This vs That: The Economic Effects of Fiscal Spending Shifts

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Abstract

In this paper, we investigate how redistributing government spending across different spending categories influences the economy. An exogenous increase in spending on a component results in a change in total spending and also a shift in the distribution of spending. Our VAR model decomposes this composite shock into a level shock and a reallocation shock. This allows us to estimate the macroeconomic implications of redistributing spending between two components without a corresponding increase in total spending. We find that a reallocation towards government investment from government consumption increases output and private investment. Conversely, a shift in spending towards military expenditures reduces the output multiplier. Additionally, a higher share of state and local government purchases is beneficial in the short-term.

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1 Introduction

Recently, there has been a revival of interest in the assessment of fiscal policy measures. This renewed interest stems from the realization, by the central banks of advanced economies, of the limitations of monetary policy (zero lower bound) in reviving their respective economies since the Global Financial Crisis of 2008. For example, since the Covid-19 crisis, the U.S. government passed three main relief packages and one supplemental package, totaling nearly \$2.3 trillion (around 11% of its GDP).[1] Due to the increased reliance on fiscal policy to boost economic growth during a downturn, there has been a surge in research that quantifies the effects of government spending.

Primarily, past studies have considered total government expenditure as a homogeneous good (Li, 2014). For example, Blanchard and Perotti (2002), Mountford and Uhlig (2009) and Ramey (2011), each apply different methodologies to identify government spending shocks while adhering to the aforementioned assumption. However, government spending spans different critical areas like military, infrastructure, healthcare, etc. Recent literature distinguishes between the fiscal multipliers arising from different categories of spending. The aggregate multiplier for the total government purchases would be approximately a weighted average of the multipliers of the components (Boehm, 2020). The effectiveness of the fiscal policy therefore does not only depend on the size but also on the composition of the basket of products purchased by the government (Ramey and Shapiro, 1998; Muratori et al., 2023). Over the years, there has been a shift in the composition of the purchases made by the U.S. government.[2] In this paper, we investigate how a cross-sectional shift in the spending distribution affects economic outcomes.

When an exogenous shock affects spending on any component, it also influences spending on other components due to underlying correlations, thus altering the total spending level. This change, if substantial, leads to a shift in the proportion of spending across components, modifying their weights within the government's expenditure basket. For instance, a substantial rise in military expenditures driven by escalating international conflicts, such as those in the Middle East, the war in Ukraine, and other global security threats, might cause a decrease in the proportion of spending allocated to education and healthcare. Such shocks to individual spending components can be

[1] https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19

[2] Federal defense spending declined from 50% of total government purchases in 1960, with defense consumption at 35% and investment at 15%, to 23% in 2020—18% for consumption and 5% for investment, as detailed in Figures 1.1 and 1.2. Conversely, state and local government spending has increased, primarily driven by consumption expenditures, which rose from 28% of the total in 1960 to nearly 50% in 2020, while their investment has consistently ranged between 10-12%.

viewed as compound or composite, which can be decomposed into a level shock, affecting the overall spending, and a reallocation shock, shifting the distribution across components. Using a structural vector autoregression (SVAR) model, we capture the effects of redistributing government spending across two components. We include the sum of the two components along with the proportion of one component to their total. A shock to the aggregate of the components equates to a level shock. Meanwhile, an unexpected increase in the proportion of one component, leading to a corresponding decrease in the proportion of the other, effectively constitutes a reallocation shock. Furthermore, an increase in the proportion of spending in a category does not necessarily equate to higher spending in that category; it could simply represent a lesser reduction compared to the decrease in aggregate spending. Similarly, a reduction in proportion does not always signal a cut in spending; it could reflect a less substantial increase compared to the increase in total spending.

In our analysis, we evaluate the effects of shifting spending across three pairs of components one pair at a time, examining each pair independently: (i) government investment and consumption, (ii) federal defense and federal non-defense spending, and (iii) state and local government spending versus federal government spending. The level shock to the sum of the two components of each pair yields economic outcomes consistent with existing literature, resulting in cumulative multipliers ranging from -0.3 to 1.12 over a 20-quarter horizon.[3]

Analysing the impact of reallocation shocks within each pair, we find that an increase in the proportion of government investment results in higher public investment and reduced government consumption, while also elevating overall spending. Furthermore, it causes an increase in output and private sector investment, generating a multiplier greater than two. Therefore, our findings underscore the beneficial impact of investment in public capital.

Disintegrating the total federal government purchases into military and non-military expenditures, we find that a reallocation shock to the share of military spending results in higher defense spending but lower non-defense spending. Although this shift does not significantly impact GDP, it does crowd out private sector investment.

Lastly, we also assess the effects of reallocating spending from federal to state and local governments. A higher share of state and local spending increases output in the short term, as long as

[3]Mountford and Uhlig (2009) reports a government spending multiplier of 0.65 over a 1-quarter horizon and -2.07 over 20 quarters, while Auerbach and Gorodnichenko (2012) finds a 0.57 multiplier over 20 quarters. Ramey (2011) estimates multipliers ranging from 0.6 to 1.2, depending on the sample, and Blanchard and Perotti (2002) reports peak multipliers between 0.9 and 1.29.

it does not trigger a decline in overall spending. However, if overall spending decreases, this shift leads to negative multipliers.

The paper provides empirical evidence that emphasizes the critical role the composition of government purchases plays in enhancing fiscal policy efficacy. Our findings show that a cross-sectional shift in spending, not necessarily accompanied by a change in total spending, can lead to significant macroeconomic consequences. A shift from a less productive to a more productive component results in positive economic outcomes, unless it hampers aggregate spending, enabling this framework to also determine which component is more efficient.

The rest of the paper is organized as follows: Section 2 reviews the relevant literature that grounds our research. Section 3 details our empirical setup and section 4 covers the data utilized. Section 5 presents and discusses the results, followed by robustness checks in Section 6, and section 7 concludes.

2 Related Literature

This paper is related to the extensive literature that concentrates on the inherent features of fiscal spending for quantifying the effectiveness of the fiscal policy. Several studies (Perotti, 2004; Pappa, 2009; Auerbach and Gorodnichenko, 2012; Ilzetzki et al., 2013; Ellahie and Ricco, 2017; Klein and Linnemann, 2023) compare the macroeconomic outcomes from two or more spending components. Different components result in heterogeneous macroeconomic implications underscoring the importance of the composition of government spending. This paper contributes to the literature by providing an empirical framework that computes dynamic responses from shifts in the composition of spending. Utilizing national time series data,our findings highlight that changes in the proportion of spending in different categories can result in changes in economic output.

The paper is also related to several strands of literature that evaluate the components within each of the three pairs considered in our analysis: (i) government investment and consumption, (ii) federal defense and federal non-defense spending, and (iii) state and local government spending versus federal government spending. Baxter and King (1993) incorporate government investment as an unpaid factor in the production function by viewing public capital as an input that directly enhances the productivity of private capital and labor. However, the short-run output multiplier may respond less to government investment than to government consumption due to the negative wealth effect of increased taxation and implementation delays (Leeper et al., 2010; Ramey, 2021). Additionally, Boehm (2020) finds that short-lived investment shocks crowd out private investment more than government consumption. This occurs because the long service life of private capital leads to a very high intertemporal elasticity of substitution in investment demand. In contrast, with long-lived investment shocks, households have less flexibility to delay their investment decisions. Furthermore, if public capital is productive, then the long-run multipliers can be sizeable (Ramey, 2021). Moreover, Auerbach and Gorodnichenko (2012), Ellahie and Ricco (2017) and Laumer and Philipps (2020) find higher multipliers for government investment compared to government consumption. Our approach focuses on the implications of shifting the share of spending within categories, rather than merely increasing the spending level of a category, as the latter does not necessarily imply a change in its proportion. A persistent increase in the government investment share results in increased private sector investment and output, with the output multiplier exceeding 2, indicating that government investment is more productive than government consumption. However, if the increase in government investment is short-lived, it tends to crowd out private investment.

Several studies investigate the multipliers from military and non-military expenditures. Military expenditures do not contribute significantly to the production or utility functions of an economy and primarily impact through a negative wealth effect, leading to reduced private sector GDP Baxter and King (1993). This type of spending decreases private consumption and investment, resulting in a multiplier that is often less than one and typically lower than those for non-defense spending (Auerbach and Gorodnichenko, 2012; Barro and De Rugy, 2013; Ellahie and Ricco, 2017; Laumer and Philipps, 2020). Our findings indicate that increasing the share of defense spending reallocates funds from non-defense spending without significantly affecting overall output. However, it results in a significant decline in private sector investment by 0.7%. Furthermore, an increase in total federal spending that does not raise the share of defense spending crowds in private sector investment more effectively than an increase in federal spending that is accompanied by a rise in the defense spending share.

Lastly, state and local government expenditures are pro-cyclical due to balanced budget requirements, resulting in multipliers below 1, consistent with Ricardian effects where households anticipate future taxes to repay government debt, leading them to save rather than spend (Clemens and Miran, 2012). Unlike federal government spending, state and local governments allocate a smaller proportion to defense, leading to higher multipliers for their expenditures (Ellahie and Ricco, 2017; Laumer and Philipps, 2020). If the share of state and local government spending is to increase (more grants from the federal government) without an accompanying change in the total government expenditures, then output increases in the short-run. Our approach helps compare spending categories by analysing output changes from redistribution, offering new insights for policy-making on the economic effects of changes in composition.

3 Econometric Methodology

3.1 Prevailing Models

Let $G_{i,t}$ represent the fiscal spending in category i at time t. Assuming $i = 1, 2$ and $G_t = G_{1,t} + G_{2,t}$ denote the aggregate government spending. Prevailing empirical studies (Blanchard and Perotti, 2002; Perotti, 2004; Auerbach and Gorodnichenko, 2012; Ilzetzki et al., 2013; Klein and Linnemann, 2023) that assess and compare the macroeconomic effects stemming from two different components employ a basic VAR specification in the following form:

$$\begin{bmatrix} G_{1,t} \\ G_{2,t} \\ Z_t \end{bmatrix} = C + \Phi(L) \begin{bmatrix} G_{1,t-1} \\ G_{2,t-1} \\ Z_{t-1} \end{bmatrix} + \begin{bmatrix} v_t^{G_1} \\ v_t^{G_2} \\ v_t^{z} \end{bmatrix} \tag{1}$$

$$v_t \sim N(0, Q)$$

where C denotes a constant term and Z_t is an $M \times 1$ vector of macroeconomic variables like government revenue, GDP, employment, etc. $\Phi(L)$ represents the lag operator polynomial and v_t is the vector of reduced form residuals with non-zero correlations. The objective is to assess how an exogenous change in spending on component G_i influences the aggregates in Z. A shock to G_i influences the spending on the other component $G_{i \neq j}$ and results in a change in the aggregate spending (G).

If the shock is substantial, it can change the distribution of spending across the two components. However, deducing specific distribution changes remains challenging.[4] An increase in G_i due to its own shock does not necessarily indicate a shift in its share; the overall increase in total spending

[4]Ellahie and Ricco (2017) incorporates six components in their SVAR specification. The number of components makes no difference, as discerning changes in distribution remains challenging with the prevailing VAR specification.

might actually decrease G_i's share. Similarly, determining the change in $G_{i \neq j}$'s proportion in response to G_i's shock is complex. Therefore, an unexpected increase in spending on G_i does not necessarily imply a strategic shift towards G_i. Conversely, we aim to estimate Z's response to shifts in government spending across categories. An unexpected redistribution towards G_i changes the spending of both G_1 and G_2 exogenously, with neither of the components held fixed. In the VAR specification above, the shock is exogenous only to G_i and $G_{i \neq j}$ adjusts in response to this shock.

3.2 Proposed Model Specification - Two Components

Considering the previously defined components of government spending, $G_{1,t}$ and $G_{2,t}$, with $G_t = G_{1,t} + G_{2,t}$, we additionally define $s_{1,t} = G_{1,t}/G_t$ to represent the share of the first component $G_{1,t}$ in the total spending G_t. In order to account for the shift or change in the share of a component to total government spending, we could rewrite the VAR for a two-components case as under:

$$\begin{bmatrix} G_t \\ s_{1,t} \\ Z_t \end{bmatrix} = C + \Phi(L) \begin{bmatrix} G_{t-1} \\ s_{1,t-1} \\ Z_{t-1} \end{bmatrix} + \begin{bmatrix} v_t^G \\ v_t^{s_1} \\ v_t^z \end{bmatrix} \tag{2}$$

$$v_t \sim N(0, Q)$$

As in the model discussed previously, C represents a constant term and Z_t is the $M \times 1$ vector that includes macroeconomic variables such as government revenue, GDP,etc. $\Phi(L)$ represents the conformable lag polynomial of finite order p and v_t is a $(2+M) \times 1$ vector of reduced form residuals that are normally distributed with a mean 0 and a non-diagonal variance covariance matrix Q.

A shock to G represents a level shock, affecting the overall spending level, which then influences the spending on each individual component and potentially alters their proportions. A shock to s_1, representing the reallocation shock, affects the distribution of spending between the components. Additionally, an increase in s_1 does not necessarily imply higher spending on component G_1; it may simply indicate a smaller reduction relative to the overall decline in aggregate spending (G). Conversely, a decrease in the proportion of G_2 does not necessarily mean a cut in its spending; it could indicate a less significant increase compared to the increase in total spending (G).

This approach allows us to decompose a composite shock to a component (G_1), outlined in equation (1), into a level (G) shock and a reallocation (s_1) shock. This decomposition is analogous to the level and slope effects of the monetary policy shock on the yield curve, where an increase or decrease in the policy interest rate shifts the yield curve level up or down (the level effect). Meanwhile, an unconventional monetary policy tool such as forward guidance might alter the slope of the yield curve (the slope effect), particularly in response to guidance that policy interest rates are expected to remain low, potentially flattening the yield curve between its short end and the term matching the duration of the guidance.

3.3 Bayesian Estimation

We take a Bayesian perspective to estimate the above reduced-form VAR, treating the model's parameters $\Phi(L)$ and Q as random variables (Bernanke et al., 2005). We further define $vec(\phi)$ as a column vector of the elements of the stacked matrix ϕ of the parameters of the lag operator $\Phi(L)$. To be more specific, define $Y_t = [G_t \; s_t \; Z_t']'$ as an $N \times 1$ vector. Rewriting the VAR specification (2) as,

$$Y_t = C + \Phi(L)Y_{t-1} + v_t \tag{3}$$

Further, if we assume p lags and define $X_t = \left(1, Y_{t-1}', \ldots, Y_{t-p}'\right)$, then

$$Y_t = X_t\Phi + v_t \tag{4}$$

Since each equation in the VAR has identical regressors,

$$y = (I_N \otimes X)\,\phi + V \tag{5}$$

where $y = vec(Y_t)$, $\phi = vec(\Phi)$ and $V = vec(v_t)$. We now assume that the prior for the VAR coefficients ϕ is normal and given by

$$p(\phi) \sim N(\tilde{\phi}_0, H) \tag{6}$$

where $\tilde{\phi}_0$ is an $[N \times (1 + N \times p)] \times 1$ vector which denotes the prior mean while H is $[N \times (1 + N \times p)] \times [N \times (1 + N \times p)]$ matrix. It can be shown that the posterior distribution of the VAR coefficients conditional on Q is normal (Kadiyala and Karlsson, 1997).

$$h(\phi|Q, y) \sim N(\phi^*, H^*) \tag{7}$$

where

$$\phi^* = H^* \left(H^{-1}\tilde{\phi}_0 + Q^{-1} \otimes X_t' X_t \hat{\phi} \right)$$

$$H^* = \left(H^{-1} + Q^{-1} \otimes X_t' X_t \right)^{-1}$$

$\hat{\phi}$ is an $[N \times (1 + N \times p)] \times 1$ vector of the OLS estimates of the VAR coefficients. The conjugate prior for the VAR covariance matrix is an inverse Wishart distribution with prior scale matrix Q_0 and prior degrees of freedom α_0.

$$p(Q) \sim iW(Q_0, \alpha_0) \tag{8}$$

Given the prior in equation (8), the posterior for Q conditional on ϕ is also an inverse Wishart distribution.

$$h(Q|\phi, y) \sim iW(Q^*, \alpha^*) \tag{9}$$

where

$$Q^* = Q_0 + (Y_t - X_t\Phi)' (Y_t - X_t\Phi)$$

$$\alpha^* = T + \alpha_0$$

Φ denotes the VAR coefficients reshaped into $(1 + N \times p)$ by N matrix and T is the sample size.

