier (2006) and Barsky and Sims (2011), among others. Figure 5 shows the impulse responses of consumer confidence and stock prices to the SPF news shock.[29] Following a positive SPF news shock, consumer confidence barely changes on impact, and then appears to increase for a year horizon. Such an increase, however, is not statistically significant. Stock prices do not change on impact and then fall gradually—their response is statistically insignificant over the first three-year horizon. These results suggest that the identified SPF news shocks are unlikely to be plagued by news about future economic conditions other than government spending.

Nevertheless, we further investigate whether SPF news shocks might capture effects of news about future productivity. Accordingly, we use Fernald's (2014) factor-utilization-adjusted TFP series to estimate the impulse response of TFP to an SPF news shock. In this case, we make an additional assumption that news shocks to government spending do not have an immediate impact on TFP. Thus, SPF news shocks are identified as the shocks, restricted to be orthogonal to current TFP as well as current government spending, that best explain the forecast error variance of the SPF news variable over the truncation horizon. As shown in Figure 5, following a positive SPF news shock, TFP rises with a delay of about 4 quarters, peaks 10 quarters after the shock, and converges to its initial level in subsequent horizons. This hump-shaped response is statistically significant especially at middle horizons. This result may suggest that SPF news shocks to government spending capture the effects of TFP news shocks.

On the other hand, rather than capturing the effects of TFP news shocks, the estimated response of TFP may indicate that government spending shocks increase productivity in the private sector, as in

[29] Consumer confidence is measured by the Michigan Survey index of consumer expectations about economic conditions over the next year. Stock prices are defined as the logarithm of per capita real S&P 500 index.

neoclassical growth models in which government investment becomes productive public capital and thus raises the productivity of private inputs—see Baxter and King (1993) and Leeper et al. (2010), among others. To explore this potential link between productive public capital and private sector productivity, we estimate the impulse response of the ratio of government gross investment to government consumption expenditures to an SPF news shock.[30] For this ratio, we consider both types of government spending: total (federal plus state and local) and solely federal. As shown in Figure 5, the government investment-consumption ratio increases significantly in response to a positive SPF news shock. More importantly, when compared to the impulse response of TFP, the government investment-consumption ratio rises more quickly.[31] This finding suggests that productive public spending has a delayed stimulative effect on private sector productivity.[32] It is also consistent with Bachmann and Sims (2012), who show that surprise shocks to government spending are geared more toward public investment during recession periods than during expansionary periods, thereby stimulating private sector productivity, and in turn, increasing output.

Previous empirical studies on TFP news shocks, including those by Beaudry and Portier (2006), Barsky and Sims (2011), and Beaudry, Nam, and Wang (2011), have consistently documented immediate and strong increases in both stock prices and consumer confidence in response to TFP news shocks. In contrast, as detailed earlier, SPF news shocks to government spending have little impact on these two variables in the short run and induce significant increases in government investment relative to government consumption. It is important to note that the government investment-consumption ratio is found to decline immediately and substantially in response to TFP news shocks. As a result, our finding of a delayed increase in TFP following the SPF news shock is viewed as evidence that SPF news shocks increase productivity in the private sector, rather than being confounded by TFP news shocks.

To ensure that the identified SPF news shocks are not contaminated by TFP news shocks, we conduct an exogeneity test. To this end, we identify TFP news shocks using the max-share approach as in

[30] Given that SPF news shocks are assumed not to have a contemporaneous impact on government spending, we impose the orthogonality restriction with respect to both the government investment-consumption ratio and government spending when employing the MFEV methodology.

[31] The responses of TFP and the government investment-consumption ratio to SPF news shocks remain robust, even when identifying SPF news shocks in a VAR that includes both variables simultaneously.

[32] It is noteworthy that this finding can offer a potential explanation for our puzzling finding of the decline in hours below their initial level, starting 8 quarters after the SPF news shock, as shown in Figure 3, detailed in Section 3.2.1, and further noted in Footnote 19. Based on our estimated responses of the four variables—the government investment-consumption ratio, TFP, hours, and GDP—we see that government investment rises shortly after the SPF news shock, which consequently triggers a significant increase in TFP approximately 8 quarters after the shock. This surge in TFP has a positive wealth effect that dominates the labor demand effect, and thus initiates a decline in hours below their initial level at around the 8-quarter horizon following the shock. Despite the reduction in hours, GDP converges back to its initial level in the subsequent periods, which is largely attributable to the enhancement in TFP.

