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Abstract

We simultaneously identify two government spending shocks: military spending shocks as defined by Ramey (2008) and federal spending shocks as defined by Perotti (2008). We analyze the effect of these shocks on state-level personal income and employment. We find regional patterns in the manner in which both shocks affect state-level variables. Moreover, we find differences in the propagation mechanisms for military versus nonmilitary spending shocks. The former benefits economies with larger manufacturing and retail sectors and states that receive military contracts. While non-military shocks also benefit states with the proper industrial mix, they appear to stimulate economic activity in lower-income states.

keywords: fiscal policy, structural VAR, government spending
[JEL codes: C32, E62, R12]

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1 Introduction

The result of fiscal stimulus is often measured as the increase in gross domestic product (GDP) per dollar spent by the government, the so-called government spending multiplier. Unfortunately, an aggregate multiplier does not capture the potential industrial, geographic, or demographic heterogeneity in the effects of a spending increase. Such dispersion, in addition to determining who benefits, may help us determine the channels in which fiscal stimulus acts.

Government spending shocks are often identified in vector autoregressions (VARs) as innovations to total government spending, which combines both federal and state/local spending [see Blanchard and Perotti (2002) and Perotti (2008)].[1] In these papers, government spending shocks are identified by ordering (exclusion) restrictions on the contemporaneous impact matrix of the VAR.[2] One typically assumes that government spending (at a quarterly frequency) is determined before other economic variables (i.e., spending does not contemporaneously respond to the realization of other economic variables). Most of the resulting impulse responses have signs and shapes broadly consistent with the theoretical literature. For example, output rises on impact and exhibits a hump-shaped response over time.[3]

This approach, however, treats shocks to state and local spending as equivalent to shocks to federal spending. Thus, shocks to, say, California's spending are allowed to have contemporaneous (within the current quarter) effects on New Jersey's income and employment. Moreover, combining the spending series ignores the variation in the composition of the government's portfolio. For example, military spending is a large part of federal spending, while education is one of the largest components of state/local spending. One might expect

[1] A notable exception to this is Engemann, Owyang, and Zubairy (2008), who consider federal and local spending separately.

[2] Alternative identification techniques using sign restrictions yield results similar to the timing restriction. Sign restrictions are often used when quarterly data are unavailable and no timing convention can be adopted.

[3] The responses of some variables, however, remain controversial. Consumption and real wages, in particular, may have different impact responses depending on whether government spending shocks are identified using the aforementioned timing convention or alternative methods such as spending dummies (Ramey and Shapiro, 1998; Edelberg, Eichenbaum, and Fisher, 1999; Ramey, 2008).

relatively little difference in the dispersion of funds from education; on the other hand, military spending might have more effect in areas where bases or weapons manufacturers are located.[4] Indeed, Schiller (1999) shows that the distribution of per-capita federal spending to the states varies quite significantly.

The combined treatment of federal and regional spending also runs contrary to the literature on intranational macroeconomics. For example, Carlino and DeFina (1998) show that VAR-identified monetary policy shocks have disparate effects on the regions. The magnitude and duration of the effects of a surprise increase in the federal funds rate depend on, for instance, the industrial mix or the banking concentration of the region in question. Owyang, Piger, and Wall (2005) show that states have their own distinct business cycles. While these cycles may be related to the national business cycle and to each other, they also tend have idiosyncratic timing and magnitudes. Crone (2005) uses k-means clustering to define new regions and finds that states in what he calls the Rust Belt and the Energy Belt have distinct business cycles from the rest of the nation. Thus, one might not expect uniformity in the responses of state-level variables, even to changes in *federal* spending.

It is this variation in the state-level response to federal spending with which we are interested. Previous work has considered differences in the responses of state-level economic variables to shocks to state-level spending. Pappa (2005) finds that positive state-level government consumption and investment shocks increase real wages and employment, and shows that federal expenditures tend to be less expansionary than expenditures of the same magnitude at the state level, based on output multipliers. Canova and Pappa (2007) show that shocks to local government spending or taxes are a source of price differentials within monetary unions, like the E.U. or U.S.

The role of military spending shocks in explaining regional fluctuations has also been explored by others. Davis, Loungani, and Mahidhara (1997) consider the role of military contract awards and basing of military personnel as driving forces for regional fluctuations,

[4]Christiansen and Goudie (2008), for example, find some differences in regional technological progress based on the variation of military prime contracts.

along with oil shocks. They find asymmetric unemployment responses to positive and negative regional shocks. Negative shocks, involving increases in oil prices or scaling back of military contract awards, cause employment to fall significantly, more so than an equal-sized positive shock causes employment to rise. Hooker and Knetter (1997) also find that adverse military spending shocks have large negative effects on state employment growth rates. Hooker (1996) finds the same effect of military spending shocks on state-level personal income.

In this paper, we consider the potential differences between state-level responses to innovations in both federal non-military and military spending. Consistent with the previous literature on federal government spending shocks, we identify innovations to federal spending in VARs by ordering government spending ahead of the state-level variables of interest. We identify large military spending shocks as per Ramey (2008), ordered first in the VAR.

We find that, while the shapes of the state-level responses of both personal income and employment are largely consistent across states, the magnitudes (and occasionally the signs on impact) vary. We note that these variations appear regional in nature, concentrated in states that have similar industrial, fiscal, and demographic characteristics. In light of this, we explore the hypothesis that state-level characteristics may determine the concentration of either military or non-military federal spending. We further consider whether military spending has a greater effect in states in which military bases or industries are located.

Our results suggest that the industrial mix is an important determinant of the magnitude of the responses of real activity to spending shocks. The industries of importance depend on the nature of the government spending shock. A state's responsiveness to federal non-military spending shocks is influenced by the shares of manufacturing, agriculture and construction. In addition, state-level fiscal policy indicators and demographic variables can influence the responsiveness of the state to non-military spending shocks. Shocks to military spending stimulate economic activity in states with higher manufacturing and retail shares, and in those that receive a large share of military prime contracts, suggesting a procurement effect.

The remainder of the paper is organized as follows. Section 2 outlines the canonical VAR model of government spending, including a review of the identification based on timing restrictions and military spending dummies. We then outline the model used to identify the state-level responses to government spending shocks. Our model can be thought of as a restricted panel extension of the baseline aggregate VAR, which rules out contemporaneous co-movements not driven by aggregate shocks. Section 3 presents the results from the estimation summarized in the impulse responses of personal income and employment to two types of government spending shocks. We also consider cross-sectional differences in the explanatory power of the two government spending shocks for states' unconditional variances. Section 4 analyzes the variation across the state-level responses by regressing the response magnitudes on sets of state-level covariates. Section 5 concludes.

2 Model and Identification

The workhorse framework for identifying the effect of government spending shocks is the structural VAR. The following discussion outlines the canonical VAR used to measure the effect of innovations in federal spending shocks. We show how the model can be modified to identify both the standard spending shocks and military spending shocks. We then further modify the model to estimate the effects on state-level economic indicators.

2.1 The Benchmark Aggregate VAR

Consider the structural representation of the VAR(p)

$$A_0 y_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} A_i y_{t-i} + v_t, \tag{1}$$

where y_t is the $n \times 1$ vector of economic variables that includes government spending and v_t is a vector of structural innovations having diagonal variance-covariance matrix Ω. Note that α_0 is a constant and α_1 is the coefficient for the linear time trend. Here, A_0 represents the contemporaneous impacts of the structural innovations on the variables in y_t.

The objective is to recover the structural innovations v_t defined by an orthonormal rotation of the reduced-form residuals

$$A_0 \varepsilon_t = v_t. \tag{2}$$

In most cases, we do not estimate (1), and thus A_0, directly. Instead, one typically estimates the reduced-form VAR

$$y_t = \beta_0 + \beta_1 t + \sum_{i=1}^{p} B_i y_{t-i} + \varepsilon_t, \tag{3}$$

where the B_i are the reduced-form coefficients and ε_t is the reduced-form innovation with variance-covariance matrix Σ, where $A_0^{-1} \Omega A_0^{-1\prime} = \Sigma$. The well-known problem in the literature on structural VARs is that the system of equations $A_0^{-1} \Omega A_0^{-1\prime} = \Sigma$ does not define a unique rotation. Instead, we require a set of identifying restrictions, which may come in several forms. The most common identifying assumptions in the fiscal policy literature are exclusion (or ordering) restrictions, which assume that some variables do not respond contemporaneously to the shock in question. These restrictions are often implemented by setting elements of A_0^{-1} to zero and generally imply a causal ordering across the variables.[5] The particular restrictions used for the identification of government spending shocks are discussed in the following section.

2.2 Identification Strategy

To identify federal spending shocks, Blanchard and Perotti (2002) and Fatás and Mihov (2001) assume that, at a quarterly frequency, government spending does not contemporaneously react to macroeconomic variables. This is typically implemented by ordering

[5] Sign restrictions on the impulse responses can also be used [see Mountford and Uhlig (2005)].

government spending first in the VAR; the rotation matrix A_0 can then be identified by taking the Cholesky factor of Σ, where the fiscal shock is represented by the first row of A_0.