We employ a Minnesota prior for the above VAR as it incorporates the prior belief that the endogenous variables included in the VAR follow a random walk process or an AR(1) process. Therefore, we set the following prior values:
$\tilde{\phi}_0 = [0,\ 0,\ 0,\ 1, \ldots, 0]'_{N\times(1+N\times p)\times 1}$ with the coefficient on the own first lag being equal to 1.

Prior variance of the distribution of the VAR coefficients, H is given by the following relations for the VAR coefficients ϕ_{bc}:

$$\left(\frac{\lambda_1}{l^{\lambda_3}} \right)^2 if\ b = c$$

$$\left(\frac{\sigma_b \lambda_1 \lambda_2}{\sigma_c l^{\lambda_3}} \right)^2 if\ b \neq c$$

$$(\sigma_b \lambda_4)^2\ \ for\ the\ constant\ and\ trend\ components$$

where b refers to the dependent variable in the b^{th} equation and c to the independent variables in that equation; σ_b^2 is the residual variance of univariate regression of variable b and l is the lag length. λ_1 controls the standard deviation of the prior on own lags. λ_2 controls the standard deviation of the prior on lags of variables other than the dependent variable. λ_3 controls the degree to which coefficients on lags higher than 1 are likely to be zero. $\lambda_4 \to 0$, the constant terms are shrunk to zero. In line with the literature (Bernanke et al., 2005), we set:

$$\lambda_1 = 1;\ \lambda_2 = 1;\ \lambda_3 = 1;\ \lambda_4 = 1$$

The initial values of Q and ϕ are taken to be the OLS estimates of the VAR equation. Having set the priors and the initial values, we can now use the Gibbs sampling methodology as follows: Conditional on the value of Q^d, draw ϕ^{d+1} from the conditional posterior distribution of the VAR coefficients. Stationarity is enforced discarding draws of ϕ^{d+1} that contain roots that lie outside the unit circle (Bernanke et al., 2005). Next, we draw Q^{d+1} from its conditional distribution using ϕ^{d+1}. These two steps constitute one iteration. For every $(d+1)^{th}$ iteration, we compute the impulse responses to the level (G) shock and reallocation (s_1) shock, as detailed in section 3.4, using the draws Q^{d+1} and ϕ^{d+1}. Using the impulse responses, we then estimate the multipliers in response to the two shocks for every iteration, as outlined in section 3.5. We use $30,000$ Gibbs sampling replications and discard the first $15,000$ as burn-in.

3.4 Impulse Responses to Fiscal Shocks

In order to measure the impact of a change in the distribution of spending on macroeconomic aggregates, we need to estimate the expected change in the aggregates in Z in response to the level (G) shock and the reallocation (s_1) shock. To obtain impulse responses, we need to make identifying assumptions that allow us to disentangle the structural shocks from the reduced-form errors in our model. The vector of reduced-form errors can be expressed as:

$$v_t = B\epsilon_t$$

$$\epsilon_t \sim N(0, I)$$

ϵ_t is a $(2+M)\times 1$ vector of structural shocks that are mutually uncorrelated. In order to estimate the impulse responses of the variables to a structural shock in ϵ_t, we use recursive identification to determine the matrix B.

We sequence the variables such that the total spending level (G_t) is ordered before the share of the component ($s_{1,t}$) and followed by the vector of other macroeconomic aggregate variables in Z_t. This ordering assumes that shock to $s_{1,t}$ does not contemporaneously affect G_t. Since a surprise increase in s_1 implies a decrease in the proportion of G_2, and aggregate spending does not change contemporaneously, an increase in the share of G_1 would lead to an increase in its spending and a decrease in spending on G_2 on impact. This allows us to capture the effect of reallocating funds from one category to another without an immediate change in overall spending. This setup is particularly useful for examining exogenous changes within various government spending categories without necessarily observing an increase in the total spending level.[5]

With these variable orderings established, we apply Cholesky decomposition to transform the non-diagonal variance-covariance matrix of the reduced-form errors, Q, into a unique lower triangular matrix B, where

$$Q = BB'$$

For every $(d+1)^{th}$ iteration, we have the corresponding estimates of Q^{d+1} which is decomposed into the respective lower triangular matrix, B^{d+1}. We can then derive the impulse responses to the level (G) shock and the reallocation (s_1) shock for every $(d+1)^{th}$ iteration by using the estimates of B^{d+1} and ϕ^{d+1}. We display the median impulse responses along with the respective 68% credible sets in all cases. By doing so, we can comprehensively analyse how both the overall level of spending and the distribution of spending affect macroeconomic aggregates.

3.5 Government Spending Multiplier

The multiplier is commonly used in literature to assess the impact of a dollar increase in fiscal spending on overall output. It is useful for analysing different fiscal policy scenarios and aiding in policy making. One approach is to measure the ratio of the output response to the initial change in the fiscal spending component, known as the impact multiplier (Mountford and Uhlig, 2009). Blanchard and Perotti (2002) define the peak multiplier as the maximum output response parameter divided by the initial change in government spending. However, this method focuses on the change in output at a particular point in time and may not capture subsequent negative output responses. Ramey (2011) calculates the fiscal multiplier using the integral under the impulse response function. To enable a comparison with the findings of Auerbach and Gorodnichenko (2012), who report multipliers for disaggregated fiscal components, we employ their approach. We

[5] As a part of robustness check, we conduct the analysis again with an alternative ordering where $s_{1,t}$ precedes G_t, positing that a shock to the total spending level does not contemporaneously influence the distribution of spending.

then calculate the multiplier in response to the level (G) over the entire path of the response upto a period K, referred to as the sum multiplier, as follows:

$$Level\ Multiplier\,(K) = \frac{\sum_{\kappa=0}^{K} y_{\kappa}}{\sum_{\kappa=0}^{K} G_{\kappa}} \times \frac{\bar{y}}{G} \tag{10}$$

Here, y_{κ} and G_{κ} are the output and the government spending responses for a particular period κ. $\frac{\bar{y}}{G}$ is the sample mean of the GDP to government spending ratio. Since we consider these variables in natural logarithms, the impulse responses represent elasticities and are thus scaled by the sample mean ratio. For a shock to the total level of spending (G), we apply the above formula.

When calculating the sum multiplier resulting from a reallocation shock, i.e., a shock to G_1's share (s_1), we obtain the impulse response of G_1 by summing the impulse responses of the total level G and share of the component s_1. This is because both are included in the VAR specification in natural logarithms. Using $G_{1,\kappa}$ to denote the response of component G_1 in period κ to the reallocation shock, the multiplier can be computed as follows:

$$Reallocation\ Multiplier\,(K) = \frac{\sum_{\kappa=0}^{K} y_{\kappa} \times \frac{\bar{y}}{s_1}}{\sum_{\kappa=0}^{K} G_{1,\kappa} \times \frac{\bar{G_1}}{s_1}} \tag{11}$$

In this equation, $\frac{\bar{y}}{s_1}$ represents the sample mean of the GDP to the share of the fiscal component, G_1 and $\frac{\bar{G_1}}{s_1}$ is the average ratio of spending in G_1 to its share, s_1. The numerator quantifies the total output response in dollars per additional unit change in the share across K quarters. Likewise, the denominator calculates the change in spending for component G_1 in dollars per additional unit change in its share over the same period. This multiplier then reflects the dollar change in output over period K for each dollar increase in spending on the component.

We compute the level and reallocation multipliers for every $(d+1)^{th}$ iteration using the impulse responses corresponding to that iteration. We report the median multiplier for different values of K along with the respective 68% credible sets in all cases.[6]

[6]Additionally, Mountford and Uhlig (2009) suggests taking into consideration the discounted values of the impulse responses to compute the sum multiplier as follows: $Present\ Value\ Multiplier\,(K) = \frac{\sum_{\kappa=0}^{K}(1+\bar{r})^{-\kappa} y_{\kappa}}{\sum_{\kappa=0}^{K}(1+\bar{r})^{-\kappa} G_{\kappa}} \times \frac{\bar{y}}{G}$ where $\bar{r}$ denotes the average federal funds rate over the sample. We use the above formula to compute the discounted sum multiplier in response to the level shock. In order to compute the multiplier from the reallocation shock, we simply adjust equation (12) to include the discounted impulse responses of y and G_1 in response to the reallocation shock. We report these multipliers in the Appendix and find negligible differences.

4 Data

The analysis covers the period from the first quarter of 1960 to the fourth quarter of 2018, utilizing quarterly data on total government purchases, which are further categorized into consumption expenditures and gross investment.Government consumption expenditures encompass the value of goods and services provided by the government free of charge, such as education and law enforcement, as well as purchases of military equipment. In cases where goods and services are provided at a subsidized cost, only the difference between the incurred costs and the revenues collected is recorded as government consumption expenditures. Government gross investment is defined as gross fixed capital formation, which includes investments made by government and government enterprises in physical assets such as structures (like highways), equipment and intellectual property products and investments made by the government on its own account.

The total government consumption expenditures and gross investments are each broken down further into spending by the federal and state and local governments.At the federal level, expenditures are further broken down into defense and non-defense categories for both consumption and investment. Therefore, the data collected includes six key components: (1) Federal Defense Consumption Expenditures (DEFC), (2) Federal Defense Gross Investment (DEFI), (3) Federal Non-Defense Consumption Expenditures (NDEFC), (4) Federal Non-Defense Gross Investment (NDEFI), (5) State and Local Government Consumption Expenditures (SLGC), and (6) State and Local Government Gross Investment (SLGI). Furthermore, federal purchases do not incorporate the grants allocated to state and local governments.

The baseline VAR model is designed to analyze the effects of an exogenous increase in the share of one of any two components, incorporating the total of the components (G_t) and the share of one component ($s_{1,t}$) in logarithmic form. Additionally, the vector Z_t within the VAR includes four variables, in alignment with existing research. Rather than using tax revenue, we include the annual income-weighted average marginal tax rate, following the approach of Barro and Redlick (2011) and Ramey (2011), to account for tax policy. We convert this annual tax series to quarterly figures by assuming that the tax rate for each quarter remains consistent with the annual rate for that respective year (Ramey, 2011). Other variables included in the Z_t vector are the natural logarithm of real GDP per capita, the real BAA bond rate (adjusted for CPI-defined inflation) to reflect the cost of private investment (Perotti, 2005; Ramey, 2011), and the natural logarithm of real private non-residential investment per capita. Further details on the definitions and data sources are provided in the Appendix.

5 Results

We now understand how an unexpected shift in the distribution of spending, characterized by an increase in the share of one component and a decrease in another, affects the economy. To investigate this, we analyse variations in the composition across three distinct pairs: (i) Government investment and consumption (ii) Federal defense and federal non-defense spending (iii) State and local government spending and federal government spending. We begin by estimating the impulse responses and multipliers for aggregate spending (level) shocks using the model proposed in Section 3.2. We then examine the outcomes from a composite shock to a disaggregated component using the existing model in literature, as outlined in Section 3.1. Finally, we compare these outcomes to those arising from a reallocation shock, which involves an exogenous increase in the share of a component.

5.1 Government Investment and Consumption

We define G_1 as government investment (GI), which includes federal defense and non-defense investment, as well as state and local government investment. Similarly, G_2 represents government consumption (GC), encompassing federal defense and non-defense consumption, as well as state and local government consumption expenditures. The sum of G_1 and G_2 equals the total government spending G. We denote s_1 as the share of government investment and s_2 as the share of government consumption in total government spending (G).

5.1.1 Responses to Total Government Spending (Level) Shock

Figure 2.1 presents the median impulse responses of total government spending (G), the share of government investment (s_1), tax rate, GDP, real BAA rate, and private non-residential investment following a shock to total government spending (G), complete with 16% - 84% credible bands. By analysing the natural logarithms of G and s_1, we calculate the impulse responses for G_1 (GI). Additionally, an increase in s_1 results in a corresponding decrease in s_2,[7] which allows us to assess

[7] We consider $log(s_1)$, noting $log(s_1) = log(1 - s_2)$. For small variations in s_1, the impulse response of s_2 can be approximated as the negative of s_1's response, assuming log-linearization holds for these small changes.

the impulse responses for G_2 (GC). The median responses of G_1 (GI) and G_2 (GC), along with their respective error bands, are highlighted in green in the lowermost row of Figure 2.1.

Figure 2.1 illustrates that G rises by 1% immediately after a shock and sustains this increase before it begins to taper off after four quarters, with the increase eventually reducing to 0.3%. The increase in G remains significantly different from zero. Following the shock, s_1 experiences an immediate increase of 0.7%, which is the peak change. This increase then gradually diminishes, returning to zero after 12 quarters. Consequently, with both G and s_1 increasing, G_1 sees an initial surge of 1.6%, which is also the peak change. This increment then decreases gradually to 0.5%. As s_1 rises, s_2 falls. Therefore, the increase in G_2 is smaller than the increase in G. G_2 increases by 0.3% on impact, peaks at 0.4% after two quarters, and then declines to stabilize at 0.2%. This increase in G_2 remains significantly different from zero for 12 quarters.

In Figure 2.1, the output initially increases by 0.2% following an uptick in G, but this increase is short-lived, returning to the baseline within two quarters. The changes in the tax rate and the real bond rate do not show statistically significant responses. Private investment, which does not react immediately, begins to decline after three quarters, reaching a low of -0.7% by the sixth quarter before returning to its original level after nine quarters. The crowding out of private investment can be attributed to the transient nature and subsequent decline of G_1 back to its original level. According to Boehm (2020), short-lived government investment shocks typically crowd out private investment due to the high intertemporal elasticity of substitution in investment demand. In contrast, with long-lived investment shocks, households have less flexibility to delay their investment decisions.

The output multipliers from the level shock are positive across all time horizons as seen in column (1) of Table 1. These multipliers peak initially and then decrease, aligning with the output response seen in Figure 2.1. They remain significantly different from zero up to a one-year horizon, decreasing from 1.1 on impact to 0.54 over one year. Over a 20-quarter horizon, the average multiplier for the full sample is 0.30 and is statistically insignificant. For the same time frame, Auerbach and Gorodnichenko (2012) estimates a multiplier of 0.57, whereas Ramey (2011) finds that the estimated government spending multiplier varies between 0.6 and 1.2, based on the sample analysed.

By including the share of one of the two components, which captures changes in the cross-sectional distribution, we can assess the significance of the composition of purchases. When s_1 is ordered before G (as detailed in section 6.1), we find no significant increase in s_1 in response to the level shock. As a result, private investment experiences a slightly larger decline, and output shows a slightly smaller increase, with the multipliers in column (3) being lower than those in column (1).

5.1.2 Responses to Government Investment Shock

We next estimate the responses from a composite shock to G_1. This analysis utilizes VAR specification (1) described in Section 3.1, which incorporates the individual components G_1 and G_2, instead of G and s_1.

Upon receiving a shock, G_1 surges by 2% and remains at this elevated level, as displayed in Figure 2.5. G_2 does not respond immediately but gradually experiences a steady and significant increase of 1%. Output initially rises by 0.2% and maintains this increase for two years, then slowly ascends to reach a 0.4% increase. The persistent and long-lived rise in G_1 also increases private investment by 0.3% initially and maintains this level, although this increase is statistically significant only for three quarters.

The cumulative multipliers are positive, increase over time, and are significantly different from zero, as detailed in column (5) of Table 1. Over a five-year period, the multiplier from a government investment shock stands at 2.67, compared to the government investment multiplier of 2.39 reported by Auerbach and Gorodnichenko (2012).