Beaudry, Nam, and Wang (2011). Having obtained the series of identified TFP news shocks, we regress identified SPF news shocks on various combinations of current and lagged identified TFP news shocks. We then perform an *F*-test on the coefficients of the identified TFP news shocks. Our results from this exogeneity test confirm that SPF news shocks are exogenous with respect to TFP news shocks.[33]

5 Conclusion

In this paper, we examined the macroeconomic effects of anticipated government spending expansions by employing the information content of the Survey of Professional Forecasters' forecasts for future government spending within a VAR framework. By using these forecasts, we first constructed a measure of news about future government spending. Then, by applying the maximum forecast error variance approach to this measure in VAR models, we identified what we denote as SPF news shocks to government spending.

According to our findings, the anticipated expansion in government spending, induced by SPF news shocks, is delayed and persistent. This expansion is associated with immediate and pronounced rises in both consumption and investment. Consequently, it crowds in private spending, leading to a short-run surge in output. Moreover, following the SPF news shock, both nondurable consumption and consumption expenditures on services rise, accounting for the increase in total consumption, while a substantial rise in nonresidential investment is the primary driver behind overall investment. Importantly, the surge in nonresidential investment underscores an investment accelerator effect: in anticipation of government spending expansions, private firms immediately increase their spending on capital goods in preparation for the expected rise in public demand. Additionally, our results show that SPF news shocks are associated with increases in real wages, hours worked, inflation, and the short-term interest rate, as well as a permanent increase in government debt.

Upon exploring various tax rate measures and revisiting the work by Ferriere and Navarro (2018) on the relationship between U.S. tax reforms and the progressivity of the U.S. federal tax system, we made an important observation. The less progressive tax reforms implemented after the early 1980s account for the distinct impulse responses of the average and marginal tax rates to the SPF news shock. Moreover, by analyzing the impulse responses of TFP and the government investment- consumption ratio to the SPF news shock, we found that SPF news shocks to government spending stimulate private sector productivity through the enhancement of productive public capital.

[33] The results from the exogeneity test are available upon request.

Our empirical finding of the increases in consumption and real wages is in line with the well- known predictions of New Keynesian models with some special features, for instance, the presence of rule-of-thumb consumers in Galí et al. (2007). These theoretical predictions are based on surprise shocks to government spending, not on news shocks. Therefore, it would be interesting to investigate whether theoretical models with those special features predict the increases in consumption and real wages in response to news shocks to government spending. We leave this issue for future research.

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Table 1: Forecasting Regressions for Changes in Government Spending

Panel A: ΔG_{t+h} is the change in total (federal plus state and local) government spending

	$h=0$		$h=4$		$h=8$		$h=16$		$h=24$	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
b_h^{spf}		0.024		0.126		0.239		0.323		0.284
NW: *t*-stat		4.68***		7.57***		11.56***		4.66***		3.08**
EWC: *t*-stat		3.51***		6.47***		11.89***		3.96***		2.69**
Adj. R^2	0.190	0.244	0.560	0.735	0.621	0.855	0.539	0.705	0.459	0.531

Panel B: ΔG_{t+h} is the change in federal government spending

	$h=0$		$h=4$		$h=8$		$h=16$		$h=24$	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
b_h^{spf}		0.033		0.128		0.226		0.324		0.309
NW: *t*-stat		7.22***		10.61***		22.02***		9.75***		6.31***
EWC: *t*-stat		5.61***		8.33***		19.06***		8.53***		6.00***
Adj. R^2	0.091	0.217	0.472	0.732	0.534	0.846	0.568	0.822	0.566	0.688

Panel C: ΔG_{t+h} is the change in defense spending

	$h=0$		$h=4$		$h=8$		$h=16$		$h=24$	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
b_h^{spf}		0.031		0.104		0.190		0.275		0.264
NW: *t*-stat		5.02***		8.63***		11.78***		9.55***		5.86***
EWC: *t*-stat		4.82***		8.05***		10.93***		9.12***		5.67***
Adj. R^2	0.195	0.314	0.579	0.768	0.600	0.836	0.603	0.787	0.556	0.647

Panel D: ΔG_{t+h} is the change in nondefense spending

	$h=0$		$h=4$		$h=8$		$h=16$		$h=24$	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
b_h^{spf}		0.002		0.011		0.022		0.022		0.018
NW: *t*-stat		0.80		1.35		2.24*		1.96*		1.87
EWC: *t*-stat		0.74		1.18		1.95*		1.89*		1.69
Adj. R^2	0.018	0.013	0.284	0.310	0.386	0.459	0.659	0.705	0.604	0.627