However, a number of studies have pointed out that the government spending shock could be anticipated if there is a significant delay between the announcement and the actual change in government spending. Leeper, Walker, and Yang (2008) call this "fiscal foresight" and argue it causes the shocks identified by timing conditions to be misspecified. Ramey (2008) shows that military buildup dummies, which use information from historical accounts and identify government spending shocks as dates which signal large increases in defense spending, Granger-cause government spending shocks identified by the recursive ordering.[6]

In light of these findings, we add a military spending variable defined by Ramey (2008) to the VAR.[7] We order the Ramey variable before federal government spending and, in addition, include the Hoover and Perez (1994) dates to identify oil shocks. The Ramey variable in the first equation identifies a military spending shock. The federal non-military spending shock is given by the third equation and is identified under the assumption that spending does not respond to the state of the economy contemporaneously. This ordering also means the federal spending shock is orthogonal to information in the Ramey variable and its lags, and the oil dates and is an innovation to the federal spending net of major military outlays.

2.3 Government Spending and Regions

When we extend our analysis to the states, the dimensionality of the problem increases dramatically. One approach to reducing the number of estimated parameters is to assume

[6] The military dummy (Ramey and Shapiro, 1998) takes a value of 1 in the following quarters: 1950:3, 1965:1 and 1980:1, which correspond with the start of the Korean War, the Vietnam war, and the Carter-Reagan buildup, respectively. Recently September 11th, 2001, was also added to the list.

[7] Unlike the Ramey-Shapiro dates, this new series does not consist of dummy variables; instead, it is based on narrative evidence that is much richer than the Ramey-Shapiro dates. The new series includes additional events when Business Week began forecasting changes in government spending. For the dates identified, the variable takes on the present discounted value of the change in anticipated government spending.

independence of the regions.[8] A second approach is to use a few large regions.[9] A third approach is to make some assumption regarding the incidence and/or propagation of shocks.[10] One set of restrictions, adopted by Davis and Haltiwanger (2001) and others, allows for the consistent computation of the impulse response to shocks produced by an aggregate block. This is accomplished by estimating a reduced-form VAR for each state that includes an aggregate block, the state's variables of interest, and the sum of the remaining states' variables of interest. While shocks to the regional variables may not be properly identified, the regional responses to the aggregate shocks are estimated consistently.

2.4 VAR Data

The VAR includes both national and state-level data at the quarterly frequency and spanning the period 1960:I to 2006:IV. The national data include the aforementioned Ramey variable, an oil shock dummy reflecting the Hoover-Perez oil dates, and the log of per-capita real federal non-defense government spending. The measure of federal government spending we use is the sum of federal current expenditures and gross federal investment net of defense expenditures.[11] State-level data include log of real per-capita personal income and per-capita employment for the 48 continental states (DC, Alaska, and Hawaii are excluded). All data are seasonally-adjusted; real quantities are obtained by deflating nominal quantities by the aggregate GDP deflator.[12] Figure 1 shows federal non-military government spending (left axis) along with the Ramey variable (right axis) and the oil dummies (vertical dotted lines).

[8]For example, Owyang, Piger, and Wall (2005) assume independence across regions to identify state-level business cycles.

[9]This approach is undertaken by, among others, Carlino and DeFina (1998), who estimate the response of monetary policy in the eight BEA regions.

[10]See, for example, the heterogeneous agent VAR of Fratantoni and Schuh (2003) and Irvine and Schuh (2005).

[11]Federal current expenditures account for federal government consumption expenditures, transfer payments (government social benefits and grants in aid to state and local governments), interest payments, and subsidies. Gross government investment consists of general government and government enterprise expenditures for fixed assets. All these data are taken from the Bureau of Economic Analysis (BEA).

[12]The federal government spending and GDP deflator data are from the BEA.

The data, ordered as follows, used in each state-level VAR are

$$Y_t = [G_t \quad O_t \quad g_t \quad \sum_{-i} PI_{jt} \quad \sum_{-i} EMP_{jt} \quad PI_{it} \quad EMP_{it}]',$$

where G_t is the Ramey military spending variable, O_t is an oil price shock dummy variable, g_t is federal government spending, PI_{it} is the personal income of state i, and $\sum_{-i} PI_{jt}$ is the sum of personal income across all states excluding state i.[13] The employment variables are defined similarly. For choice of lag length, AIC and SBIC suggest an optimal lag length of 2 or 3 lags depending on the equation; results reported are for the specifications with 3 lags.

We also considered alternative specifications by adding to the VAR the federal funds rate, ordered last, as a control for monetary policy. In addition, we considered a specification ordering total tax revenues net of transfers after federal spending to account for the intertemporal government budget constraint.[14] The results reported in the following sections are qualitatively robust to both these controls and are reported in the Appendix.

3 Empirical Results

We are interested in the response of state-level personal income and employment to a military spending shock and a one-standard-deviation federal non-military government spending shock. For comparison, we present the aggregate responses in the following subsection before presenting the state-level responses in the subsequent subsection.

3.1 Aggregate Responses

Figures 2 and 3 show the response of U.S. aggregate personal income and employment to a military spending and federal spending shock, respectively. The shaded regions indicate

[13] For ease of exposition, we will refer to the shock identified by the Ramey variable as a *military spending shock* and the shock identified by the innovation to federal non-defense government spending as a *federal spending shock*.

[14] This is the same measure as used in Blanchard and Perotti (2002).

the 95-percent confidence bands constructed by Monte Carlo simulations. In response to a military spending shock, both personal income and employment rise with a delay of four quarters, and peak at about 8-10 quarters after the shock hits the economy. In response to an unanticipated one-standard-deviation increase in federal spending, personal income rises on impact but employment rises slowly to peak at close to 10 quarters. It is important to note that, except for relatively small differences on impact, the shapes of the responses of both variables to either shock are similar.

Federal spending rises in response to a military spending shock, and peaks with a delay of 3-4 quarters. This is mainly because the Ramey variable accounts for events that signal large increases in defense spending which might be realized over time. On the other hand in response to a federal spending shock, the response on impact is largest and overall very persistent.

3.2 State-level Responses

Figures 4 and 5 depict the point responses for state-level personal income and employment, respectively, to a federal spending shock for eight of the twenty quarters for which the impulse responses are computed.[15] Darker shades of gray (red) indicate a larger positive (negative) response to the shock. Although the magnitude and timing of the responses vary across states, the typical response of personal income is weakly positive in the short run and strongly positive in the long run. Some states experience a brief decline in periods 2 to 4; however, most recover strongly by end of the second year.

In addition, differences in the state-level responses appear to follow a regional pattern. For example, states that do not experience a temporary downturn are, for the most part, located along the east coast; also included in this group are California,and most of the Southwest states. On impact, the states that experience negative effects include energy-producing states like Alaska and Wyoming, and also Washington and Virginia. States in

[15] The full set of impulse responses for both shocks are included in the Appendix.

the Southeast have the strongest positive response.

On average, a federal spending shock has a negative impact response but gradually increases employment over the first few years. Again, the magnitude of the employment response varies across states. Similar to some of the responses of personal income, energy-producing states have a persistent negative response, including Texas, North Dakota, Wyoming, and now Louisiana.

In order to gage the distribution of the responses of state personal income and employment to a federal spending shock, we computed a dispersion index as follows:

$$D = \frac{\sigma}{\mu}, \tag{4}$$

where σ is the standard deviation of the (mean) responses to the shock and μ is the average of the mean responses. We found that, for all horizons, the personal income response to the federal spending shock is more concentrated than the employment response. This result may suggest that income rises in areas that manufacture or sell goods bought by the government, whereas the increase in employment is due, in some part, to the purchase of services or an increase in transfer payments.

For most states, the personal income response to a shock to the Ramey military spending variable is qualitatively similar to that for the shock to federal spending. For military spending shocks, however, the impact responses of personal income for most states are negative; states in the Mideast and a few states in the Rocky Mountains are exceptions (see Figure 6). At longer horizons, the negative personal income response appears to be isolated in the energy (and perhaps agricultural) states.

Figure 7 depicts the employment response to a military spending shock for eight of the twenty quarters. For employment, a number of states in the Northeast, Mideast, and Great Lakes have a positive response on impact. At long horizons, however, the negative response in employment appears restricted to Alaska, Oregon, South Dakota and some Southeast states including Louisiana.

While Figures 6 and 7 again suggest that the personal income response is more concentrated than the employment response, the difference for the military spending shock is not as large as for the federal spending shock, at least at long horizons. The dispersion index reveals that, at horizons above six quarters, the cross-state dispersion in the two responses is rather similar.

3.3 Variance Decompositions

In addition to impulse response functions, we compute the contribution of the military and non-military spending shocks to the unconditional variance of both state-level personal income and employment. Figures 8 and 9 show the variance decomposition across states for federal spending shocks and military spending shocks, respectively. Once again, we see a large amount of cross-state variation with some geographic concentration. As depicted in Figure 8, federal spending shocks explain a significant amount of variation – above 30 percent – of personal income in some states in the Midwest and South, as well as Michigan and Wyoming. For employment, federal spending explains a significant portion of the unconditional variation, above 30 percent, in the Midwest and Southwest, as well as Michigan, Minnesota, Ohio, and Georgia. For the majority of the states in the Northwest and Northeast, however, federal spending accounts for a smaller proportion of states' unconditional variance of personal income and employment, often below 10 percent.