As spending on both components increases in response to a shock to G_1, G likewise rises, yet assessing the changes in spending distribution and their effects on the economy proves difficult. By incorporating both G and s_1 in the VAR analysis, we can effectively evaluate the effects of reallocating spending between the spending components.

5.1.3 Responses to Government Investment Share (Reallocation) Shock

We now understand the macroeconomic impact from a shift in spending towards government investment from government consumption.

In Figure 2.2, a shock to s_1 results in an immediate increase of 1.6%. This increase then decreases over three quarters to 1% before rising again to stabilize at around 1.3%. Since G is ordered before s_1, it does not respond contemporaneously. G significantly declines after three quarters, returning to its baseline after five quarters, and then begins a steady increase, eventually reaching a 1%

rise after ten quarters. G_1 mirrors the trajectory of G, rising by 1.6% on impact, declining over three quarters, then increasing steadily and remaining elevated. Conversely, as s_1 increases, the government consumption share (s_2) decreases. G_2 drops by 1.6% on impact, marking the peak response to the reallocation shock. As G begins to increase, the decrease in G_2 also lessens and gradually returns to the baseline.

Output increases slightly on impact by 0.1% in response to an increase in s_1. This significant rise in output disappears after three quarters, only to surge again significantly and stabilize at an elevated level of about 0.3-0.4%.[8] As the increase in G_1 (GI) persists and the cost of investment, measured by the real bond rate, remains unchanged, private investment rises. Private investment grows by 0.3% on impact and reaches a peak increase of 1% after six quarters, before it begins to decline, eventually returning to its original level after three and a half years. Ellahie and Ricco (2017) also observed a positive response of private investment to non-defense and state and local government investment shocks. They suggested that this increase in output and investment could be linked to the activation of a supply-side channel, which improves the productivity of the private sector. Therefore, a shift from government consumption to government investment not only results in an increase in output but also fosters an increase in private non-residential investment. Government investment is more productive than government consumption.[9]

The output multipliers is response to this reallocation shock are positive, increase over time, and are all significantly different from zero, as detailed in column (2) of Table 1. Over a 5-year period, the multiplier is approximately 3.82.[10] Since government consumption typically yields a lower multiplier than government investment, the multipliers resulting from a redistribution shock (as shown in column (2)) are higher than those from a straightforward government investment shock (as shown in column (5)) over the medium to long term. This difference arises because a redistribution shock increases total government spending while simultaneously reducing government consumption spending. Conversely, a government investment shock leads to an increase in total government spending, including an increase in government consumption.

[8] We observe a similar output response when s_1 is ordered before G, as shown in Figure 2.3.

[9] Auerbach and Gorodnichenko (2012) estimate a government consumption multiplier of 1.20 as compared to a government investment multiplier of 2.39 over a five-year horizon.

[10] We find a significant cumulative multiplier of 2.94 when s_1 is ordered before G, as detailed in column (4) of Table 1.

5.2 Federal Defense and Federal Non-Defense Spending

We explore the implications of changes in the distribution of federal spending between military and non-military purchases in this sub-section. G_1 now represents federal defense spending (DEFS) which is the aggregate of federal defense consumption expenditures and federal defense gross investment. Similarly, G_2 encompasses total federal non-military spending (NDEFS), including federal non-defense consumption expenditures and gross investment. The sum $G_1 + G_2 = G$ represents total federal government purchases, and s_1 denotes the share of military spending while s_2 represents the share of non-military spending within these total federal government purchases, G.

5.2.1 Responses to Total Federal Government Spending (Level) Shock

In Figure 3.1, a shock to G results in an increase of 1.6% on impact, with this change showing persistence over time. This increase in G is associated with a rise in s_1. It initially increases by 0.15%, reaches a peak increase of 0.45% after six quarters, and then stabilizes at an increase of around 0.4%. G_1 (DEFS) also surges by 1.8% on impact, reaching a peak of 2.5% after six quarters, and the increase remains steady around 2.2%. The pattern in G_2 (NDEFS) reflects that of G, with an initial increase of 1.5% and a peak at 1.6% after six quarters, followed by a slight decline but remaining steady at an increase of around 1.4%.

Economic output initially increases by 0.2%, returns to its baseline after two quarters, and then begins to rise after eight quarters, to stabilize at around an increase of 0.25% after four years. The responses of the tax rate and the real bond rate are not statistically significant. Private investment shows no change initially but begins to decline from the third quarter, reaching a low of -0.4% after six quarters, then recovering gradually. Notably, private investment significantly increases after four and a half years. The increase in G initially crowds out private investment. Over time, the economy-wide productivity benefits from investments in productive public capital, encouraging firms to invest more in capital and hire additional labour.

The cumulative multipliers in response to the level shock, as detailed in columns (1) of Table 2, are positive across all horizons, reflecting the positive output responses displayed in Figure 3.1. The multiplier peaks on impact, then decreases, and begins to increase again after eight quarters, remaining significantly different from zero only during the first year, as shown in column (1). Over a five-year horizon, the federal government spending multiplier is 0.75 and statistically insignificant.

Examining the level shock with an alternative ordering, and contrasting it with the initial s_1 and G arrangement, can also emphasize the key role of the composition of military and non-military expenditures, much like the reallocation shock. With s_1 not being affected contemporaneously by a level shock, the increase in s_1 is much smaller (as elaborated in section 6.2. This leads to a more rapid and significant rise in private sector investment and output, with the multipliers in column (3) over longer horizons being both significant and slightly larger than those in column (1) of Table 2.

5.2.2 Responses to Defense Spending Shock

We examine the impulse responses to a direct shock to G_1 before analysing the responses to a shock to s_1. As in the earlier subsection, we employ VAR specification (1), detailed in section 3.

As displayed in Figure 3.5, G_1 (DEFS) surges by 2% on impact upon receiving the shock, further increasing by 2.8% after six quarters before slightly declining to stabilize at an increase of 2%. Concurrently, G_2 (NDEFS) initially rises by 0.3%, and subsequently increases by 0.9%. The tax rate and bond rate show no significant response to the shock. GDP rises by 0.17% on impact but then returns to baseline levels within three quarters. Private investment increases by 0.13% at the outset, then declining after two quarters, remaining significantly below baseline for several quarters before returning to the original level. From column (5) of Table 2, we see that the multipliers are significantly different from zero over a one-year horizon. Over a 20-quarter period, the multiplier for defense spending stands at 0.67 and is not statistically significant, reflecting similar findings by Auerbach and Gorodnichenko (2012), who reports a defense spending multiplier of -0.21, also not significantly different from zero.

5.2.3 Responses to Defense Spending Share (Reallocation) Shock

Figure 3.2 displays the responses to a reallocation shock that increases the defense spending share and reduces the non-defense spending share. s_1 increases by 0.9% on impact, marking the peak response. This increase then fluctuates, declining for two quarters before rising in the third, and gradually diminishing thereafter. In response to the reallocation shock, G rises for two quarters, peaking with a 0.3% increase, then stabilizes and starts to decline after three years. The significance of this increase in G persists only through the first eight quarters. As both s_1 and G increase, G_1 rise by 0.9%, representing the peak response. This increase slightly declines but remains steady for about ten quarters before it starts to taper off as the effects of the reallocation shock fade, and both s_1 and G decline. Given that G does not rise substantially, the increase in G_1 is offset by a reduction in G_2. It decreases immediately by 0.9%, follows a hump-shaped trajectory, and this change in G_2 remains significantly below zero for six quarters.

The responses of GDP and the tax rate are not significantly different from zero. The real bond rate is unresponsive for two quarters, after which it increases by 0.13 percentage points, maintaining an elevation of about 0.1 percentage points for the next five quarters. This increase is significant for a total of seven quarters before it returns to 0. Private non-residential investment initially rises by 0.19%, peaks at a 0.3% increase in the second quarter, but begins to fall as the cost of private investment rises. This downward trend continues, with the decrease in private investment stabilizing around 0.7%. This scenario illustrates how an increase in military expenditures, without a corresponding rise in non-defense investment, crowds out private investment.

Since both G_1 and G_2 increase in response to a direct shock to G_1 (Figure 3.5), the impact on private investment is less pronounced compared to the effects of a reallocation shock, which increases G_1 while reducing G_2. Consequently, GDP growth is more pronounced than it is with reallocation.

The output increases by \$1.22 on impact for every dollar spent on defense, with the multiplier peaking at \$1.66 during the first quarter before declining and eventually turning negative after two years, as detailed in column (2) of Table 2. The multipliers are significant only till the first quarter, contrasting with those from a composite shock to defense spending (column(5)), which remain significant for a year. Over a 20-quarter period, the multipliers in columns (2) and (5) are -1.35 and 0.67, respectively, neither statistically significant. This aligns with findings by Auerbach and Gorodnichenko (2012), who report a similarly insignificant defense spending multiplier of -0.21.

5.3 State and Local Government Spending and Federal Spending

Federal grant-in-aid to state and local governments constitutes a significant portion of federal government spending, especially during economic downturns. In this subsection, we estimate the effects on aggregates of an increase in the share of state and local government spending in total federal spending. We define G_1 as the state and local government spending (SLGS), which encompasses both state and local government consumption expenditures and gross investment. G_2 represents total federal government spending (FGS), which includes both defense and non-defense spending components. The combined total of G_1 and G_2 equates to total government purchases (G). Furthermore, s_1 now represents the share of state and local government spending and s_2 represents the share of federal government spending in total spending, G.

5.3.1 Responses to Total Government Spending (Level) Shock

In Figure 4.1, G experiences an initial increase of 0.9% in response to its own shock and results in a persisted elevated level of total government spending. The level shock leads to a reduction in s_1. It decreases by 0.5% on impact and continues to decline, with a total reduction of 0.75% by the end of six quarters. Subsequently, it gradually recovers but remains reduced by 0.5%. Therefore, s_1 is negatively associated with G.

Since s_1 decreases, G_1 increases but the increase is smaller than the increase in G. The level of G_1 rises by 0.4% on impact, returns to its original level after four quarters, and then shows a significant increase after four years. On the other hand, the pattern of G_2 mirrors the trend of G. G_2 surges by 1.4% on impact and peaks at 1.7% after three quarters, then slightly decreases after six quarters but stabilizes at an increase of about 1.3%.

The response of the output to the increase in G is positive and remains significant for the first three quarters. Output increases by 0.2% on impact and returns to its original level after four quarters, before starting to rise again after eight quarters and significantly after 12 quarters. The peak response of output occurs with an increase of 0.3% after four and a half years. Meanwhile, private investment displays an insignificant inverted hump-shaped impulse response.

The sum multipliers peak in the first quarter, then decline, and begin to increase again after eight quarters, remaining significantly different from zero. Over a 20-quarter horizon, the full sample multiplier averages 1.01 as shown in column (1) of Table 3 and is consistent with the literature. Ramey (2011) finds that the implied government spending multiplier ranges from 0.6 to 1.2, depending on the sample.

Since the state and local government spending share (s_1) is not affected contemporaneously by the level (G_1) shock, the decline is s_1 is more subdued in Figure 4.3 than in Figure 4.1, where the level (G) is ordered before the share of the component (s_1). This results in a larger increase in state and local government spending (G_1) and a smaller increase in federal government spending (G_2) in Figure 4.3 than in Figure 4.1. Although the output response is similar in both scenarios, these dynamics cause the multipliers shown in column (3) of Table 3 to be larger than those in column (1) in the short term, although the differences diminish over a longer horizon. Over a 20-quarter horizon, the total government spending multiplier averages 1.12, as seen in column (3), compared to 1.01 in column (1).

Consistent with previous analyses, changing the ordering so that s_1 precedes G results in a subdued response of s_1 to the level shock. With s_1 experiencing a much smaller decline than before, the increase in spending in G_1 is considerably larger. The short-term output response is only marginally larger, leading to slightly higher short-term multipliers in column (3) relative to column (1) of Table 3.

5.3.2 Responses to State and Local Government Spending Shock

As in previous analyses, we revisit the VAR specification (1) described in section 3, which incorporates the spending in each category given by G_1 and G_2. In Figure 4.5, G_1 increases by 1% upon receiving the shock and then gradually declines, yet remains above zero. There is a slight increase in G_2 of about 0.2%, and it subsides within two quarters. The tax rate and bond rate exhibit no significant responses to the shock. The private investment response mirrors the pattern observed in its reaction to the level shock (Figure 4.1), and remains statistically insignificant.

Output rises by 0.2% on impact, remains at 0.2% and significant, but reverts to its baseline after two quarters. The multipliers remain significantly different from zero for up to four quarters, with the one-year multiplier at 1.45, as displayed in column (5) of Table 3. Over a 20-quarter horizon, the multiplier decreases to 1.05 and is also insignificant.

5.3.3 Responses to State and Local Government Spending Share (Reallocation) Shock

Given the responses from an increase in state and local government spending that may not necessarily alter the distribution of spending, we now examine the effects of redistribution between the two spending components.

From Figure 4.2, it is evident that s_1 increases by 0.7% on impact in response to its own shock, and this increase peaks at 0.8% after three quarters, remaining elevated at around 0.6% in response to its own shock. Since we order s_1 after G, there is no contemporaneous change in G. It increases slightly by 0.2% after a quarter which is also the peak response. It then begins to decline and reverts back to its original level. Since G remains unchanged in response to the reallocation shock, the observed increase in s_1 corresponds to a rise in the numerator, specifically G_1. G_1 increases by 0.7% on impact (as G remains stable at the outset) and exhibits a hump-shaped trajectory. These purchases begin to decline after eight quarters as both G and s_1 decrease. Nevertheless, the increase in G_1 remains significantly different from zero for five and a half years. Furthermore, since G does not change in response to a reallocation shock, the increase in G_1 must result in a decline in spending by the federal government (G_2). Federal governments may increase the grants allocated to state and local governments.

The output increases only very slightly by 0.1% on impact and reaches its peak at 0.12% after a quarter. The increase in output is significantly different from zero only for the first two quarters. The responses of tax rate and real bond rate continue to be statistically insignificant. Private non-residential investment does not experience a change when there is a redistribution shock from federal government spending to state and local government spending.

The multipliers, positive across all horizons, gradually decrease over time and are significant for only one year, as seen in column (2) of Table 3. Over a four-quarter horizon, the reallocation multiplier is 1.08, as seen in column (2), and is lower than the multiplier of 1.45 in response to the direct shock to G_1, as seen in column (5). Since the total government spending does not change, reallocating funds from the federal government to state and local governments results in increased output and a short-term multiplier greater than 1.

On the other hand, when the ordering is switched so that s_1 comes before G, total government spending experiences a significant decline in response to the reallocation shock. In this scenario, the decline in G_2 surpasses the increase in G_1. Output decreases by 0.1% on impact, briefly returns to its original level, only to decline again, with the overall response being insignificant. Consequently, the multiplier on impact is negative and significant (-2.06), with subsequent multipliers remaining negative and insignificant, as detailed in column (4) of Table 3. This contrasts with the multipliers derived in response to the reallocation shock when the level (G) is ordered before the share (s), as shown in column (2). A positive effect on the economy is observed with an increase in state and local government spending, provided that it does not lead to federal government spending being excessively crowded out.

6 Robustness

We assess the robustness of our results by considering an alternative ordering within our VAR model:

$$\begin{bmatrix} s_{1,t} \\ G_t \\ Z_t \end{bmatrix} = C + \Phi(L) \begin{bmatrix} s_{1,t-1} \\ G_{t-1} \\ Z_{t-1} \end{bmatrix} + \begin{bmatrix} v_t^{s_1} \\ v_t^{G} \\ v_t^{z} \end{bmatrix} \tag{12}$$

$$v_t \sim N(0, Q)$$

In this rearranged specification, the total government spending (G) is ordered after the share (s_1) of the first component (G_1) within total spending (G), with no other changes to the previous specification. Thus, a shock to the component share (s_1) contemporaneously influences the total spending level (G). Given the quarterly nature of the data, the aggregate spending level could adjust within the same quarter to the variation in the distribution. With this ordering,an unexpected rise in the share of G_1 and a corresponding fall in the proportion of G_2 do not necessarily lead to an increase in spending on G_1 or a decrease in spending on G_2 on impact, because the total of the two components may change concurrently. We estimate the impulse responses and multipliers for both the level and reallocation shocks across the three pairs of spending components in the same manner, but with this altered ordering for shock identification.