Note: This table presents the estimation results from the forecasting regression of Equation (1) at various forecast horizons in quarters (h) for four types of government spending: total (Panel A), federal (Panel B), defense (Panel C), and nondefense (Panel D). For each forecast horizon in each panel, Column (1) reports the result from the regression onto only four lags of X_t, presenting the adjusted R^2 (Adj. R^2). Meanwhile, Column (2) reports the result from the regression onto the SPF news variable as well as four lags of X_t, displaying the estimate of the coefficient on the SPF news variable (b_h^{spf}), its *t*-statistic (*t*-stat) obtained from both the Newey-West (NW) and equal-weighted cosine (EWC) heteroscedasticity-autocorrelation-robust (HAR) estimations, and the adjusted R^2 (Adj. R^2). Following Lazarus et al. (2018), we use the rule for the NW truncation parameter $S = 1.3T^{1/2}$ and the rule for the EWC cosine term number $\nu = 0.4T^{2/3}$, where T is the sample size. In the *t*-statistic, ***, **, * represent its significance at 1%, 5%, and 10% levels, respectively. This significance is based on fixed-*b* critical values for the *t*-statistic, obtained from simulations, in the NW HAR inference, and on *t*-statistic critical values from the Student *t* distribution in the EWC HAR inference.

Table 2: Non-Fundamentalness Test for Identified SPF News Shocks

Panel A: Truncation Horizon (H) = 4 Quarters

Lags in Principal Component	Principal Component						
	1	2	3	4	1 to 2	1 to 3	1 to 4
1	0.51	0.27	0.23	0.19	0.25	0.34	0.37
2	0.74	0.36	0.28	0.25	0.43	0.27	0.27
3	0.65	0.52	0.31	0.37	0.65	0.29	0.17
4	0.39	0.29	0.20	0.45	0.39	0.19	0.22

Panel B: Truncation Horizon (H) = 16 Quarters

Lags in Principal Component	Principal Component						
	1	2	3	4	1 to 2	1 to 3	1 to 4
1	0.47	0.40	0.37	0.21	0.41	0.62	0.72
2	0.54	0.57	0.22	0.48	0.48	0.34	0.33
3	0.34	0.46	0.36	0.64	0.51	0.37	0.30
4	0.27	0.19	0.34	0.70	0.31	0.21	0.19

Note: This table displays the results of the orthogonality F-test proposed by Forni and Gambetti (2014). Each entry denotes the p-value from this F-test for a regression of SPF news shocks on lags (1 to 4 lags) of the first difference of the i-th largest principal component (i = 1, 2, 3, 4) or on lags of the first differences of the principal components, ranging from the first largest (denoted by 1) to the j-th largest (j = 2, 3, 4). Panels A and B represent the F-test results associated with SPF news shocks identified using the truncation horizon (H) of 4 quarters and 16 quarters within the maximum forecast error variance approach, respectively.

Table 3: Forecast Error Variance Shares Attributable to SPF News Shocks

Panel A: Truncation Horizon (H) = 4 Quarters

Horizon	Government Spending	GDP	Consumption	Investment
0	0.00	0.59	1.08	1.22
	(0.00)	(1.73)	(2.35)	(1.65)
4	4.08	6.74	12.85	2.79
	(3.40)	(4.50)	(8.15)	(2.88)
8	14.64	8.37	17.86	3.28
	(6.87)	(5.20)	(8.68)	(4.05)
12	27.74	7.26	19.12	2.48
	(9.07)	(5.03)	(8.30)	(4.26)
16	34.43	6.26	17.94	1.96
	(9.59)	(4.93)	(8.04)	(4.10)
20	35.11	5.82	16.68	1.74
	(9.69)	(4.80)	(7.93)	(3.87)
24	32.74	5.58	15.69	1.74
	(9.96)	(4.66)	(7.79)	(3.80)

Panel B: Truncation Horizon (H) = 16 Quarters

Horizon	Government Spending	GDP	Consumption	Investment
0	0.00	0.14	7.33	1.08
	(0.00)	(2.77)	(5.76)	(2.29)
4	0.74	4.95	17.65	4.70
	(2.63)	(4.83)	(9.99)	(4.06)
8	6.58	9.11	22.56	6.98
	(5.82)	(6.00)	(10.34)	(5.47)
12	22.14	10.47	26.52	7.03
	(8.86)	(6.20)	(9.99)	(6.08)
16	35.50	11.00	27.66	6.74
	(10.18)	(6.57)	(9.87)	(6.36)
20	42.34	11.54	27.84	6.53
	(10.70)	(6.75)	(9.94)	(6.27)
24	44.28	11.68	27.60	6.28
	(11.11)	(6.68)	(9.94)	(6.05)