Military spending shocks, relative to federal spending shocks, overall explain a smaller amount of variance in personal income and employment across states.[16] The effectiveness of military spending shocks in explaining fluctuations in both personal income and employment is concentrated in Hawai'i, Maine, and Virginia, where it accounts for at least 4 percent of the variance. Other states in which military spending shocks account for a larger than average portion (2 percent) of both variances are California, Connecticut, New Jersey, Mississippi, New Hampshire, and Washington. Military spending also accounts for at least 4 percent of

[16]The same is true for the nation as a whole. The military spending shock explains 1.5 and 3.3 percent of the unconditional variances of national personal income and employment, respectively.

the variance in personal income in Rhode Island and employment in Arkansas, Alabama, and Massachusetts. Strikingly, most of these states receive large amounts of military contracts.

4 Explaining the Variation in State-level Responses

The similarity in the *shape* of the response of most states to government spending shocks belies fundamental differences in their *magnitude* and *timing* (see Appendix). For example, Maine and Vermont respond to the Ramey military spending shock similarly – both experience a temporary decline followed by a delayed gradual increase. However, the long-run point response of Maine's personal income is, at times, twice Vermont's. In this section we try to understand which state-specific factors explain the differences in the response of personal income and employment to the two spending shocks across states.

In order to study the effects of federal spending, it is important to first consider its composition. Federal spending is typically divided into discretionary spending on defense and non-defense, and mandatory spending on federal programs such as social security, means-tested and non-means-tested entitlements.[17] Over the last couple of decades, federal spending on defense has decreased, while spending on transfer programs and grants-in-aid to states has increased significantly.

To understand the differential responses of states to a federal spending shock, it is useful to think of factors that potentially influence federal spending at the state level. States vary greatly in the need for federal grant programs, and this is determined by a multitude of differences. Presumably, states with higher poverty rates have a greater need for assistance programs such as health care, employment benefits, and other services. However, these states also lack the ability to cover these expenditures themselves as they bring in less tax revenues.[18] Another consideration is the percentage of population aged-65-or-older and

[17]As explained in Schiller (1999), means-tested entitlements are the ones for which recipients qualify based on income level, such as food stamps, and non-means-tested entitlements are the ones for which qualification is based on some other criterion, for example federal employees' retirement benefits.

[18]Toikka, Gais, Nikolov, and Billen (2004) explore the relationship between fiscal capacity and state

qualify-for-assistance programs for the elderly.

Besides demographic or economic composition and fiscal need, the industry mix of a state might also be important. For instance, a high concentration of defense-related industries boosts federal procurement dollars, and a larger farming sector means more federal expenditures on agricultural assistance. Other explanations include political determinants; for instance, Hoover and Pecorino (2005) suggest that states with higher per-capita Senate representation have higher federal spending per capita.

To consider the differential effects of military spending, presumably the effects of a military shock are concentrated in states where military bases or industries are located. Another variable of interest is the size of military prime contract awards a state receives, which comprise roughly half of defense spending and exhibit considerable state-level dispersion. These military contracts are sorted across states based on which region is allocated the largest dollar amount of work. Davis, Loungani, and Mahidhara (1997) and Hooker and Knetter (1997), among others, use military prime contracts to identify military expenditure shocks and find sizable employment and unemployment responses for the different regions.

In order to understand the cross-sectional differences in the state-level response to government spending shocks, a summary statistic for the impulse response is used as a dependent variable in a cross-state regression equation. Since the effects of both federal and military spending shocks are very persistent, an indicator for how much personal income and employment are affected by a spending shock is the cumulative percentage change in personal income and employment in response to the two shocks, over the 20 quarter horizon. This statistic captures the variation in magnitude and sign of impulse response functions across states. Table 1 reports the statistics computed for personal income and employment in response to a federal spending shock, and Table 2 reports the statistics for the two variables as a result of a military spending shock for the 50 different states.

spending on social welfare programs.

Our regression looks as follows:

$$z_i = c + \beta X_i + u_i,$$

where z_i is the summary statistic for the impulse response to a federal or military spending shock for state i and X_i is the vector of independent state-specific explanatory covariates. The next three subsections describe the set of covariates and the results for federal and military spending shocks. The results shown in the following sections are for the summary statistic using the mean impulse response functions, but are robust to considering the median impulse responses constructed by Monte Carlo simulations.

4.1 State-level Covariates

The state-level covariates we consider can be divided into four major categories. The first category considered consists of various industry shares, which are constructed by taking the average share of total state GDP for the time period of 1963-2001. The industry shares we consider are agriculture, manufacturing, oil, finance (which includes insurance and real estate), construction, and retail.

The second category is state-specific fiscal variables. We consider the per-capita federal assistance a state receives, which includes grants, loans, insurance, and direct payments (e.g., Social Security); the per-capita federal tax burden of a state; and the fiscal capacity index. Fiscal capacity measures the state's revenue capacity relative to its expenditure need.

Third, we add a few military-related variables. We include the average dollar value of military prime contracts from 1967-1995 received by different states. In addition, we consider the number of military personnel in a given state, which includes active duty personnel, Reserves, and the National Guard. Note that in the covariate regression we use per-capita values of these variables.

The last category includes a variety of non-policy variables related to the particular demographics of a state. These include state-level population density, median income level, and median age. These particular demographic variables help us test our hypothesis that a government spending shock affects a state through the federal assistance it receives based on the age and income level of the state's population.[19]

4.2 Federal Spending Shocks

The covariate regression results in Table 1 suggest that the effect on personal income is larger in states that receive high per-capita federal assistance. Examples of such states are those in the Southeast Region including Florida, Louisiana, and Mississippi, among others. However, states with a higher federal tax burden are not the ones to benefit from an increase in federal spending. Personal income is also more sensitive to federal spending in states with a lower fiscal capacity, which indicates a relatively small revenue base, a relatively high need for expenditure, or a combination of both.

Because we have controlled for shocks to military spending through the Ramey variable, the federal spending shocks represent innovations to transfer payments, grants in aid to states, and expenditures on infrastructure, health, education, and general public services. This explains why a shock to federal spending is more effective in states receiving large per capita federal assistance.[20] Note also that median age, which might suggest alternately higher Social Security or Medicare transfers or lower education transfers, does not have significant explanatory power.

Agricultural subsidies seem to be important as agricultural share is significant in explaining the rise in personal income to a federal spending shock. Similarly, personal income rises more in states with higher shares of manufacturing, finance, and construction. This points towards a spending increase on infrastructure and manufactured goods. On the other hand,

[19] A detailed description of the covariate data, including summary statistics and sources are given in the Appendix.

[20] In results not shown, we found that military-related variables such as troop deployments are not significant in explaining the effects of a federal spending shock. This result is consistent with the identification that the federal spending shock is orthogonal to military spending shocks.

a higher concentration in the oil sector is not an important factor in explaining the effects of a spending shock on economic activity.

The response of employment to a federal spending shock can be explained by similar covariates (see Table 2). The employment is greater in states with high industry shares of construction, and manufacturing, but agricultural share is no longer an important explanatory variable. For employment, the variation in the responses is not well explained by most policy variables and only one of the demographic variables: median income.

4.3 Military Spending Shocks

Tables 3 and 4 depict the results of the explanatory regressions for the personal income and employment responses to a military spending shock. While the responses to federal and military spending shocks can be qualitatively similar, the state-level characteristics important in determining the magnitudes of the responses are different. For example, the response of personal income to a military spending shock is not explained by most fiscal variables.[21] This reflects the fact that the disbursement of military funds is not based on the per capita federal funding being received by the state. Fiscal capacity index is an important explanatory factor, but, in contrast, to a federal spending shock, states with a higher fiscal capacity index are more likely to see a rise in personal income in response to a military spending shock. Similar to the case of federal spending, the response of state-level personal income is higher in states with large manufacturing and retail shares. If we decompose manufacturing into durables and non-durables, personal income in the states with larger shares of non-durables sectors are the ones to see a rise in personal income. These results potentially point toward the ultimate destination of military contract funds: The effect of a rise in military spending is concentrated in states that produce goods – either upstream or final. On the other hand, finance and construction shares have significant negative coefficients, and agricultural and oil shares do not appear to influence the magnitude of the response to military shocks.

[21] For brevity, these results are not shown in Tables 3 and 4 but are available on request.

In agreement with our initial hypothesis and findings by previous studies [Hooker (1996), Hooker and Knetter (1997), and Davis, Loungani, and Mahidhara (1997), for example], military prime contracts have significant explanatory power.[22] States that receive a large share of military contracts are the ones that see a boom in personal income. Examples of such states include Virginia, Massachusetts, Missouri, and Maryland. However, the number of military personnel based in a state does not affect the magnitude of the personal income response to a military spending shock.