6.1 Government Investment and Consumption

As noted in subsection 5.1, G_1 represents the total investment at both federal and state and local government levels, while G_2 accounts for total consumption expenditures. Consequently, the sum of these two components, denoted as G, constitutes the total government spending. We have re-estimated the VAR specification described in section 6, applying recursive identification where the share of government investment (s_1) is now ordered before the combined total of government investment and consumption (G). The results are qualitatively similar to those in subsection 5.1.

In Figure 2.3, the government investment share (s_1) remains relatively unchanged in response to a level shock. The crowding out of private investment is larger than in Figure 2.1 because the investment share does not react to the level shock as it does in Figure 2.1.

In subsection 5.1, we find government investment to be more productive that government consumption. Since the government investment share (s_1) does not significantly react to the level (G) shock, the increase in output is smaller than in Figure 2.1. The multipliers in column (3) of Table 1 are lower than those in column (1). Consequently, if the investment share rises with an increase in total spending, a slightly higher GDP response is observed. This underscores how the composition of purchases can affect the aggregate multiplier.

6.2 Federal Defense and Federal Non-Defense Spending

To recap, G_1 signifies defense spending and G_2 represents non-defense spending. Together, these two components sum up to total federal government spending, denoted as G, while s_1 denotes the defense spending share in total federal government spending (G).

As noted in subsection 5.2, the share of defense spending (s_1) and total federal government spending (G) are positively correlated. Since the defense spending share (s_1) is not affected contemporaneously by an unexpected increase in federal spending (G), the response of defense spending share (s_1) to the level (G) shock is more muted in Figure 3.3 than in Figure 3.1.Consequently, the increase in defense spending is lower than that in Figure 3.1. Private sector investment in Figure 3.3 shows a larger and sooner significant increase compared to Figure 3.1. A significant increase in GDP occurs after 12 quarters in Figure 3.3, whereas in Figure 3.1, this increase appears after 18 quarters. Thus, the multipliers in column (3) of Table 2 show significant differences from zero in the long term, notably after 12 quarters. This suggests that an increase in the share of defense spending leads to lower and insignificant multipliers over extended horizons, as evident in column(1), illustrating the negative economic effects of a shift in the distribution from more productive non-defense spending to less productive defense spending.

The output and private sector investment responses to the reallocation shock in Figure 3.4 are quantitatively similar to those in Figure 3.2.

6.3 State and Local Government Spending and Federal Spending

Recalling, G_1 represents state and local government spending, and G_2 refers to federal government spending. Therefore, G is total government spending, while s_1 is the share of state and local government spending.

Since the state and local government spending share (s_1) is not affected contemporaneously by the level (G_1) shock, the decline is s_1 is more subdued in Figure 4.3 than in Figure 4.1, where the level (G) is ordered before the share of the component (s_1). This results in a larger increase in state and local government spending (G_1) and a smaller increase in federal government spending (G_2) in Figure 4.3 than in Figure 4.1. Although the output response is similar in both scenarios, these dynamics cause the multipliers shown in column (3) of Table 3 to be larger than those in column (1) in the short term, although the differences diminish over a longer horizon. Over a 20-quarter horizon, the total government spending multiplier averages 1.12, as seen in column (3), compared to 1.01 in column (1).

Figure 4.1 shows a significant decrease in the share of state and local government spending in response to the level shock. Similarly, Figure 4.4 indicates a significant decline in total spending following an exogenous increase in the proportion of state and local government spending. As a result, the reduction in federal government spending is more pronounced than in Figure 4.2. With overall spending reduced, a shift towards state and local government spending does not enhance output, resulting in negative multipliers as shown in column (4) of Table 3. However, when overall spending remains unchanged, reallocation towards state and local government spending leads to a short-term increase in output (see Figure 4.2), with positive multipliers observed in column (2).

Consistent with existing literature that identifies heterogeneous multipliers for different components of government spending, our findings extend this understanding by showing that the distribution of spending across these components also significantly influences these effects.

7 Conclusion

Since the 2008 financial crisis, fiscal policy has become a pivotal area of focus. A growing literature suggests that different components of government spending produce varied output multipliers, highlighting that the composition of government purchases significantly influences the effectiveness of fiscal measures. Even though the makeup of government expenditures has changed over time, the consequences of these changes remain largely unexplored. This paper investigates the potential effects of variations in the cross-sectional distribution of government spending components, aiming to enhance our understanding of their influence on fiscal policy outcomes.

In this paper, we introduce a new empirical approach to analyse the macroeconomic effects of reallocating spending from one component to another. This is accomplished by incorporating the ratio of one spending component to the total of two components into a structural vector autoregression model, along with the sum of these components. A shock to the share of one component causes the share of the other to move in the opposite direction, reflecting reallocation. For shock identification, we consider changes in the distribution of spending that either preserve the level of total spending contemporaneously, or allow for changes in the distribution that also alter the total spending level. This methodology can be applied to assess the effects of redistributing spending across any two components.

We decompose government expenditures into three distinct pairs for analysis - (*i*) Public investment and consumption, (*ii*) Federal defense and federal civilian and (*iii*) State and local government spending versus federal government spending, analysing shifts within each pair. Our findings show that a reallocation shock shifting spending from government consumption to government investment results in notably higher multipliers.This aligns with existing literature suggesting that government investment typically yields higher multipliers than government consumption. A sustained shift towards a higher proportion of government investment could provide substantial economic advantages, surpassing those from a mere increase in overall government investment.

Within federal government expenditures, shifting federal funds from civilian to military spending does not significantly decrease GDP but crowds out private investment. These scenarios show that moving funds from less productive to more productive components can lead to positive economic outcomes as long as the overall spending does not decrease. Although state and local spending differs from federal spending and includes minimal military expenditures, which should make it more effective, a higher share of this spending decreases overall spending and results in negative multipliers.

Our results suggest that a deeper understanding of government spending distribution and the interaction between its components can enhance fiscal policy effectiveness. Future research should consider incorporating multiple components of government spending to determine an optimal spending mix. Additionally, examining the shifts in fiscal policy effectiveness over time as the composition of government expenditures evolves could provide valuable insights into more effective fiscal strategies.

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Figures and Tables

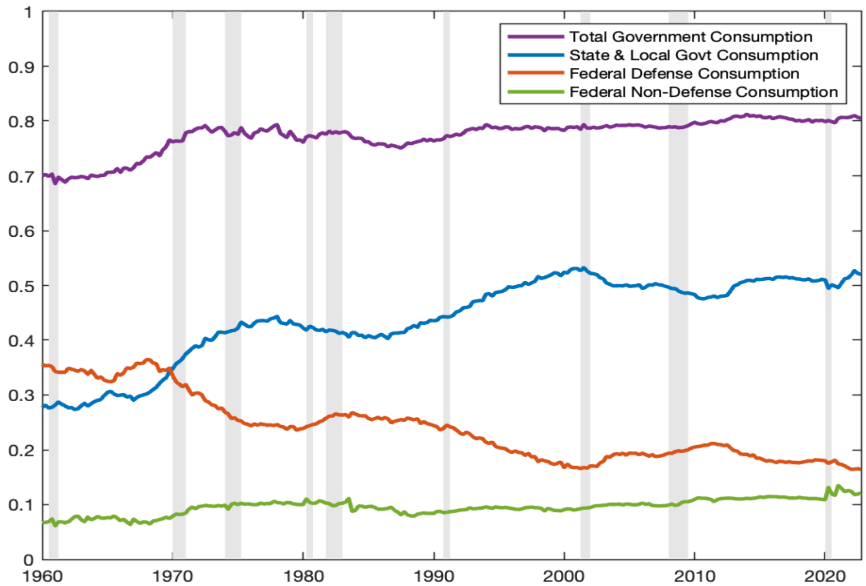

Figure 1.1: Components of Government Consumption Fraction of Total Government Spending

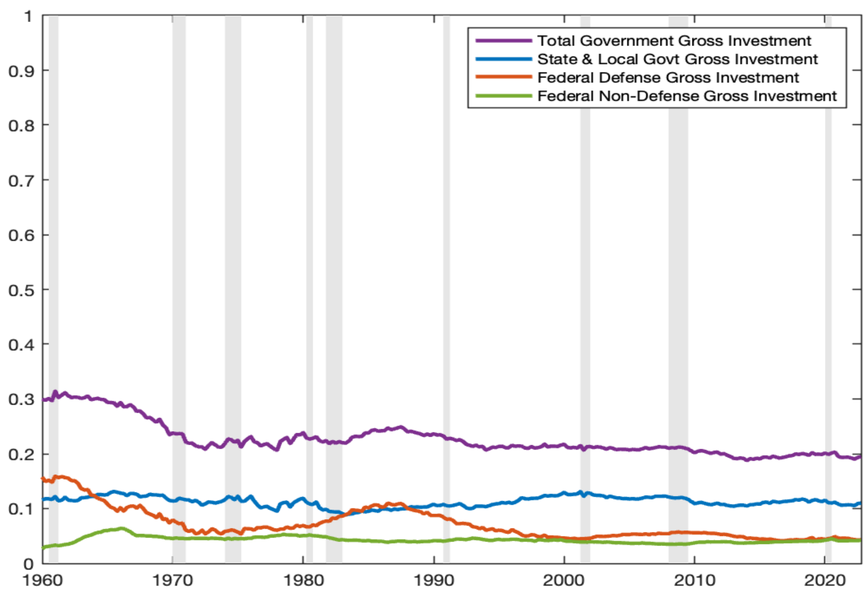

Figure 1.2: Components of Government Gross Investment Fraction of Total Government Spending

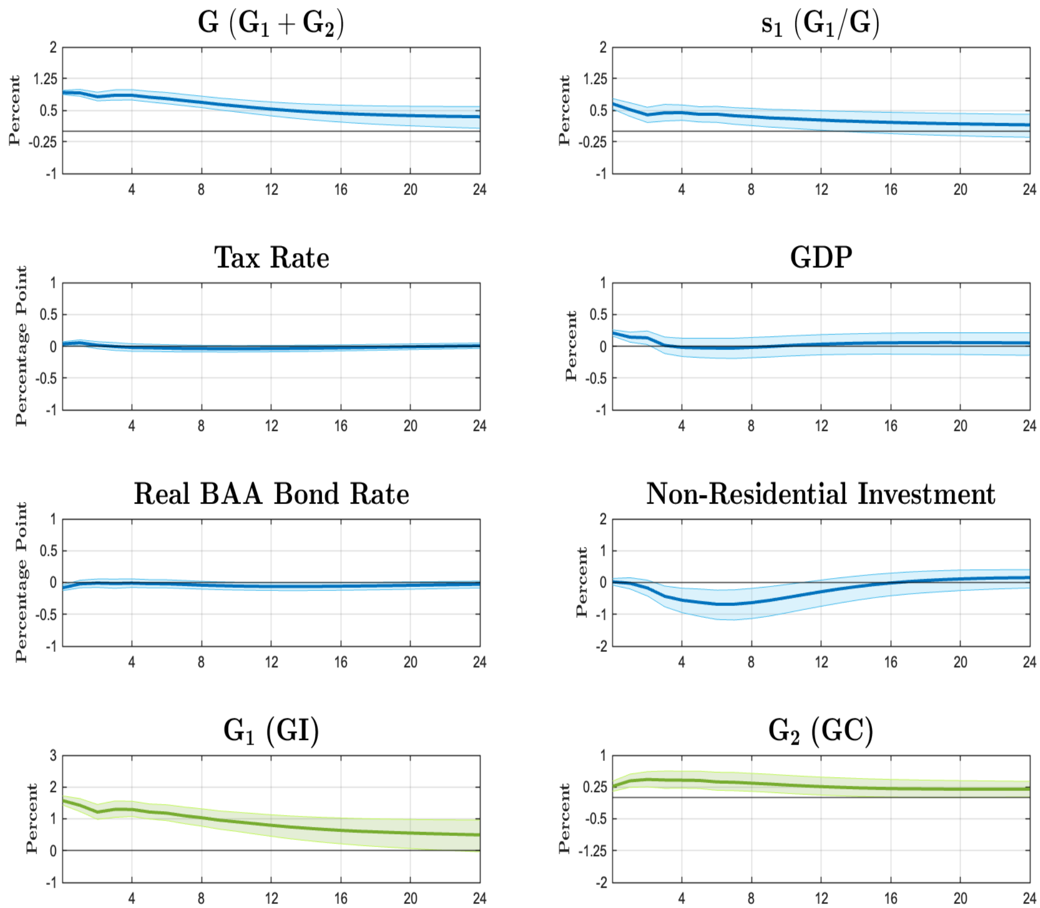

Figure 2.1: Impulse responses to a level shock (shock to G) generated from the VAR specification (2) using recursive identification with the level (G) ordered before the share of the component (s_1). Here, the level (G) represents total government spending, which consists of government investment (G_1) and government consumption (G_2), while the share (s_1) is defined as the ratio of government investment (G_1) to total government spending (G). Blue and green solid lines represent medians, and the shaded area represents the 68% credible bands.

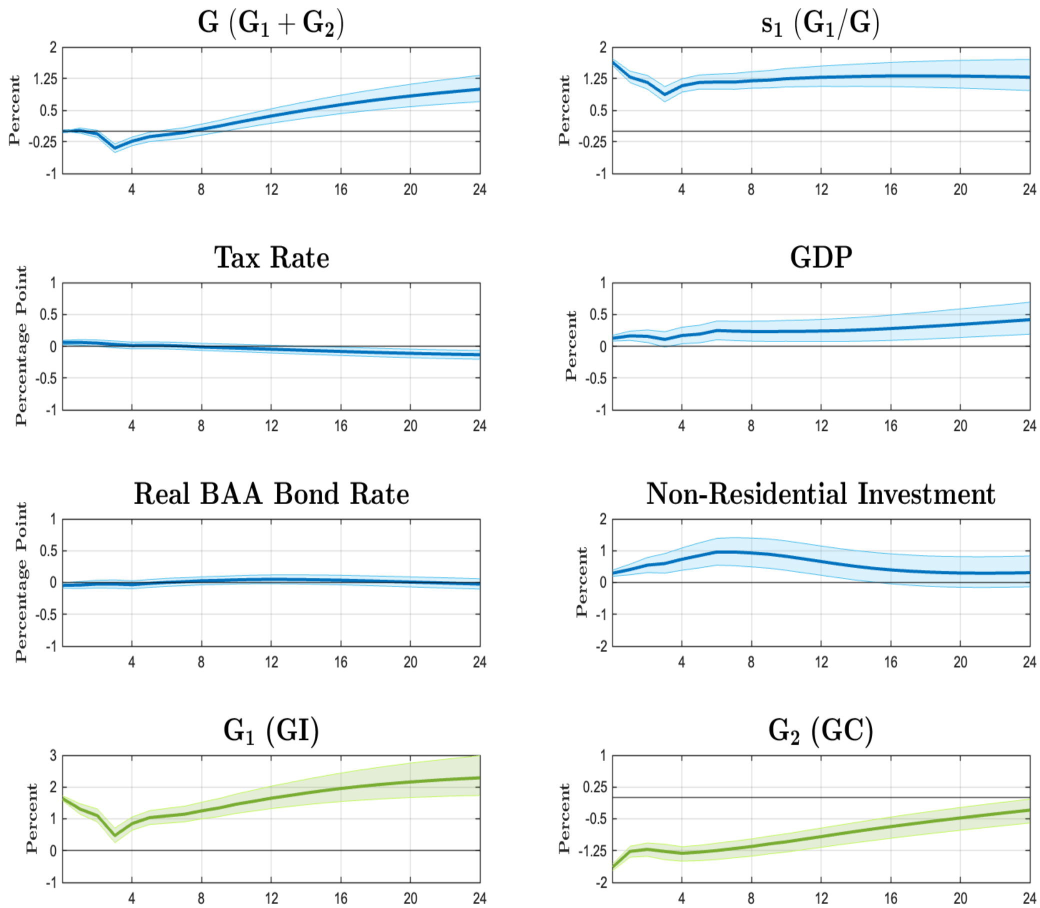

Figure 2.2: Impulse responses to a reallocation shock (shock to s_1) generated from the VAR specification (2) using recursive identification with the level (G) ordered before the share of the component (s_1). Here, the level (G) represents total government spending, which consists of government investment (G_1) and government consumption (G_2), while the share (s_1) is defined as the ratio of government investment (G_1) to total government spending (G). Blue and green solid lines represent medians, and the shaded area represents the 68% credible bands.