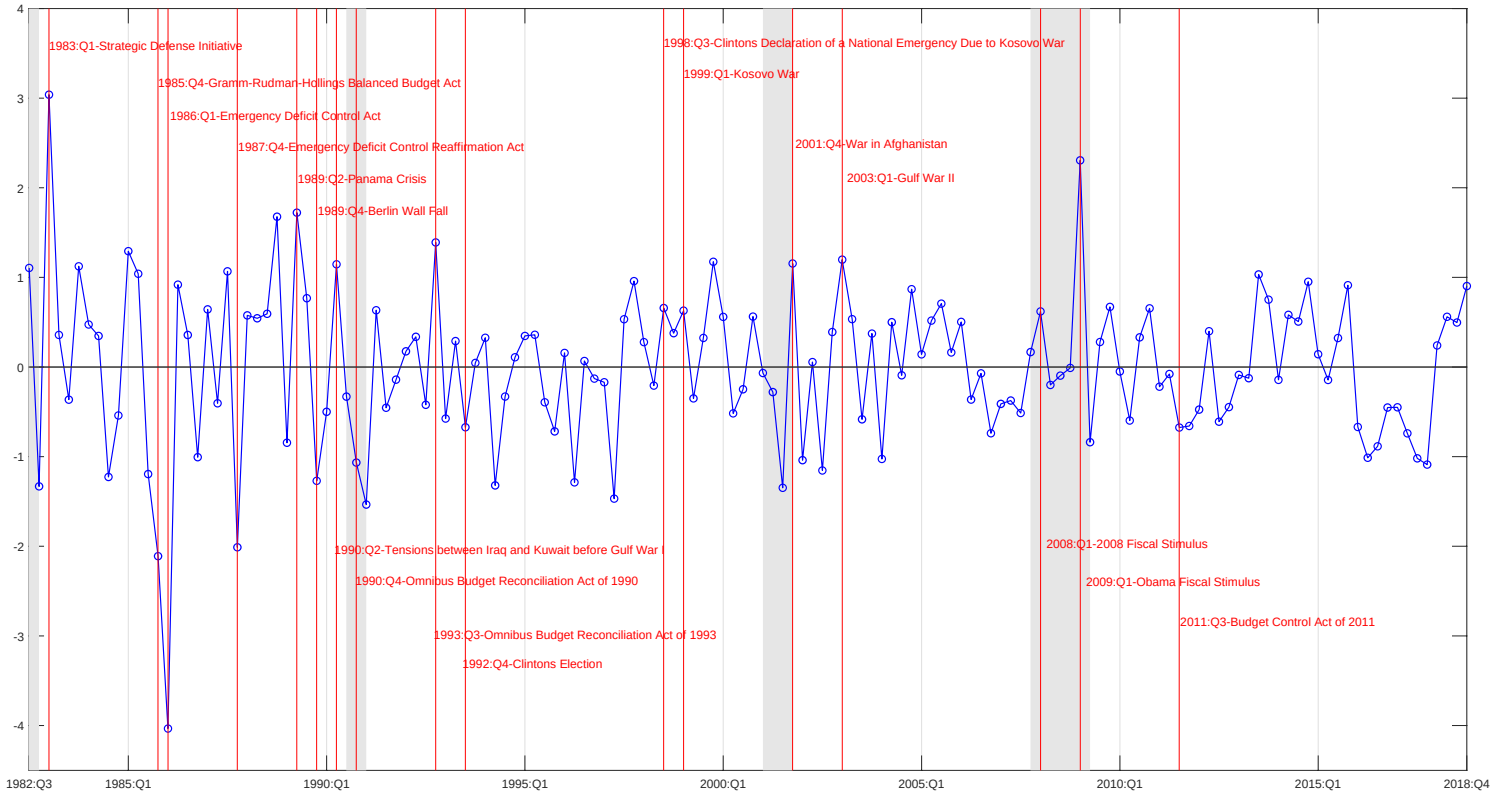
Note: This table reports OLS point estimates of forecast error variance shares attributable to SPF news shocks at various horizons in quarters, when SPF news shocks are identified using the truncation horizon (H) of 4 quarters (Panel A) or 16 quarters (Panel B) in the maximum forecast error variance approach. Numbers in parentheses are standard errors of the estimates, computed based on 1,000 replications from the residual-based moving block bootstrap with the block length of 20 quarters.