The response of employment to a military spending shock is also explained by states receiving a high share of military prime contracts. Of all industries, states with a larger share of retail are the ones that see a large rise in employment, but share of manufacturing is no longer significant in explaining the response of employment to a military shock. Like personal income, the response of employment to a military spending shock is also concentrated in states that have a high fiscal capacity index.

5 Conclusions

Government spending, though determined at a national level, appears to have diverse effects on state-level economies. This paper contributes to the broad literature on the regional effects of national macroeconomic shocks. Similar to previous studies on, for example, monetary policy, we find significant and important variation in the responses of state-level indicators of real economic activity to innovations in both federal government spending and military spending. Moreover, these differences appear to be, at least in part, regionally clustered – that is, similarities in the magnitudes of the state-level responses are often closely tied to geographic proximity.

In addition, we find that industrial mix is an important determinant of the magnitude of the responses of real activity to spending shocks. Which industries are important, however,

[22] This is best seen in regressions where we remove manufacturing shares from the list of explanatory variables since manufacturing share and number of military prime contracts received by a state are collinear.

depends on the nature of the government spending shock. While manufacturing concentration appears to influence the responsiveness to both types of shocks, a state's responsiveness to federal non-military spending shocks also appears to be influenced by the shares of agriculture and construction. In addition, state-level fiscal policy indicators and demographic variables can influence the responsiveness of the state to non-military spending shocks.

These results highlight the distinct propagation mechanisms for the two types of government spending shocks. Shocks to military spending stimulate economic activity in states with higher manufacturing and retail shares, and in those that receive a large share of military prime contracts, suggesting a procurement effect. Shocks to non-military spending, on the other hand, appear to benefit lower-income states, and ones that have expenditure needs greater than their ability to generate revenue.

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	Cumulative % change in personal income	**Cumulative % change in employment**
Alabama	5.058*	3.355*
Alaska	9.735*	6.736*
Arizona	5.540*	7.293*
Arkansas	9.797*	3.441*
California	2.378	3.557*
Colorado	2.967	5.665*
Connecticut	0.175	0.470
Delaware	0.915	3.919*
Florida	3.844	3.007
Georgia	6.278*	8.154*
Hawaii	2.685	1.990
Idaho	3.872*	3.894*
Illinois	4.153*	4.408*
Indiana	4.202*	4.787*
Iowa	5.500*	2.670*
Kansas	5.356*	4.719*
Kentucky	5.971*	7.140*
Louisiana	6.133*	4.416*
Maine	2.655	1.344
Maryland	1.510	2.836
Massachusetts	2.532	2.018
Michigan	9.617*	10.137*
Minnesota	4.589*	5.056*
Mississippi	5.521*	6.627*
Missouri	4.817*	5.490*
Montana	6.281*	3.622*
Nebraska	5.649*	2.749*
Nevada	3.947*	6.413*
New Hampshire	4.275*	6.356*
New Jersey	2.929*	1.326
New Mexico	3.877*	4.649*
New York	3.594*	1.514
North Carolina	1.902	3.245*
North Dakota	11.170*	3.244
Ohio	4.547*	5.242*
Oklahoma	4.631	4.622*
Oregon	5.480*	4.840*
Pennsylvania	3.227*	1.663
Rhode Island	4.101*	4.785*
South Carolina	3.948*	4.880*
South Dakota	5.481*	3.058*
Tennessee	5.864*	5.294*
Texas	3.980*	5.235*
Utah	3.909*	3.069*
Vermont	2.752	3.663*
Virginia	2.105	4.138*
Washington	-0.063	0.539
West Virginia	5.733*	3.840
Wisconsin	4.870*	3.754*
Wyoming	-2.831	0.455
Aggregate	2.630*	5.848*

Table 1: Results for the response of personal income and employment to a federal spending shock. The table reports the cumulative percentage change in the two variables, which is given by $\sum_{i=1}^{20} \Delta pi_{t+i}$ for personal income and similarly for employment. * indicates the statistic is significantly positive.

	Cumulative % change in personal income	**Cumulative % change in employment**
Alabama	-1.028	-1.604
Alaska	-1.515	-0.998
Arizona	-0.577	-0.136
Arkansas	1.137	-1.772
California	1.231	2.024
Colorado	1.583	2.241*
Connecticut	2.939*	2.512*
Delaware	-1.887	-1.272
Florida	-0.182	0.859
Georgia	-0.511	-0.269
Hawaii	-5.932	-4.449
Idaho	-1.124	-1.863
Illinois	0.538	-0.062
Indiana	0.912	1.226
Iowa	0.685	-0.245
Kansas	0.195	0.301
Kentucky	0.687	-0.592
Louisiana	-0.738	-1.322
Maine	4.067*	4.039*
Maryland	-0.141	1.501
Massachusetts	1.913	2.703*
Michigan	-0.297	-0.044
Minnesota	0.714	0.415
Mississippi	-1.004	-2.405
Missouri	1.413	0.851
Montana	0.490	0.115
Nebraska	0.580	-0.123
Nevada	0.366	1.650
New Hampshire	3.579*	3.830*
New Jersey	2.428*	2.788*
New Mexico	0.244	0.199
New York	1.035	1.536
North Carolina	0.183	0.393
North Dakota	0.786	1.486
Ohio	-0.462	-0.775
Oklahoma	1.446	2.056
Oregon	0.099	-0.727
Pennsylvania	0.447	1.123
Rhode Island	2.806*	1.410
South Carolina	0.737	0.518
South Dakota	0.578	-0.288
Tennessee	1.153	1.016
Texas	1.368	1.611
Utah	-0.216	0.917
Vermont	1.782	1.888
Virginia	2.474*	2.717*
Washington	1.880	2.813*
West Virginia	-0.036	-0.379
Wisconsin	0.472	-0.169
Wyoming	2.706	1.791
Aggregate	0.808	0.349

Table 2: Results for the response of personal income and employment to a military spending shock. The table reports the cumulative percentage change in the two variables, which is given by $\sum_{i=1}^{20} \Delta pi_{t+i}$ for personal income and similarly for employment. * indicates the statistic is significantly positive.

Median income		-0.16***	-0.16**	-0.16**	-0.00	-0.11	
		(0.06)	(0.07)	(0.07)	(0.10)	(0.08)	
Population density	-0.00	0.00	0.00	0.01	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Median age	-0.12	-0.21	-0.18	-0.20	0.12	-0.22	-0.07
	(0.18)	(0.18)	(0.18)	(0.18)	(0.22)	(0.18)	(0.18)
Manufacturing share	0.13*	0.16**	0.16**	0.13	0.15**	0.14*	0.14*
	(0.07)	(0.07)	(0.07)	(0.08)	(0.08)	(0.08)	(0.08)
Construction share	0.44	1.10**	1.10*	1.19**	1.54***	0.97	0.93*
	(0.50)	(0.53)	(0.56)	(0.57)	(0.57)	(0.59)	(0.49)
Agricultural share	0.29**	0.29**	0.31**	0.30**	0.35***	0.25**	0.26**
	(0.12)	(0.11)	(0.12)	(0.12)	(0.11)	(0.12)	(0.11)
Oil share		0.01		-0.09	-0.06	-0.13	-0.10
		(0.07)		(0.11)	(0.1)	(0.11)	(0.11)
Finance share			-0.05	-0.10	0.07	-0.17	-0.08
			(0.14)	(0.15)	(0.16)	(0.16)	(0.15)
Retail share			-0.24	-0.47	-0.88*	-0.55	-0.70
			(0.35)	(0.45)	(0.47)	(0.45)	(0.44)
Fiscal capacity index					-0.10**		
					(0.05)		
Per capita federal assistance						0.22	0.20
						(0.17)	(0.15)
Per capita federal tax burden							-0.10***
							(0.03)
Intercept	4.34	11.01	12.64	16.72	7.13	16.78	12.25
	(7.40)	(7.67)	(7.78)	(9.29)	(9.79)	(16.78)	(8.29)
Adjusted R^2	0.132	0.240	0.226	0.229	0.302	0.244	0.306

Table 3: Results for the response of personal income to a federal spending shock. Standard errors in parentheses. *, ** and *** indicate significance at 10%, 5% and 1% levels respectively.