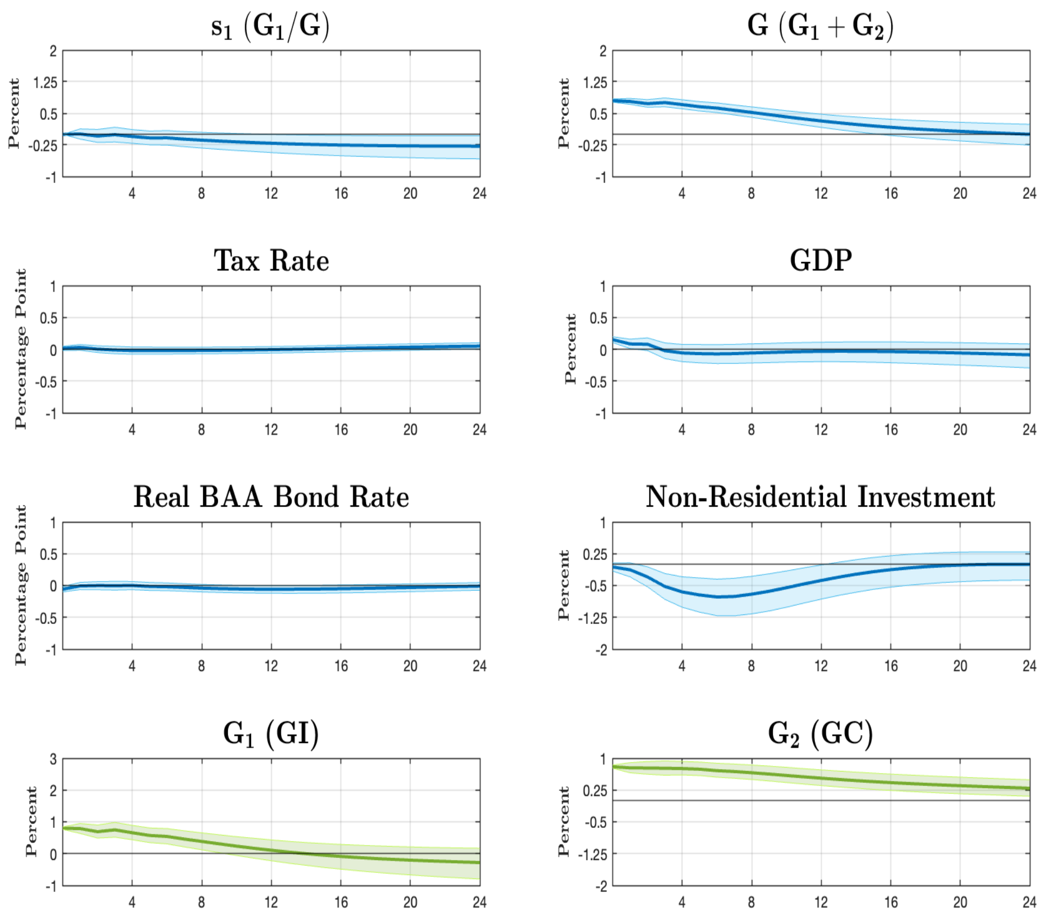

Figure 2.3: Impulse responses to a level shock (shock to G) generated from the VAR specification (12) using recursive identification with the share of the component (s_1) ordered before the level (G). Here, the level (G) represents total government spending, which consists of government investment (G_1) and government consumption (G_2), while the share (s_1) is defined as the ratio of government investment (G_1) to total government spending (G). Blue and green solid lines represent medians, and the shaded area represents the 68% credible bands.

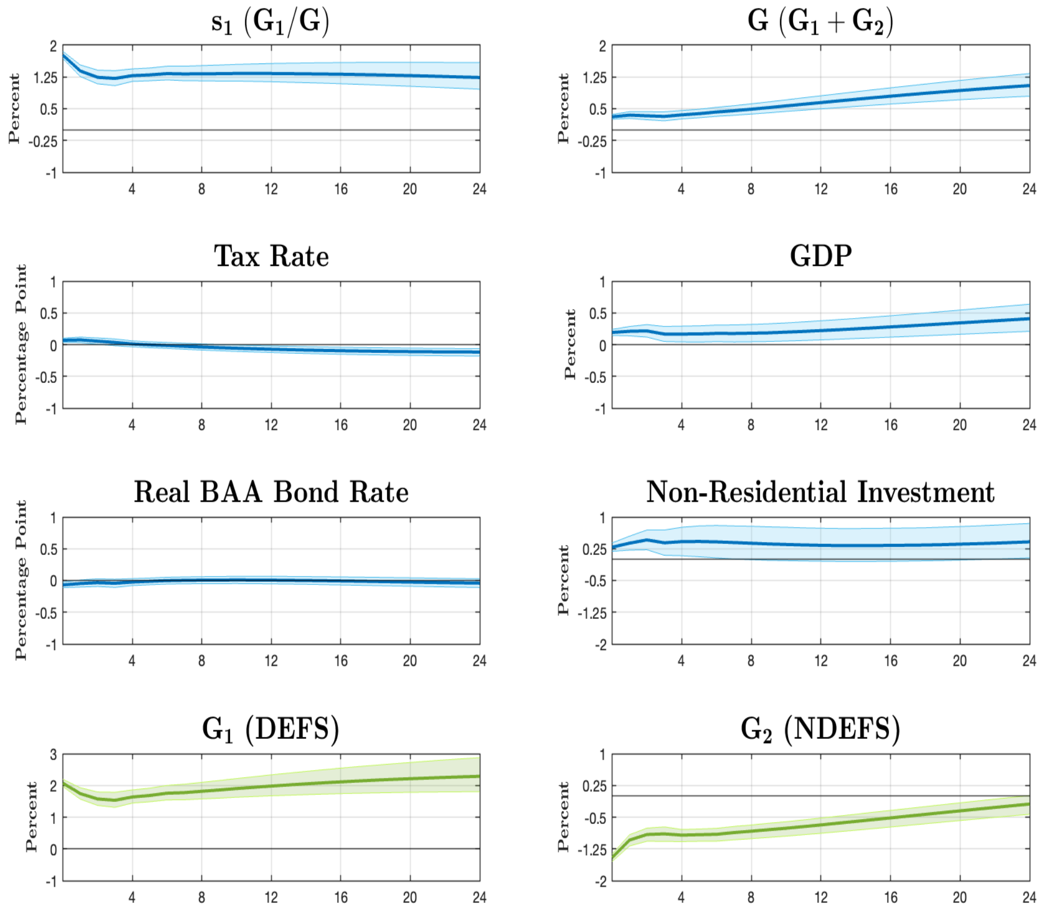

Figure 2.4: Impulse responses to a reallocation shock (shock to s_1) generated from the VAR specification (12) using recursive identification with the share of the component (s_1) ordered before the level (G). Here, the level (G) represents total government spending, which consists of government investment (G_1) and government consumption (G_2), while the share (s_1) is defined as the ratio of government investment (G_1) to total government spending (G). Blue and green solid lines represent medians, and the shaded area represents the 68% credible bands.

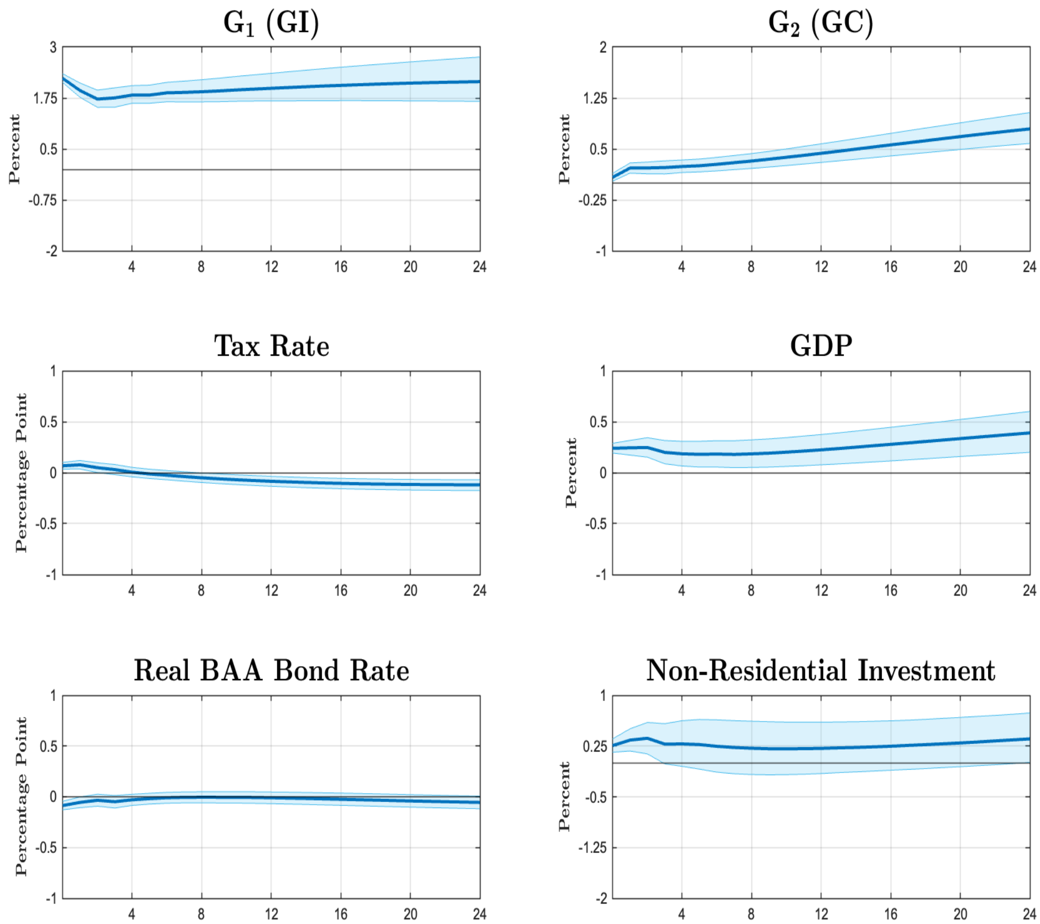

Figure 2.5: Impulse responses to a shock to G_1 generated from the VAR specification (1) using recursive identification with the spending component G_1 ordered before G_2. Here, G_1 represents government investment, and G_2 represents government consumption. Blue solid lines represent medians, and the shaded area represents the 68% credible bands.

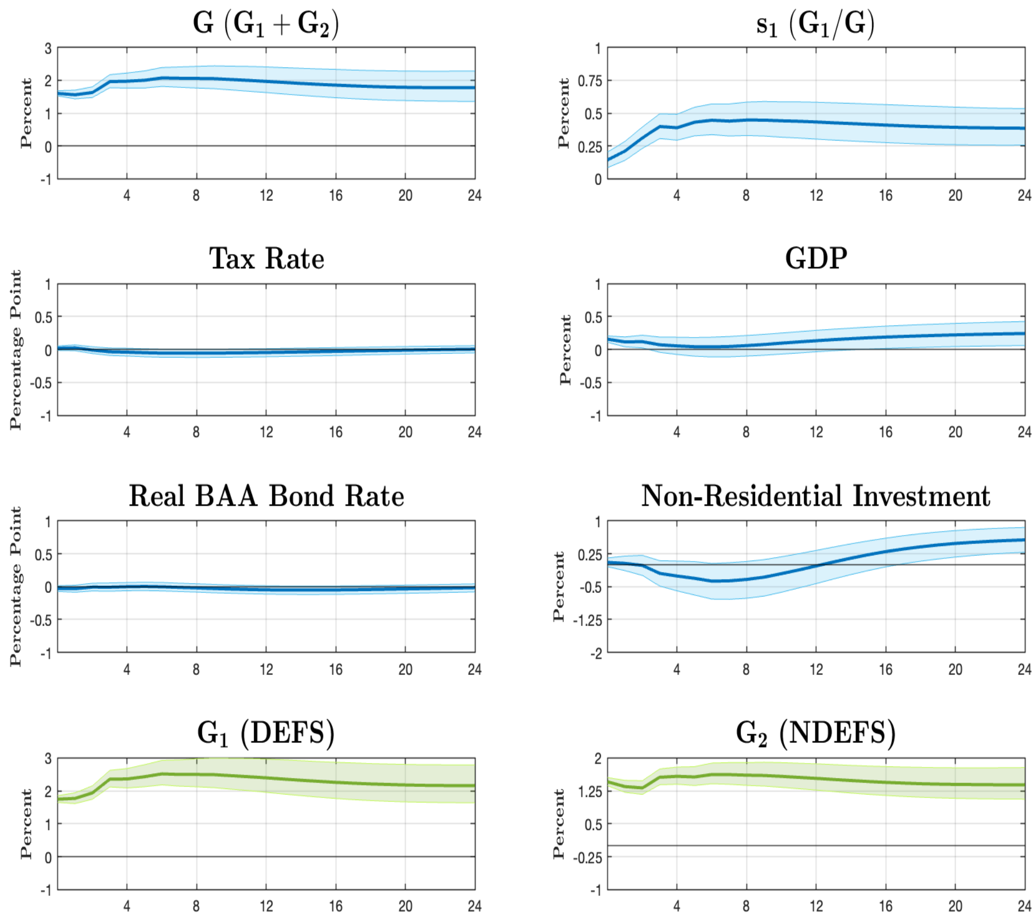

Figure 3.1: Impulse responses to a level shock (shock to G) generated from the VAR specification (2) using recursive identification with the level (G) ordered before the share of the component (s_1). Here, the level (G) represents total federal government spending, which consists of defense spending (G_1) and non-defense spending (G_2), while the share (s_1) is defined as the ratio of defense spending (G_1) to total federal government spending (G). Blue and green solid lines represent medians, and the shaded area represents the 68% credible bands.