Table 4: Estimates of Government Spending Multipliers

Horizon	Truncation Horizon (H) = 4 Quarters	Truncation Horizon (H) = 16 Quarters
0	N/A (N/A)	N/A (N/A)
4	6.85 (11.86)	12.26 (32.53)
8	3.97 (4.18)	6.47 (12.19)
12	2.54 (1.61)	3.73 (3.39)
16	1.89 (1.05)	2.74 (1.28)
20	1.55 (0.85)	2.23 (0.91)
24	1.32 (0.74)	1.87 (0.73)

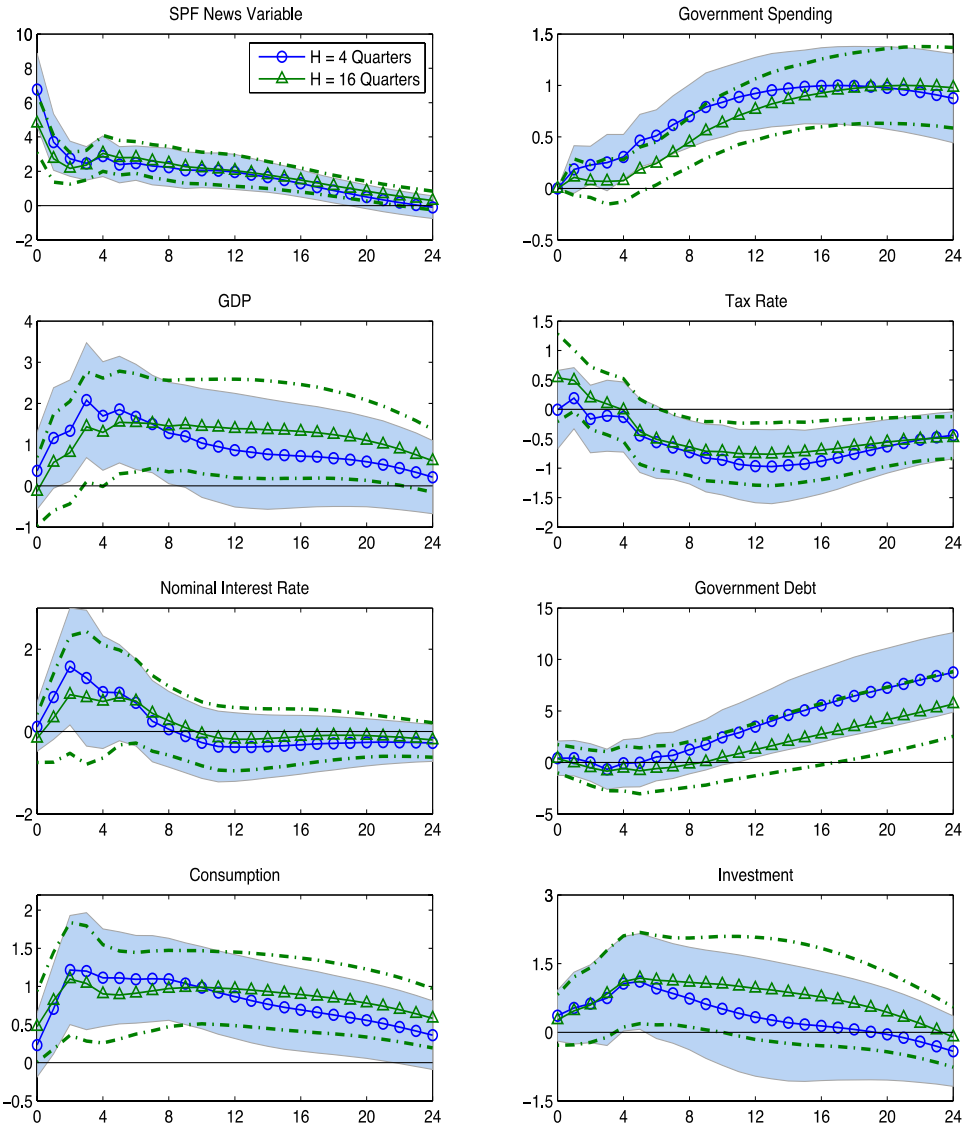
Note: This table presents OLS point estimates of integral government spending multipliers at various horizons in quarters, when SPF news shocks are identified using the truncation horizon (H) of 4 quarters or 16 quarters in the maximum forecast error variance approach. Numbers in parentheses are standard errors of the estimates, computed based on 1,000 replications from the residual-based moving block bootstrap with the block length of 20 quarters.