Median income		-0.11**	-0.09	-0.10**	-0.11	-0.09	
		(0.05)	(0.06)	(0.06)	(0.08)	(0.07)	
Population density	-0.01**	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Median age	-0.24*	-0.31**	-0.28*	-0.30**	-0.33*	-0.31**	-0.22
	(0.14)	(0.14)	(0.14)	(0.14)	(0.19)	(0.14)	(0.15)
Manufacturing share	0.16***	0.16***	0.17***	0.14***	0.14***	0.14**	0.14**
	(0.05)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Construction share	0.60	1.04**	0.95**	1.05**	1.01**	1.00**	0.83**
	(0.38)	(0.41)	(0.44)	(0.45)	(0.47)	(0.47)	(0.41)
Agricultural share	-0.09	-0.10	-0.09	-0.10	-0.11	-0.11	-0.12
	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.10)	(0.09)
Oil share		-0.04		-0.09	-0.09	-0.10	-0.09
		(0.05)		(0.08)	(0.08)	(0.13)	(0.09)
Finance share			-0.03	-0.08	-0.10	-0.10	-0.09
			(0.11)	(0.12)	(0.13)	(0.13)	(0.13)
Retail share			0.04	-0.21	-0.17	-0.22	-0.25
			(0.27)	(0.35)	(0.39)	(0.36)	(0.36)
Fiscal capacity index					0.01		
					(0.04)		
Per capita federal assistance						0.05	0.07
						(0.13)	(0.13)
Per capita federal tax burden							0.04
							(0.03)
Intercept	8.53	13.88	12.20	16.53	17.44	16.54	13.12
	(5.54)	(5.92)	(6.10)	(7.23)	(8.10)	(7.31)	(6.87)
Adjusted R^2	0.250	0.303	0.278	0.282	0.265	0.266	0.265

Table 4: Results for the response of employment to a federal spending shock. Standard errors in parentheses. *, ** and *** indicate significance at 10%, 5% and 1% levels respectively.

Median income		-0.05 (0.07)	-0.03 (0.07)	-0.02 (0.07)	-0.06 (0.07)	-0.06 (0.07)
Population density		0.004 (0.003)	0.003 (0.003)	0.002 (0.003)	0.006* (0.003)	0.006* (0.003)
Median age		0.04 (0.16)	-0.00 (0.15)	0.16 (0.10)	0.09 (0.16)	0.08 (0.16)
Fiscal capacity index	0.05** (0.02)	0.06* (0.03)	0.08** (0.03)	0.07** (0.03)	0.06* (0.03)	0.06* (0.03)
Oil share	0.12 (0.08)	0.10 (0.08)	0.11 (0.08)	0.10 (0.08)	-0.00 (0.06)	-0.00 (0.06)
Finance share	-0.05 (0.09)	-0.11 (0.11)	-0.20* (0.11)	-0.23* (0.12)	-0.23** (0.11)	-0.23** (0.08)
Retail share	0.69** (0.34)	0.69** (0.35)	0.84** (0.34)	0.80** (0.34)	0.38 (0.30)	0.38 (0.29)
Manufacturing share	0.10** (0.04)	0.07* (0.04)	0.02 (0.05)	0.03 (0.05)		
Construction share			-0.93** (0.41)	-0.79* (0.43)		
Agricultural share			-0.04 (0.08)	-0.02 (0.08)		
Military prime contracts				0.06 (0.06)	0.10** (0.06)	0.16** (0.09)
Military personnel						-0.01 (0.01)
Intercept	-12.10 (4.97)	-10.94 (7.47)	-6.91 (7.66)	-8.34 (7.75)	-6.27 (6.64)	-5.23 (6.73)
Adjusted R^2	0.101	0.104	0.173	0.178	0.105	0.104

Table 5: Results for the response of personal income to a military shock. Standard errors in parantheses. *, ** and *** indicate significance at 10%, 5% and 1% levels respectively.

Median income		0.00	0.01	0.01	-0.00	-0.00
		(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Median age		0.00	-0.04	-0.01	0.07	0.06
		(0.16)	(0.16)	(0.16)	(0.16)	(0.16)
Population density		0.003	0.001	0.001	0.004	0.004
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Fiscal capacity index	0.06***	0.06*	0.08	0.08**	0.06*	0.06*
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.296)
Oil share	0.12	0.11	0.08	0.06	0.03	0.03
	(0.08)	(0.08)	(0.08)	(0.08)	(0.06)	(0.06)
Finance share	0.01	-0.05	-0.17	-0.21	-0.17	-0.17
	(0.10)	(0.11)	(0.12)	(0.12)	(0.11)	(0.11)
Retail share	0.73**	0.75**	0.87**	0.83**	0.55**	0.55**
	(0.34)	(0.35)	(0.34)	(0.34)	(0.29)	(0.30)
Manufacturing share	0.06	0.04	-0.03	-0.02		
	(0.04)	(0.04)	(0.05)	(0.05)		
Construction share			-0.92**	-0.74*		
			(0.42)	(0.43)		
Agricultural share			-0.14*	-0.12		
			(0.10)	(0.09)		
Military prime contracts				0.08	0.12**	0.13
				(0.05)	(0.05)	(0.08)
Military personnel						-0.00
						(0.01)
Intercept	-13.62	-13.05	-6.78	-8.69	-10.77	-10.60
	(4.96)	(7.61)	(7.78)	(7.79)	(6.50)	(6.66)
Adjusted R^2	0.178	0.143	0.214	0.235	0.339	0.340

Table 6: Results for the response of employment to a military shock. Standard errors in parantheses. *, ** and *** indicate significance at 10%, 5% and 1% levels respectively.

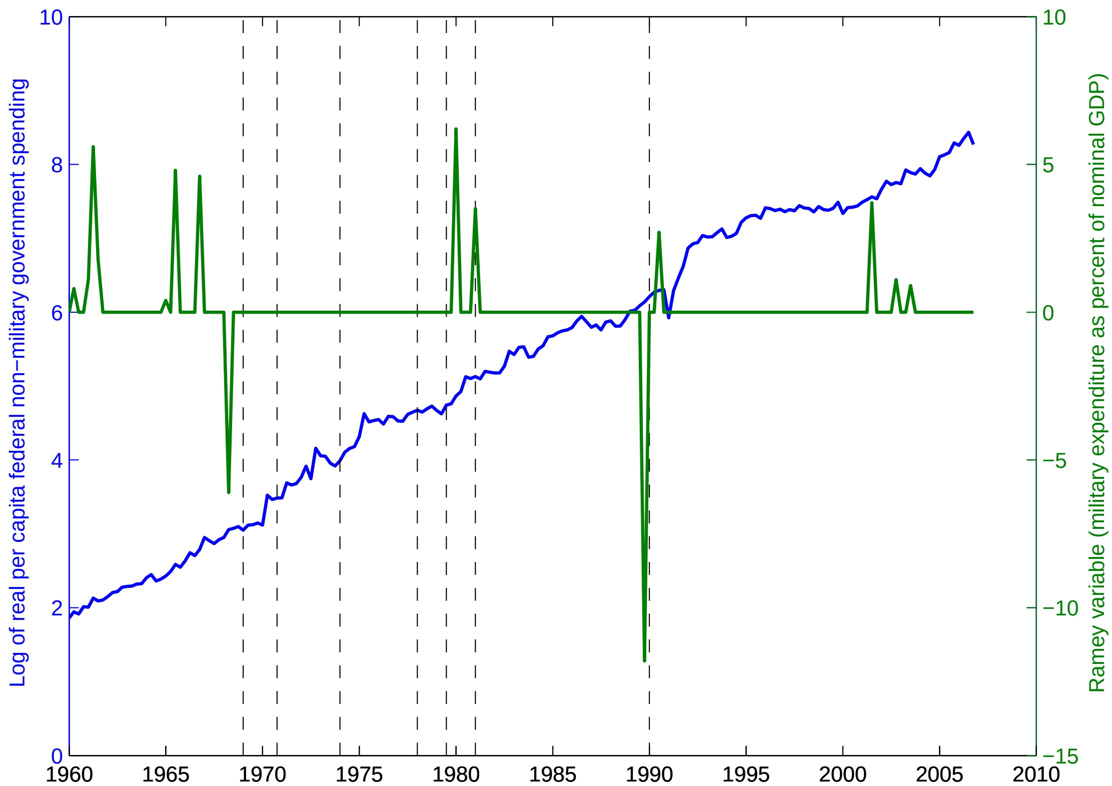


Figure 1: The left axis shows the log per-capita federal government spending, the right axis shows the Ramey variable, and the vertical dotted lines are the Hoover-Perez oil dates.