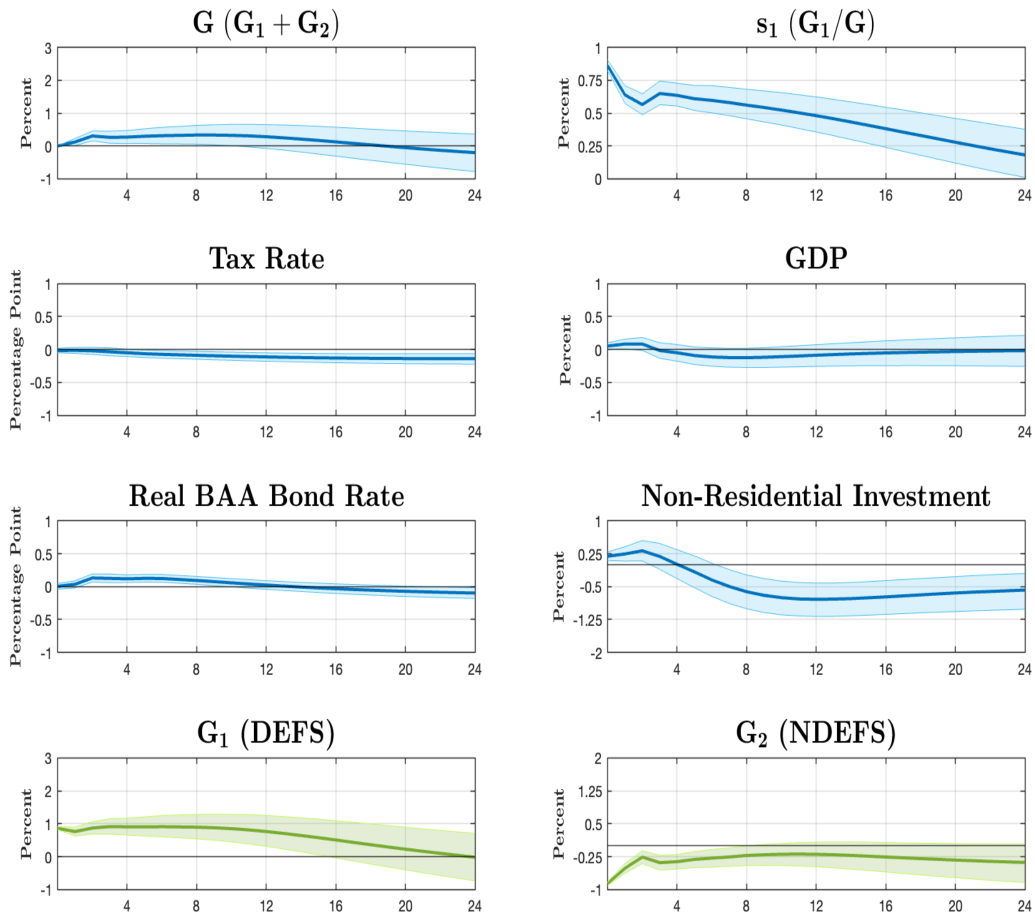

Figure 3.2: Impulse responses to a reallocation shock (shock to s_1) generated from the VAR specification (2) using recursive identification with the level (G) ordered before the share of the component (s_1). Here, the level (G) represents total federal government spending, which consists of defense spending (G_1) and non-defense spending (G_2), while the share (s_1) is defined as the ratio of defense spending (G_1) to total federal government spending (G). Blue and green solid lines represent medians, and the shaded area represents the 68% credible bands.

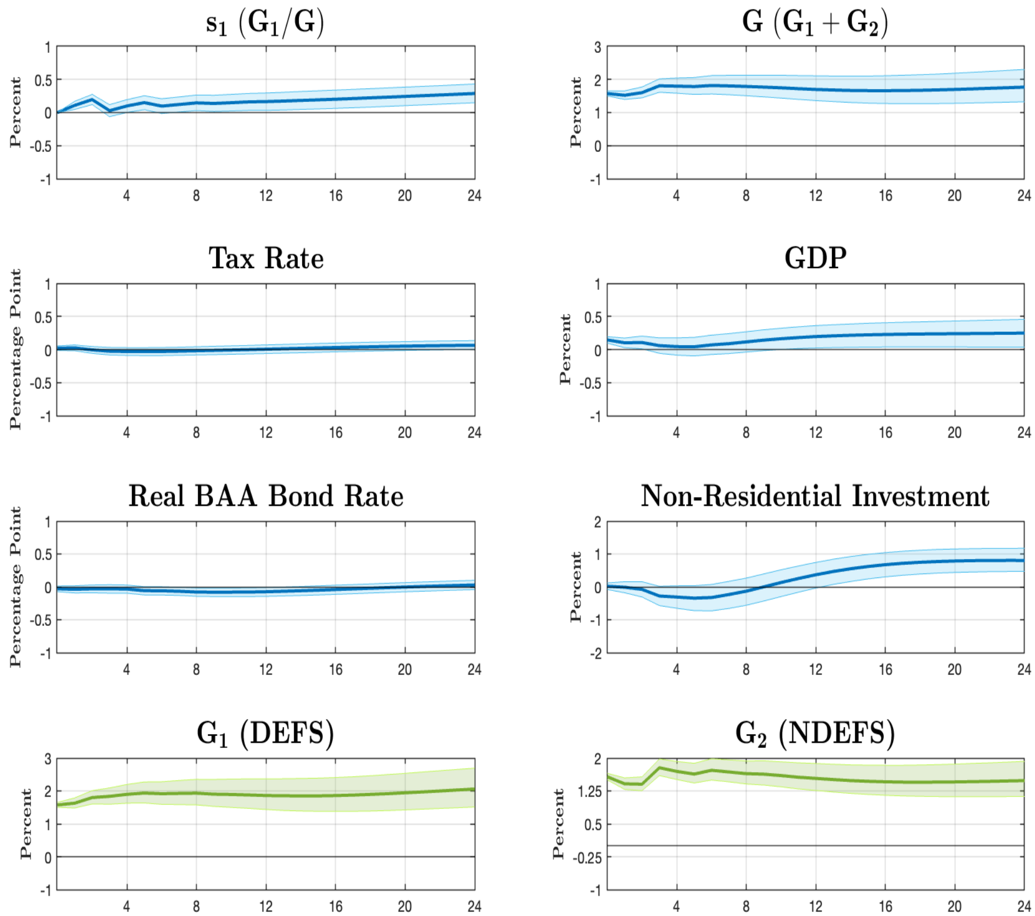

Figure 3.3: Impulse responses to a level shock (shock to G) generated from the VAR specification (12) using recursive identification with the share of the component (s_1) ordered before the level (G). Here, the level (G) represents total federal government spending, which consists of defense spending (G_1) and non-defense spending (G_2), while the share (s_1) is defined as the ratio of defense spending (G_1) to total federal government spending (G). Blue and green solid lines represent medians, and the shaded area represents the 68% credible bands.

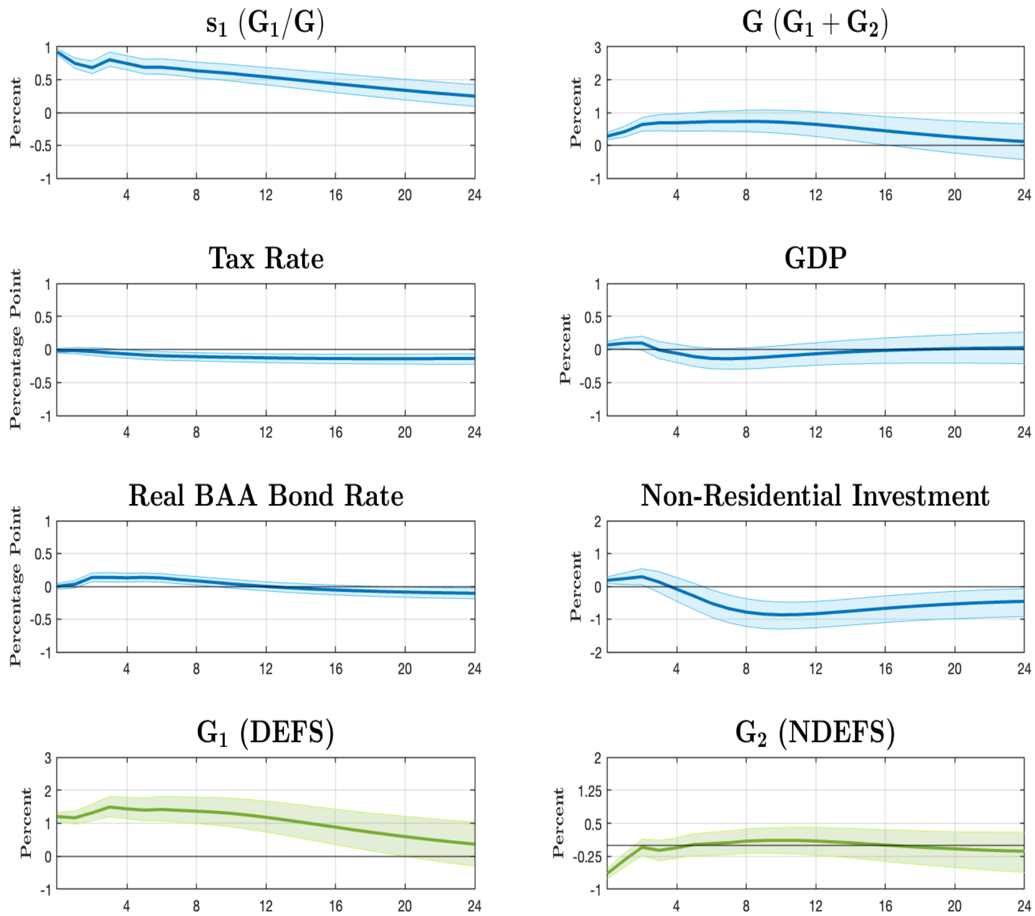

Figure 3.4: Impulse responses to a reallocation shock (shock to s_1) generated from the VAR specification (12) using recursive identification with the share of the component (s_1) ordered before the level (G). Here, the level (G) represents total federal government spending, which consists of defense spending (G_1) and non-defense spending (G_2), while the share (s_1) is defined as the ratio of defense spending (G_1) to total federal government spending (G). Blue and green solid lines represent medians, and the shaded area represents the 68% credible bands.

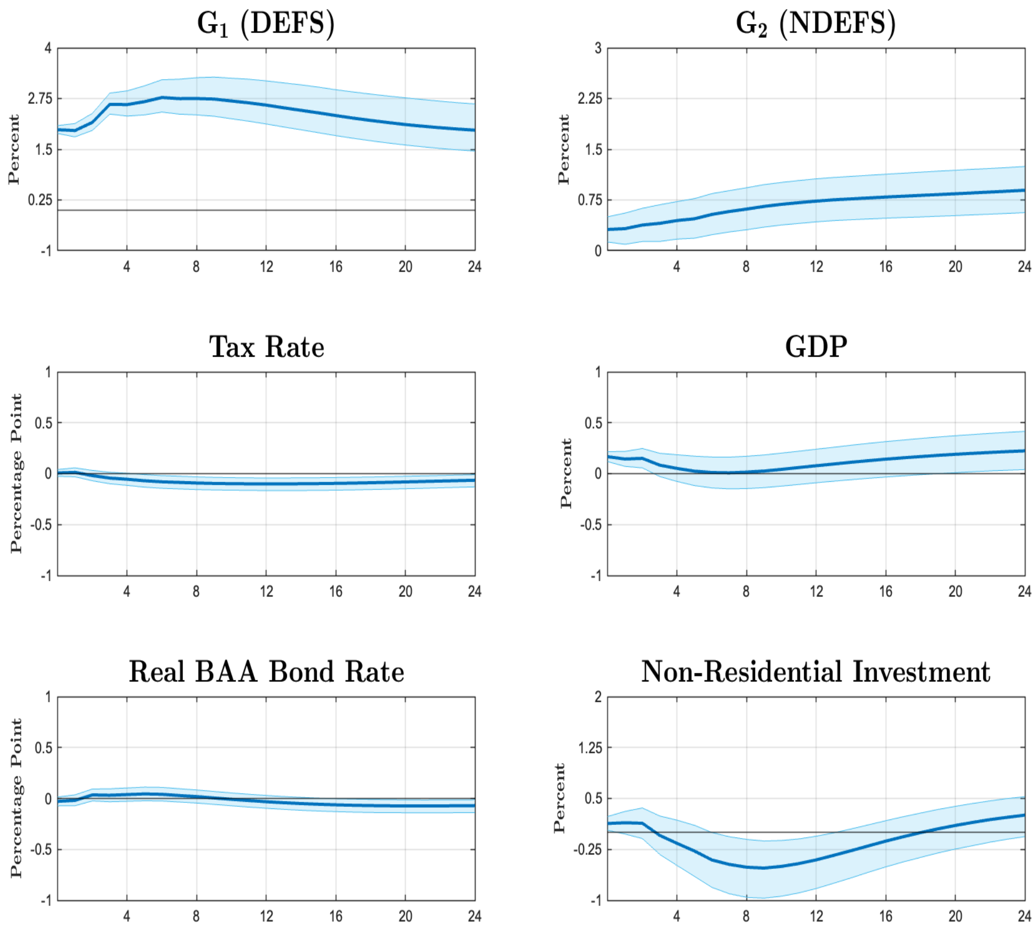

Figure 3.5: Impulse responses to a shock to G_1 generated from the VAR specification (1) using recursive identification with the spending component G_1 ordered before G_2. Here, G_1 represents defense spending, and G_2 represents non-defense spending. Blue solid lines represent medians, and the shaded area represents the 68% credible bands.

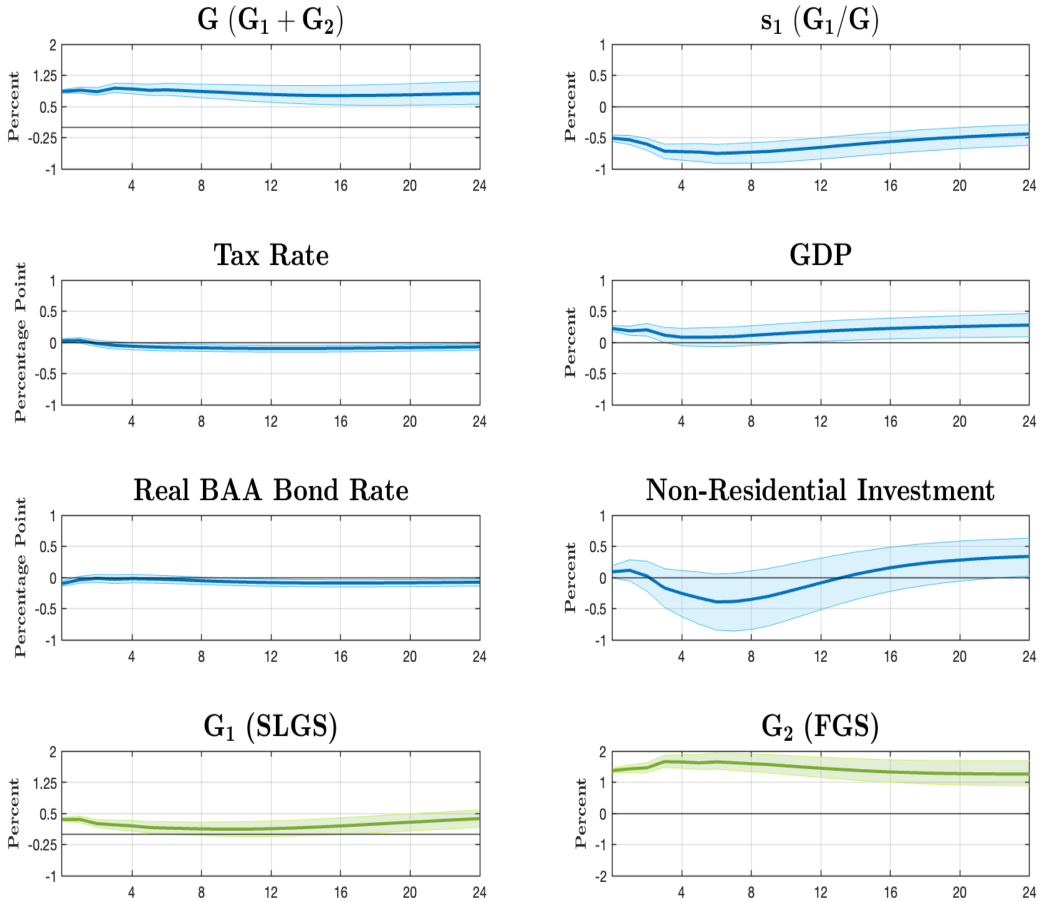

Figure 4.1: Impulse responses to a level shock (shock to G) generated from the VAR specification (2) using recursive identification with the level (G) ordered before the share of the component (s_1). Here, the level (G) represents total government spending, which consists of state and local government spending (G_1) and federal government spending (G_2), while the share (s_1) is defined as the ratio of state and local government spending (G_1) to total government spending (G). Blue and green solid lines represent medians, and the shaded area represents the 68% credible bands.