Figure 1: The Sequence of Identified SPF News Shocks



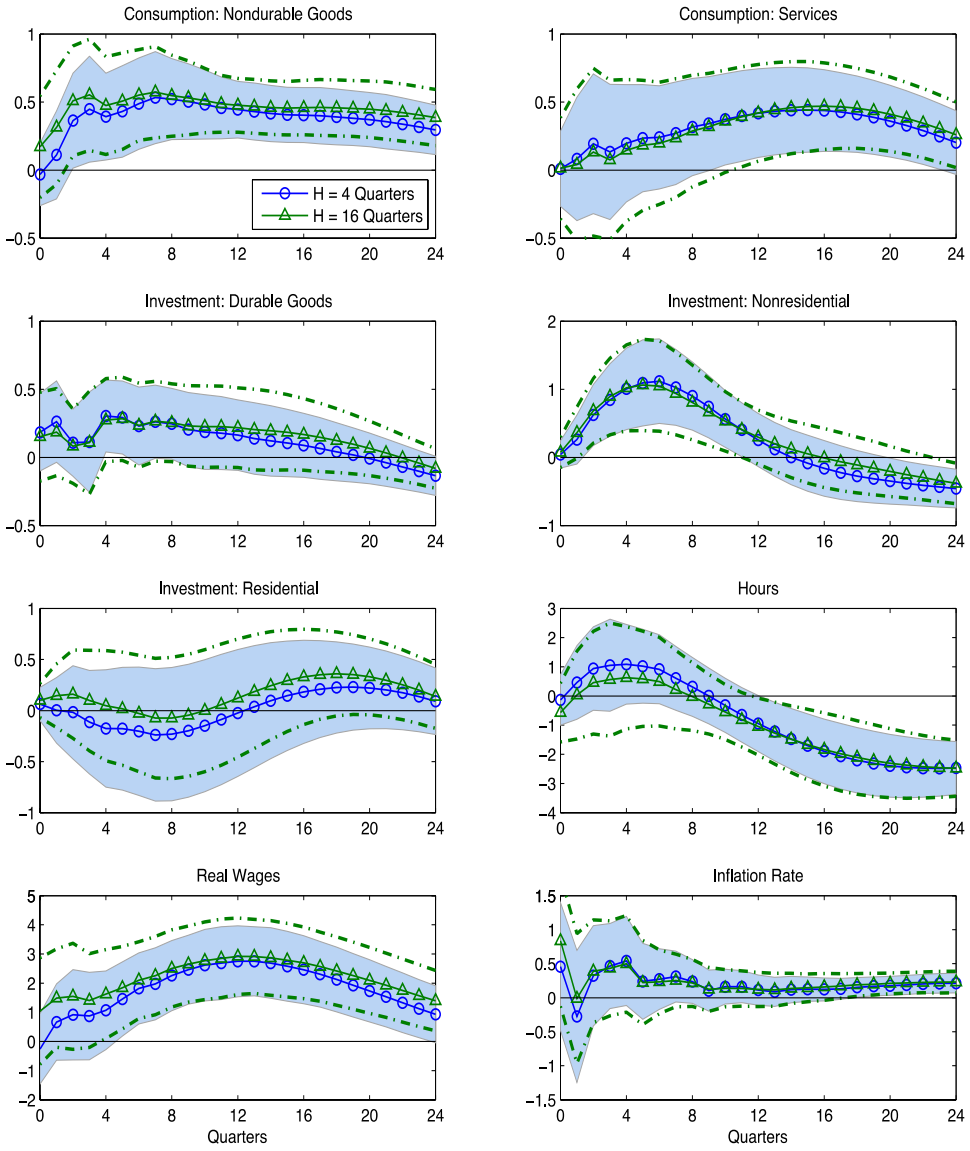
Note: This figure plots the sequence of the OLS point estimates of SPF news shocks that are identified by using the truncation horizon (H) of 4 quarters in the maximum forecast error variance approach. Vertical lines indicate the dates of fiscal and geopolitical episodes. Shaded areas represent NBER recession dates.