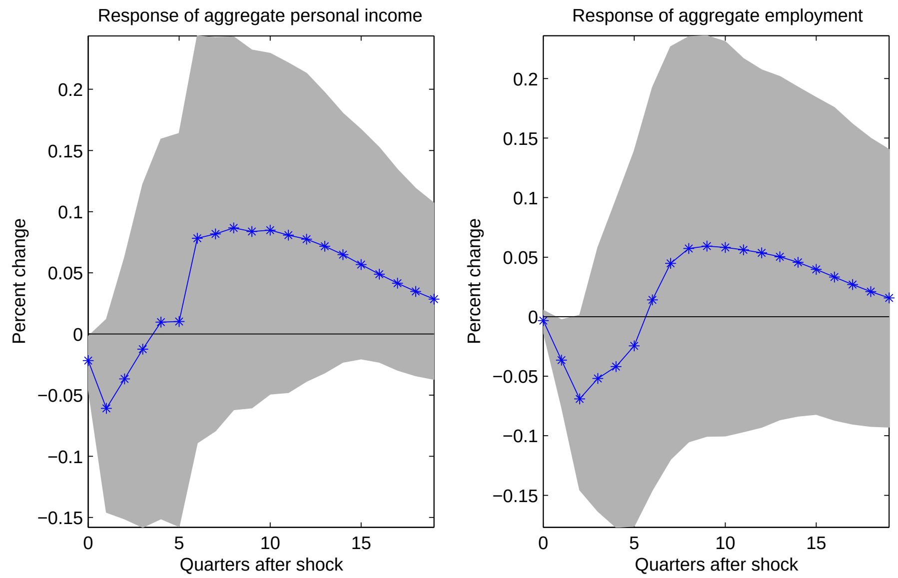


Figure 2: Response of aggregate variables to military spending shock

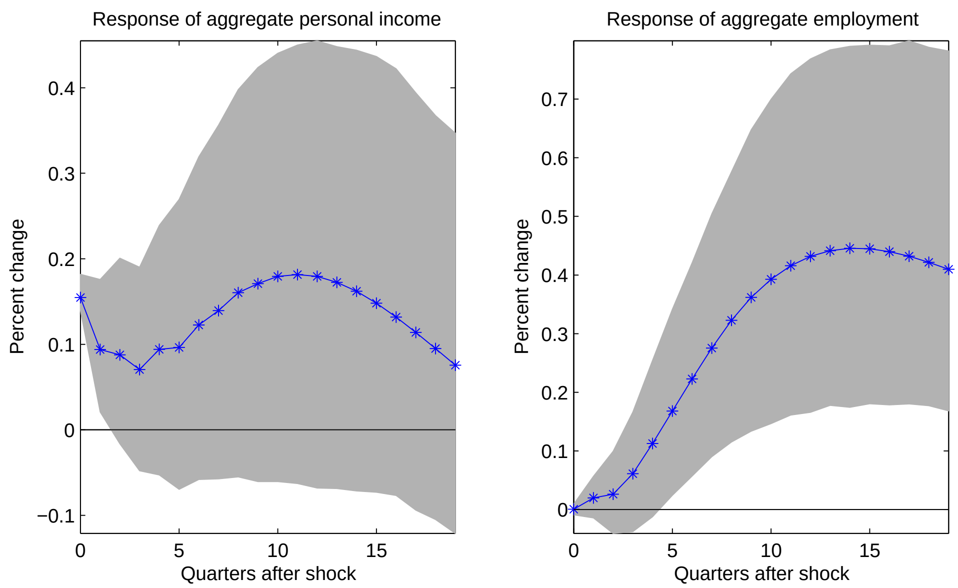


Figure 3: Response of aggregate variables to federal spending shock

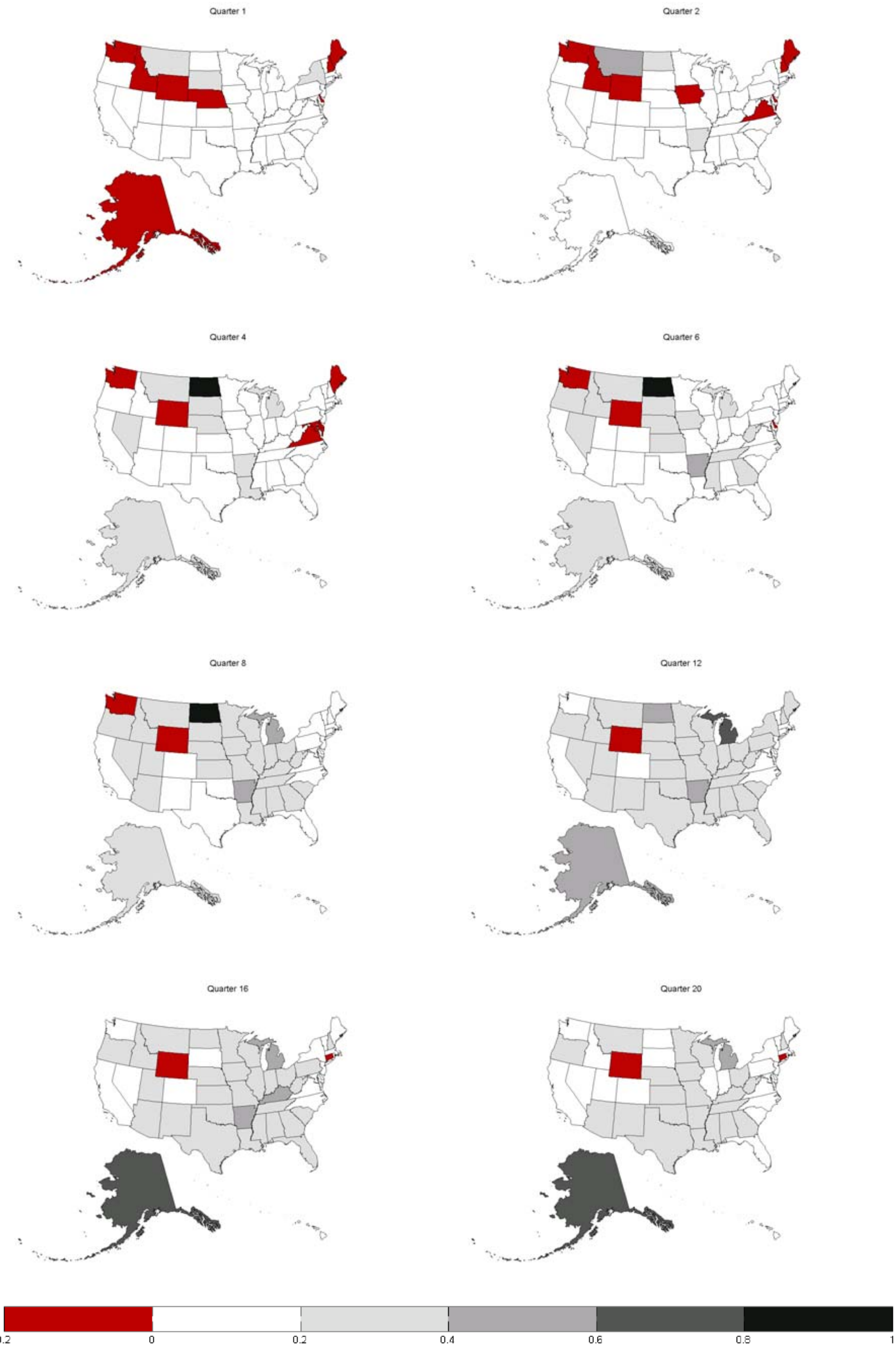


Figure 4: Response of state-level personal income to federal spending shock

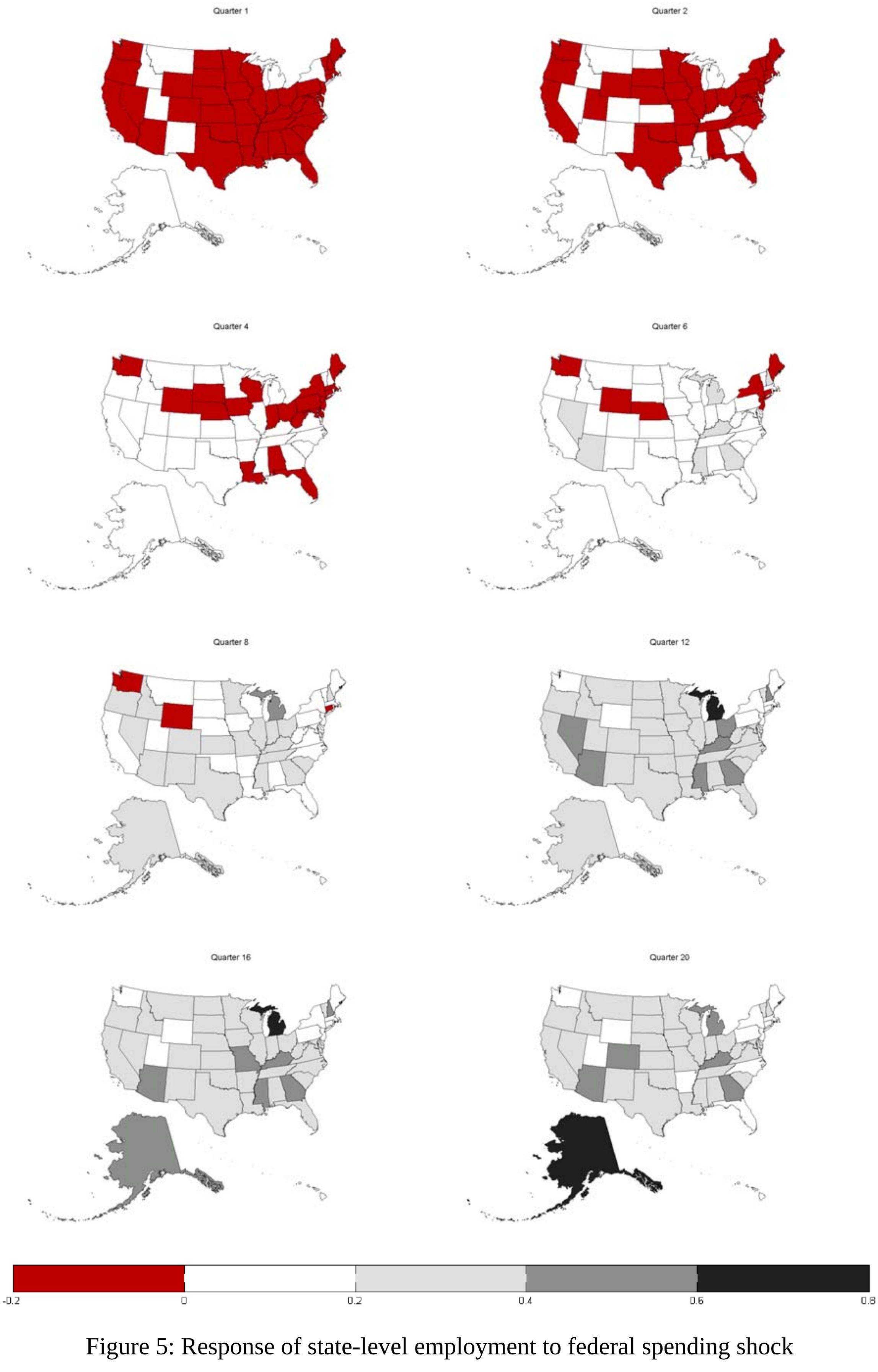


Figure 5: Response of state-level employment to federal spending shock

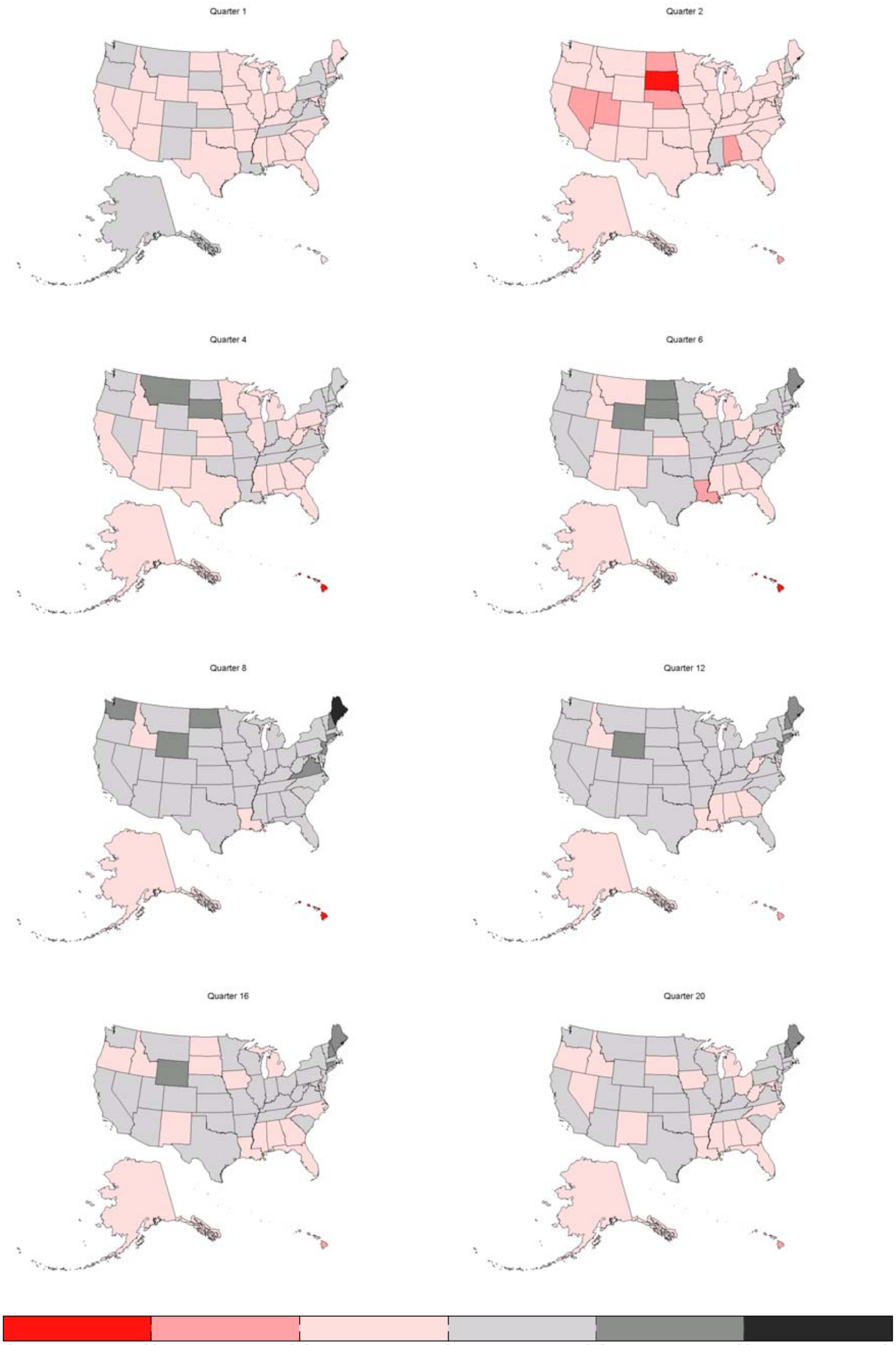


Figure 6: Response of state-level personal income to military spending shock

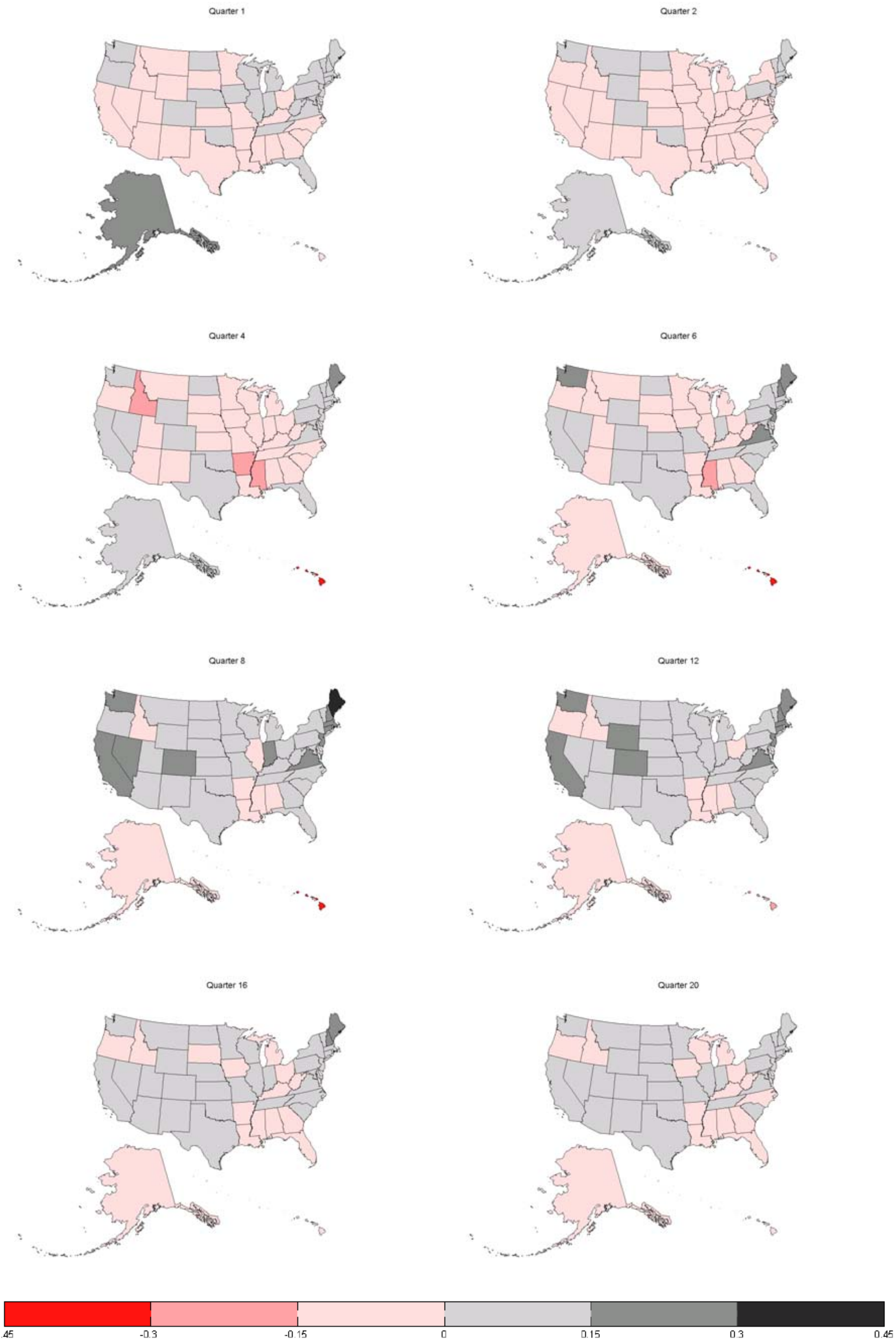


Figure 7: Response of state-level employment to military spending shock

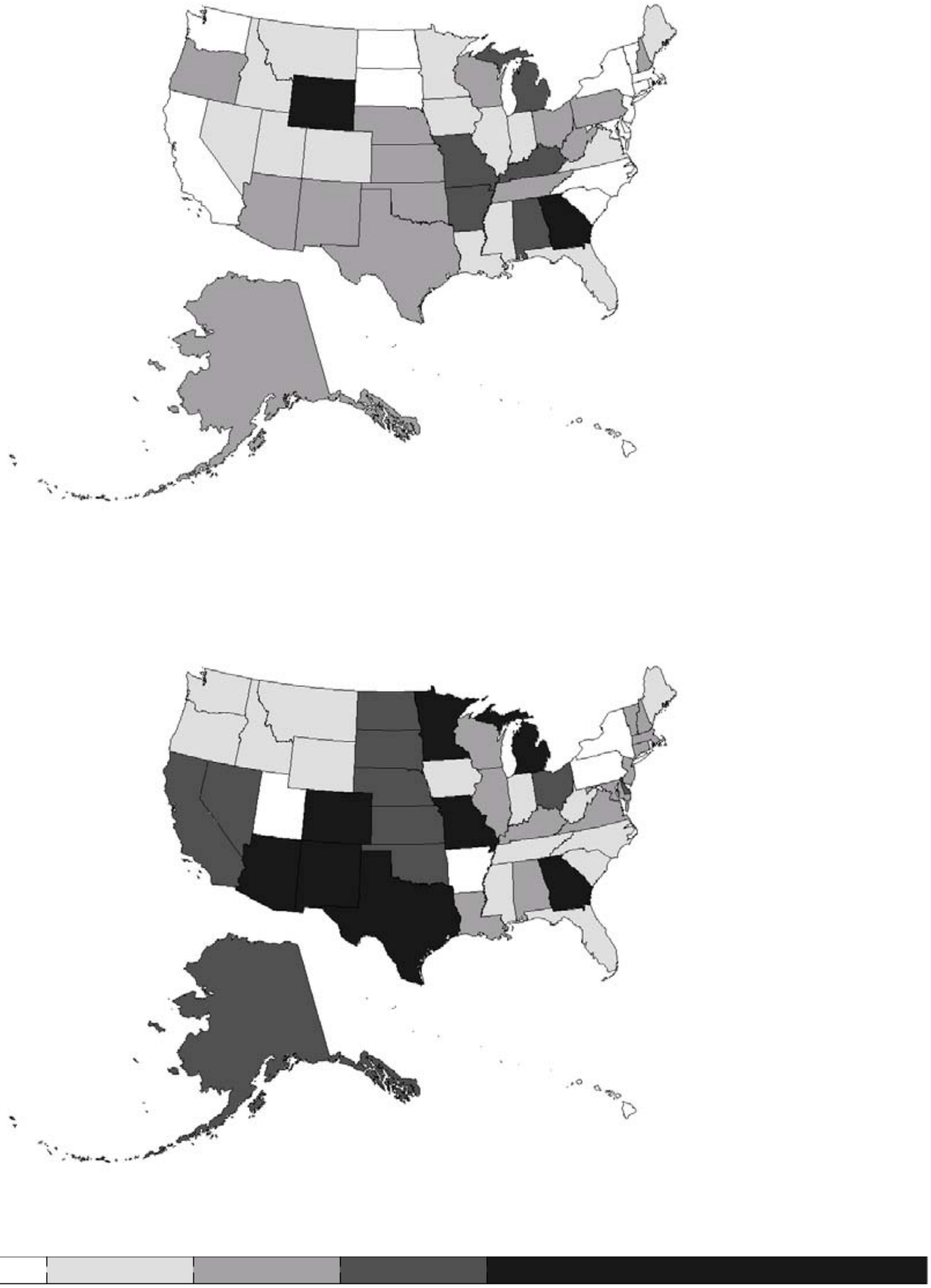