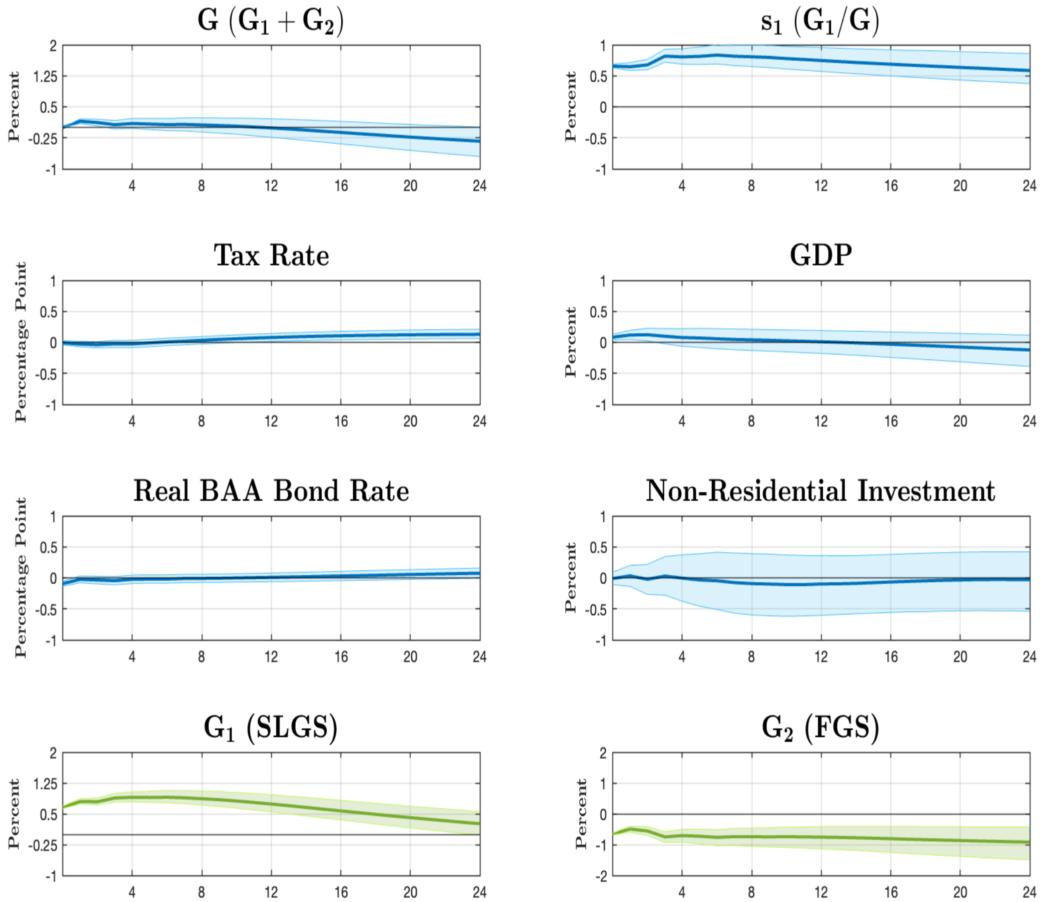

Figure 4.2: Impulse responses to a reallocation shock (shock to s_1) generated from the VAR specification (2) using recursive identification with the level (G) ordered before the share of the component (s_1). Here, the level (G) represents total government spending, which consists of state and local government spending (G_1) and federal government spending (G_2), while the share (s_1) is defined as the ratio of state and local government spending (G_1) to total government spending (G). Blue and green solid lines represent medians, and the shaded area represents the 68% credible bands.

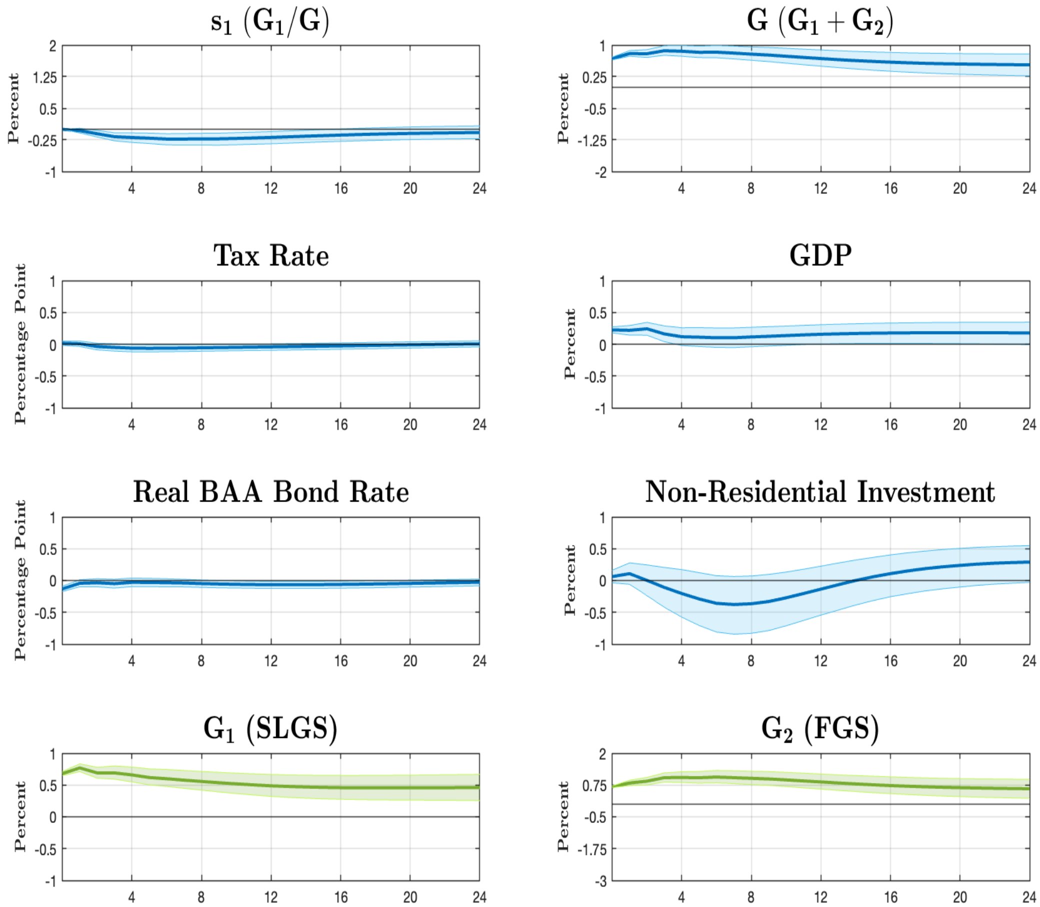

Figure 4.3: Impulse responses to a level shock (shock to G) generated from the VAR specification (12) using recursive identification with the share of the component (s_1) ordered before the level (G). Here, the level (G) represents total government spending, which consists of state and local government spending (G_1) and federal government spending (G_2), while the share (s_1) is defined as the ratio of state and local government spending (G_1) to total government spending (G). Blue and green solid lines represent medians, and the shaded area represents the 68% credible bands.

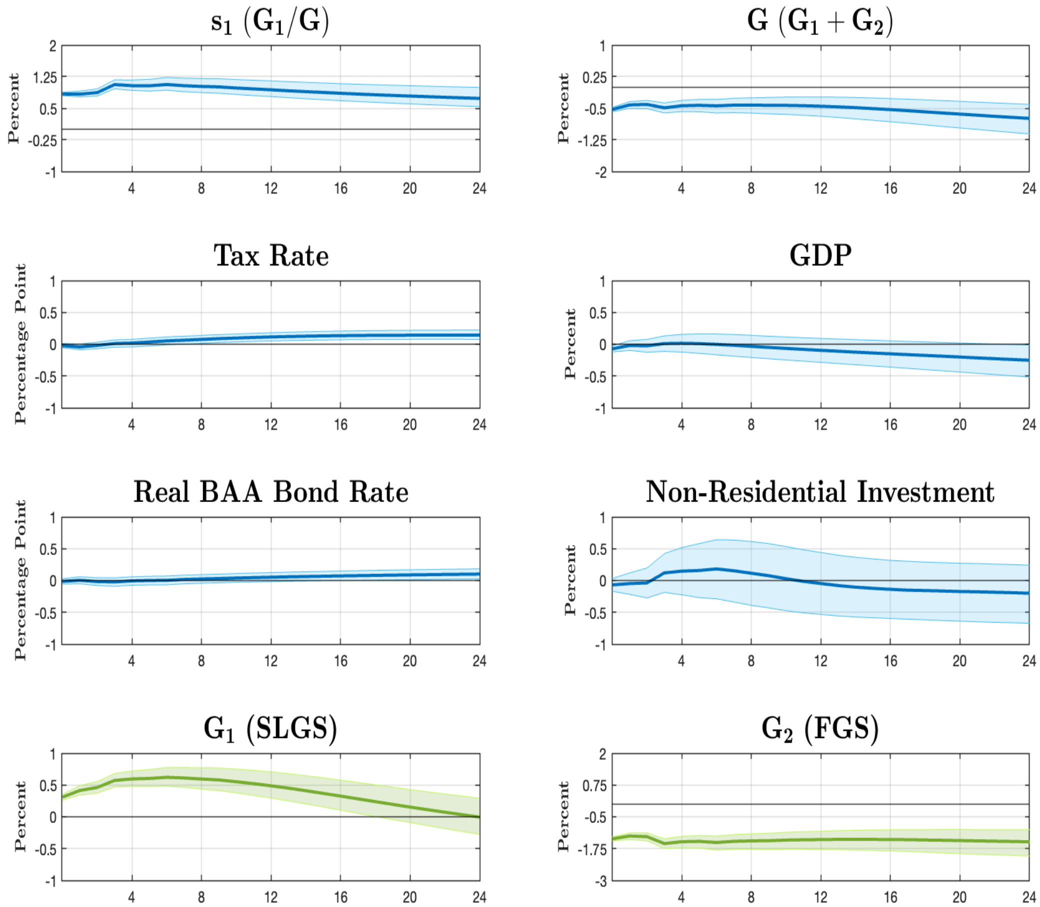

Figure 4.4: Impulse responses to a reallocation shock (shock to s_1) generated from the VAR specification (12) using recursive identification with the share of the component (s_1) ordered before the level (G). Here, the level (G) represents total government spending, which consists of state and local government spending (G_1) and federal government spending (G_2), while the share (s_1) is defined as the ratio of state and local government spending (G_1) to total government spending (G). Blue and green solid lines represent medians, and the shaded area represents the 68% credible bands.

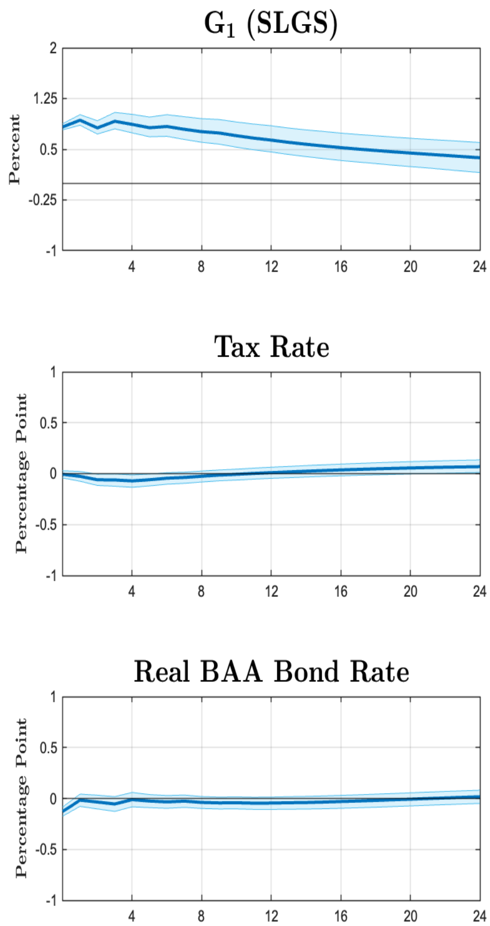

Figure 4.5: Impulse responses to a shock to G_1 generated from the VAR specification (1) using recursive identification with the spending component G_1 ordered before G_2. Here, G_1 represents state and local government spending, and G_2 represents federal government spending. Blue solid lines represent medians, and the shaded area represents the 68% credible bands.

Table 1: Multipliers - Government Investment and Consumption

This table presents the cumulative multipliers for GDP across the full sample at different horizons with 68% credible bands in brackets. Here, G_1 represents government investment, and G_2 represents government consumption, with G being the sum of these two components, or total government spending, and s_1 being the ratio of government investment (G_1) to total government spending (G). Columns (1) and (2) represent multipliers in response to a level shock (shock to G) and a reallocation shock (shock to s_1), respectively, generated from the VAR specification (2) using recursive identification with the level (G) ordered before the share of the component (s_1). Columns (3) and (4) represent multipliers in response to a level shock (shock to G) and a reallocation shock (shock to s_1), respectively, generated from the VAR specification (12) using recursive identification with the share of the component (s_1) ordered before the level (G). Column (5) represents multipliers in response to G_1 generated from the VAR specification (1) using recursive identification with the spending component G_1 ordered before G_2.

	Ordering $\{G, s_1, Z\}$		Ordering $\{s_1, G, Z\}$		Ordering $\{G_1, G_2, Z\}$
Horizon	Shock to G / Level (1)	Shock to s_1 / Reallocation (2)	Shock to G / Level (3)	Shock to s_1 / Reallocation (4)	Shock to G_1 (5)
On Impact	1.11	1.89	0.93	2.29	2.38
	[0.85, 1.37]	[1.21, 2.59]	[0.64, 1.20]	[1.73, 2.83]	[1.93, 2.84]
1 quarter	0.94	2.43	0.73	2.61	2.57
	[0.62, 1.26]	[1.50, 3.37]	[0.38, 1.07]	[1.89, 3.33]	[1.99, 3.15]
4 quarters	0.54	3.33	0.30	2.76	2.62
	[0.01, 1.05]	[1.36, 5.28]	[-0.29, 0.86]	[1.55, 3.94]	[1.67, 3.54]
8 quarters	0.24	4.07	-0.04	2.62	2.41
	[-0.48, 0.92]	[1.71, 6.46]	[-0.87, 0.73]	[1.18, 4.02]	[1.25, 3.52]
12 quarters	0.21	4.00	-0.14	2.63	2.40
	[-0.67, 0.99]	[1.68, 6.31]	[-1.25, 0.79]	[1.12, 4.05]	[1.16, 3.56]
16 quarters	0.25	3.83	-0.22	2.75	2.50
	[-0.79, 1.10]	[1.64, 6.01]	[-1.69, 0.89]	[1.23, 4.19]	[1.20, 3.68]
20 quarters	0.30	3.82	-0.31	2.94	2.67
	[-0.92, 1.20]	[1.68, 5.91]	[-2.38, 0.99]	[1.39, 4.41]	[1.32, 3.86]
24 quarters	0.35	3.94	-0.46	3.18	2.87
	[-1.11, 1.29]	[1.84, 5.97]	[-3.37, 1.09]	[1.59, 4.68]	[1.47, 4.10]

Table 2: Multipliers - Federal Defense and Non-Defense Spending

This table presents the cumulative multipliers for GDP across the full sample at different horizons with 68% credible bands in brackets. Here, G_1 represents defense spending, and G_2 represents non-defense spending, with G being the sum of these two components, or total federal government spending, and s_1 being the ratio of defense spending (G_1) to total federal government spending (G). Columns (1) and (2) represent multipliers in response to a level shock (shock to G) and a reallocation shock (shock to s_1), respectively, generated from the VAR specification (2) using recursive identification with the level (G) ordered before the share of the component (s_1). Columns (3) and (4) represent multipliers in response to a level shock (shock to G) and a reallocation shock (shock to s_1), respectively, generated from the VAR specification (12) using recursive identification with the share of the component (s_1) ordered before the level (G). Column (5) represents multipliers in response to G_1 generated from the VAR specification (1) using recursive identification with the spending component G_1 ordered before G_2.