Figure 2: Impulse Responses to an SPF News Shock



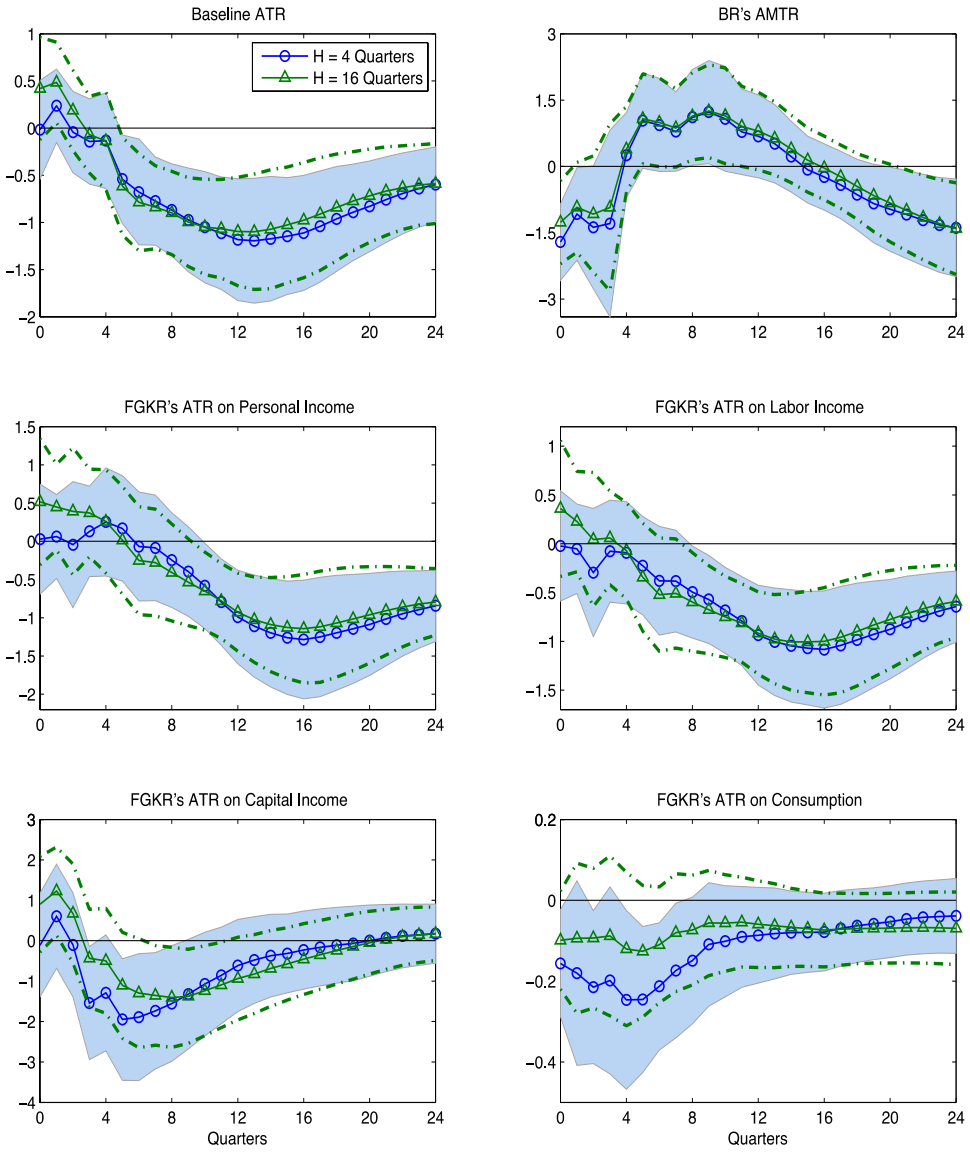
Note: This figure displays the impulse response functions of all eight variables in the baseline VAR model to a positive SPF news shock. SPF news shocks are identified using the truncation horizon (H) of 4 quarters (or 16 quarters) in the maximum forecast error variance approach. The lines with circles (or the lines with triangles) are the OLS point estimates, and the shaded areas (or the dash-lined areas) are the two-standard-error confidence intervals. These confidence intervals are calculated based on 1,000 replications from the residual-based moving block bootstrap with the block length of 20 quarters.

Figure 3: Impulse Responses to an SPF News Shock (continued)



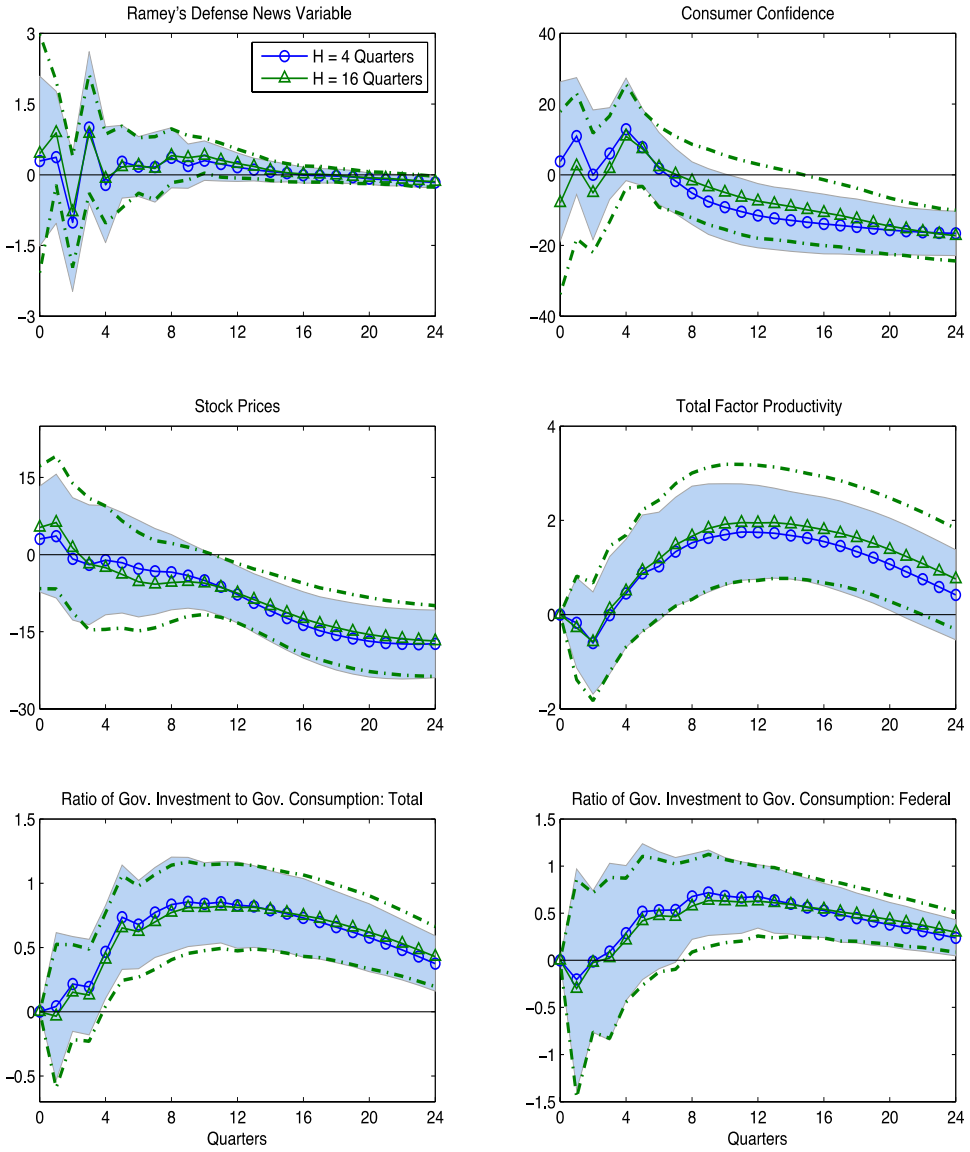
Note: This figure displays the impulse response functions of two components of consumption, three components of investment, total hours, real wages, and the inflation rate to a positive SPF news shock. See the note below Figure 2 for more details.

Figure 4: Impulse Responses of Different Tax Rate Measures to an SPF News Shock



Note: This figure displays the impulse response functions of six distinct measures of the tax rate to a positive SPF news shock. The baseline ATR represents the average tax rate as our baseline measure of the tax rate, defined as federal current receipts divided by nominal GDP. The BR's AMTR is Barro and Redlick's (2011) average marginal tax rate. Four FGKR's ATRs are Fernández-Villaverde, Guerrón-Quintana, Kuester and Rubio-Ramírez's (2015) average tax rates on personal income, labor income, capital income, and consumption. See the note below Figure 2 for more details.

Figure 5: Impulse Responses of Other Variables of Interest to an SPF News Shock



Note: This figure displays the impulse response functions of Ramey's (2011) defense news variable, consumer confidence, stock prices, total factor productivity, and the ratio of (total or federal) government gross investment to government consumption expenditures to a positive SPF news shock. See the note below Figure 2 for more details.