	Ordering $\{G, s_1, Z\}$		Ordering $\{s_1, G, Z\}$		Ordering $\{G_1, G_2, Z\}$
Horizon	Shock to G / Level (1)	Shock to s_1 / Reallocation (2)	Shock to G / Level (3)	Shock to s_1 / Reallocation (4)	Shock to G_1 (5)
On Impact	1.11	1.22	1.05	1.13	1.43
	[0.77, 1.45]	[0.10, 2.33]	[0.70, 1.39]	[0.32, 1.96]	[1.02, 1.85]
1 quarter	0.98	1.66	0.90	1.37	1.34
	[0.56, 1.39]	[0.24, 3.09]	[0.49, 1.32]	[0.35, 2.41]	[0.84, 1.84]
4 quarters	0.67	0.70	0.62	0.58	0.90
	[0.11, 1.23]	[-1.33, 2.71]	[0.04, 1.21]	[-0.84, 1.98]	[0.26, 1.55]
8 quarters	0.47	-0.78	0.56	-0.55	0.50
	[-0.20, 1.13]	[-3.36, 1.60]	[-0.15, 1.28]	[-2.29, 1.12]	[-0.26, 1.27]
12 quarters	0.51	-1.28	0.74	-0.82	0.44
	[-0.23, 1.21]	[-4.43, 1.33]	[-0.07, 1.51]	[-2.84, 1.03]	[-0.39, 1.25]
16 quarters	0.63	-1.41	0.91	-0.79	0.53
	[-0.16, 1.35]	[-5.47, 1.61]	[0.03, 1.72]	[-3.21, 1.29]	[-0.36, 1.38]
20 quarters	0.75	-1.35	1.04	-0.69	0.67
	[-0.07, 1.50]	[-6.88, 2.34]	[0.10, 1.88]	[-3.72, 1.72]	[-0.28, 1.56]
24 quarters	0.87	-1.03	1.13	-0.56	0.82
	[0.02, 1.63]	[-8.34, 3.81]	[0.14, 1.99]	[-4.33, 2.30]	[-0.20, 1.76]

Table 3: Multipliers - State and Local Government and Federal Government Spending

This table presents the cumulative multipliers for GDP across the full sample at different horizons with 68% credible bands in brackets. Here, G_1 represents state and local government spending, and G_2 represents federal government spending, with G being the sum of these two components, or total government spending, and s_1 being the ratio of state and local government spending (G_1) to total government spending (G). Columns (1) and (2) represent multipliers in response to a level shock (shock to G) and a reallocation shock (shock to s_1), respectively, generated from the VAR specification (2) using recursive identification with the level (G) ordered before the share of the component (s_1). Columns (3) and (4) represent multipliers in response to a level shock (shock to G) and a reallocation shock (shock to s_1), respectively, generated from the VAR specification (12) using recursive identification with the share of the component (s_1) ordered before the level (G). Column (5) represents multipliers in response to G_1 generated from the VAR specification (1) using recursive identification with the spending component G_1 ordered before G_2.

	Ordering $\{G, s_1, Z\}$		Ordering $\{s_1, G, Z\}$		Ordering $\{G_1, G_2, Z\}$
Horizon	Shock to G / Level (1)	Shock to s_1 / Reallocation (2)	Shock to G / Level (3)	Shock to s_1 / Reallocation (4)	Shock to G_1 (5)
On Impact	1.27	1.10	1.63	-2.06	1.88
	[1.01, 1.55]	[0.49, 1.72]	[1.29, 1.97]	[-3.68, -0.67]	[1.31, 2.43]
1 quarter	1.15	1.21	1.48	-1.13	1.76
	[0.83, 1.46]	[0.53, 1.90]	[1.10, 1.85]	[-2.75, 0.28]	[1.13, 2.39]
4 quarters	0.89	1.08	1.19	-0.34	1.45
	[0.41, 1.36]	[0.11, 2.04]	[0.65, 1.73]	[-2.16, 1.28]	[0.47, 2.40]
8 quarters	0.73	0.82	0.95	-0.26	1.08
	[0.09, 1.33]	[-0.41, 2.00]	[0.26, 1.61]	[-2.37, 1.61]	[-0.18, 2.29]
12 quarters	0.79	0.64	0.95	-0.55	1.03
	[0.07, 1.43]	[-0.79, 1.96]	[0.18, 1.65]	[-3.10, 1.51]	[-0.43, 2.37]
16 quarters	0.90	0.49	1.03	-0.98	1.06
	[0.14, 1.56]	[-1.22, 1.94]	[0.19, 1.74]	[-4.25, 1.35]	[-0.61, 2.50]
20 quarters	1.01	0.29	1.12	-1.58	1.05
	[0.22, 1.68]	[-1.79, 1.93]	[0.21, 1.84]	[-6.09, 1.22]	[-0.86, 2.61]
24 quarters	1.11	0.04	1.18	-2.33	1.01
	[0.30, 1.77]	[-2.60, 1.93]	[0.20, 1.92]	[-9.03, 1.16]	[-1.22, 2.71]

Appendix

Variable Definitions

1. **Government Spending Components**: Quarterly data for each of the components of government purchases are sourced from Table 3.9.5 of the National Income and Product Accounts (NIPA), provided by the Bureau of Economic Analysis. Details for each component are as follows:

   - Federal Defense Consumption Expenditures (DEFC) - Row 18
   - Federal Defense Gross Investment (DEFI) - Row 19
   - Federal Non-Defense Consumption Expenditures (NDEFC) - Row 26
   - Federal Non-Defense Gross Investment (NDEFI) - Row 27
   - State and Local Government Consumption Expenditures (SLGC) - Row 34,
   - State and Local Government Gross Investment (SLGI) - Row 35

   All components are adjusted to real per capita terms by dividing the nominal values by the GDP deflator and the population measure. The sum of these components constitutes total government spending. To calculate total federal spending, we aggregate the federal defense and federal non-defense components. Similarly, state and local government spending is computed by summing the respective consumption and investment figures.

2. **Population**: Quarterly population data, including resident population plus armed forces overseas from the Federal Reserve Board of St Louis website (B230RC0Q173SBEA).

3. **Nominal GDP and Private Non-Residential Investment**: These metrics are available from Lines 1 and 5 of Table 1.1.5 in the National Income and Product Accounts (NIPA). Real per capita values are calculated by dividing nominal values by both the GDP deflator and the population figure.

4. **Implicit Price Deflator for GDP**: This is sourced from Row 1 of Table 1.1.9 of National Income and Product Accounts (NIPA).

5. **Average Marginal Tax Rate**: The annual income-weighted average marginal tax rate is

sourced from the National Bureau of Economic Research's TAXSIM[11]. The series is converted to a quarterly frequency, assuming the tax rate for each quarter matches the annual rate for that year (Ramey, 2011).

6. **Real BAA Bond Rate**: The Moody's Seasoned Baa Corporate Bond Yield is taken from the Federal Reserve Board of St Louis website[12]. A quarterly rate is calculated by taking the arithmetic average of the monthly figures, and is then adjusted for inflation as defined by the CPI (Mountford and Uhlig, 2009; Ramey, 2011).

7. **Consumer Price Index (CPI)**: This is the consumer price index for all urban consumers given by the series CPIAUCSL on the Federal Reserve Board of St Louis website.The inflation rate is then computed as the annualized quarter-to-quarter log-change in the consumer price index (CPI).

[11] https://taxsim.nber.org/allyup/fixed-ally.html
[12] https://fred.stlouisfed.org/series/BAA

Table A.1: Present Value Multipliers - Government Investment and Consumption

This table presents the discounted cumulative multipliers for GDP across the full sample at different horizons with 68% credible bands in brackets. Here, G_1 represents government investment, and G_2 represents government consumption, with G being the sum of these two components, or total government spending, and s_1 being the ratio of government investment (G_1) to total government spending (G). Columns (1) and (2) represent multipliers in response to a level shock (shock to G) and a reallocation shock (shock to s_1), respectively, generated from the VAR specification (2) using recursive identification with the level (G) ordered before the share of the component (s_1). Columns (3) and (4) represent multipliers in response to a level shock (shock to G) and a reallocation shock (shock to s_1), respectively, generated from the VAR specification (12) using recursive identification with the share of the component (s_1) ordered before the level (G). Column (5) represents multipliers in response to G_1 generated from the VAR specification (1) using recursive identification with the spending component G_1 ordered before G_2.

	Ordering $\{G, s_1, Z\}$		Ordering $\{s_1, G, Z\}$		Ordering $\{G_1, G_2, Z\}$
Horizon	Shock to G / Level (1)	Shock to s_1 / Reallocation (2)	Shock to G / Level (3)	Shock to s_1 / Reallocation (4)	Shock to G_1 (5)
On Impact	1.11	1.89	0.93	2.29	2.38
	[0.85, 1.37]	[1.21, 2.59]	[0.64, 1.20]	[1.73, 2.83]	[1.93, 2.84]
1 quarter	0.94	2.44	0.72	2.62	2.58
	[0.62, 1.26]	[1.51, 3.39]	[0.37, 1.07]	[1.89, 3.35]	[2.00, 3.16]
4 quarters	0.51	3.41	0.27	2.76	2.61
	[-0.04, 1.04]	[1.34, 5.45]	[-0.34, 0.85]	[1.51, 3.98]	[1.63, 3.56]
8 quarters	0.19	4.21	-0.11	2.61	2.38
	[-0.57, 0.90]	[1.75, 6.71]	[-0.99, 0.72]	[1.11, 4.05]	[1.18, 3.54]
12 quarters	0.17	4.05	-0.22	2.62	2.38
	[-0.79, 1.00]	[1.65, 6.42]	[-1.46, 0.79]	[1.05, 4.10]	[1.08, 3.59]
16 quarters	0.24	3.82	-0.31	2.78	2.52
	[-0.96, 1.16]	[1.59, 6.03]	[-2.17, 0.96]	[1.19, 4.29]	[1.15, 3.75]
20 quarters	0.33	3.81	-0.46	3.05	2.76
	[-1.19, 1.32]	[1.64, 5.93]	[-3.51, 1.17]	[1.42, 4.59]	[1.32, 4.02]
24 quarters	0.42	3.98	-0.48	3.38	3.06
	[-1.49, 1.46]	[1.86, 6.03]	[-5.30, 1.62]	[1.71, 4.96]	[1.55, 4.36]

Table A.2: Present Value Multipliers - Federal Defense and Non-Defense Spending

This table presents the cumulative multipliers for GDP across the full sample at different horizons with 68% credible bands in brackets. Here, G_1 represents defense spending, and G_2 represents non-defense spending, with G being the sum of these two components, or total federal government spending, and s_1 being the ratio of defense spending (G_1) to total federal government spending (G). Columns (1) and (2) represent multipliers in response to a level shock (shock to G) and a reallocation shock (shock to s_1), respectively, generated from the VAR specification (2) using recursive identification with the level (G) ordered before the share of the component (s_1). Columns (3) and (4) represent multipliers in response to a level shock (shock to G) and a reallocation shock (shock to s_1), respectively, generated from the VAR specification (12) using recursive identification with the share of the component (s_1) ordered before the level (G). Column (5) represents multipliers in response to G_1 generated from the VAR specification (1) using recursive identification with the spending component G_1 ordered before G_2.

	Ordering $\{G, s_1, Z\}$		Ordering $\{s_1, G, Z\}$		Ordering $\{G_1, G_2, Z\}$
Horizon	Shock to G / Level (1)	Shock to s_1 / Reallocation (2)	Shock to G / Level (3)	Shock to s_1 / Reallocation (4)	Shock to G_1 (5)
On Impact	1.11	1.22	1.05	1.13	1.43
	[0.77, 1.45]	[0.10, 2.33]	[0.70, 1.39]	[0.32, 1.96]	[1.02, 1.85]
1 quarter	0.97	1.68	0.90	1.37	1.34
	[0.56, 1.39]	[0.24, 3.11]	[0.48, 1.32]	[0.35, 2.42]	[0.84, 1.84]
4 quarters	0.65	0.62	0.60	0.52	0.87
	[0.08, 1.22]	[-1.45, 2.68]	[0.01, 1.20]	[-0.94, 1.95]	[0.22, 1.53]
8 quarters	0.44	-0.99	0.55	-0.72	0.44
	[-0.25, 1.12]	[-3.71, 1.45]	[-0.18, 1.30]	[-2.53, 1.02]	[-0.34, 1.23]
12 quarters	0.50	-1.53	0.77	-0.98	0.40
	[-0.27, 1.22]	[-4.98, 1.22]	[-0.07, 1.58]	[-3.14, 0.96]	[-0.47, 1.24]
16 quarters	0.66	-1.61	0.99	-0.89	0.54
	[-0.17, 1.42]	[-6.43, 1.76]	[0.05, 1.85]	[-3.65, 1.38]	[-0.42, 1.42]
20 quarters	0.84	-1.30	1.16	-0.70	0.74
	[-0.04, 1.62]	[-8.33, 3.26]	[0.14, 2.06]	[-4.42, 2.10]	[-0.30, 1.69]
24 quarters	1.00	-0.41	1.28	-0.36	0.98
	[0.07, 1.81]	[-9.59, 6.65]	[0.18, 2.20]	[-5.45, 3.22]	[-0.16, 1.99]

Table A.3: Present Value Multipliers - State and Local Government and Federal Government Spending

This table presents the discounted cumulative multipliers for GDP across the full sample at different horizons with 68% credible bands in brackets. Here, G_1 represents state and local government spending, and G_2 represents federal government spending, with G being the sum of these two components, or total government spending, and s_1 being the ratio of state and local government spending (G_1) to total government spending (G). Columns (1) and (2) represent multipliers in response to a level shock (shock to G) and a reallocation shock (shock to s_1), respectively, generated from the VAR specification (2) using recursive identification with the level (G) ordered before the share of the component (s_1). Columns (3) and (4) represent multipliers in response to a level shock (shock to G) and a reallocation shock (shock to s_1), respectively, generated from the VAR specification (12) using recursive identification with the share of the component (s_1) ordered before the level (G). Column (5) represents multipliers in response to G_1 generated from the VAR specification (1) using recursive identification with the spending component G_1 ordered before G_2.

	Ordering $\{G, s_1, Z\}$		Ordering $\{s_1, G, Z\}$		Ordering $\{G_1, G_2, Z\}$
Horizon	Shock to G / Level (1)	Shock to s_1 / Reallocation (2)	Shock to G / Level (3)	Shock to s_1 / Reallocation (4)	Shock to G_1 (5)
On Impact	1.27	1.10	1.63	-2.06	1.88
	[1.01, 1.55]	[0.49, 1.72]	[1.29, 1.97]	[-3.68, -0.67]	[1.31, 2.43]
1 quarter	1.14	1.21	1.47	-1.11	1.76
	[0.82, 1.46]	[0.53, 1.90]	[1.10, 1.85]	[-2.73, 0.30]	[1.12, 2.39]
4 quarters	0.87	1.07	1.17	-0.31	1.42
	[0.37, 1.36]	[0.08, 2.05]	[0.61, 1.72]	[-2.13, 1.33]	[0.41, 2.40]
8 quarters	0.70	0.78	0.91	-0.24	1.02
	[0.03, 1.33]	[-0.49, 2.01]	[0.19, 1.59]	[-2.40, 1.68]	[-0.30, 2.28]
12 quarters	0.78	0.58	0.93	-0.59	0.98
	[0.03, 1.46]	[-0.95, 1.96]	[0.12, 1.66]	[-3.31, 1.54]	[-0.59, 2.39]
16 quarters	0.94	0.38	1.05	-1.18	1.02
	[0.12, 1.64]	[-1.54, 1.96]	[0.14, 1.80]	[-4.95, 1.35]	[-0.83, 2.58]
20 quarters	1.10	0.09	1.17	-2.05	1.03
	[0.24, 1.79]	[-2.47, 1.95]	[0.16, 1.94]	[-8.07, 1.23]	[-1.23, 2.77]
24 quarters	1.24	-0.31	1.28	-3.02	0.98
	[0.36, 1.92]	[-3.99, 1.98]	[0.16, 2.06]	[-13.47, 1.52]	[-1.88, 2.94]