Figure 8: Variance share explained by federal spending shocks.
The top panel is personal income and the bottom panel is employment.

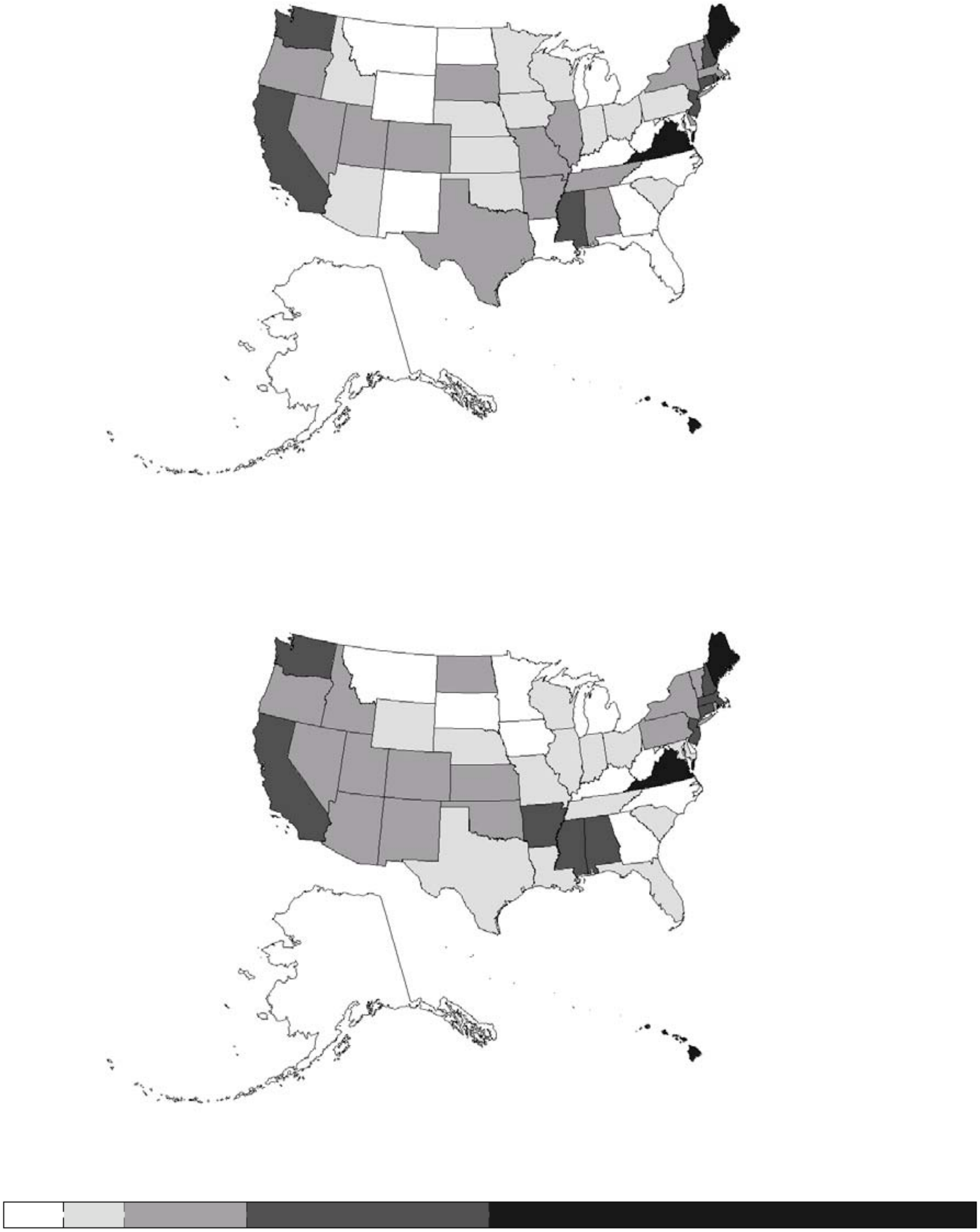


Figure 9: Variance share explained by military spending shocks.
The top panel is personal income and the bottom panel is employment.

Appendix

Robustness results

We also considered alternative specifications by adding to the VAR the federal funds rate, ordered last, as a control for monetary policy. In this case the data is ordered as follows for each state-level VAR,

$$Y_t = [G_t \quad O_t \quad g_t \quad \sum_{-i} PI_{jt} \quad \sum_{-i} EMP_{jt} \quad PI_{it} \quad EMP_{it} \quad FFR_t]',$$

In addition, we considered a specification ordering total tax revenues net of transfers after federal spending to account for the intertemporal government budget constraint.[1] In this case the data is ordered as follows,

$$Y_t = [G_t \quad O_t \quad g_t \quad Tax_t \quad \sum_{-i} PI_{jt} \quad \sum_{-i} EMP_{jt} \quad PI_{it} \quad EMP_{it}]',$$

The following table shows the cumulative percentage change in personal income and employment to a federal spending shock in the case of the baseline VAR and the alternative specifications. The results are qualitatively robust to both these controls.

[1]The data is taken from BEA and is the same measure as used in **?**.

	Cumulative % change in personal income			Cumulative % change in employment		
	Baseline	**with** FFR_t	**with** Tax_t	**Baseline**	**with** FFR_t	**with** Tax_t
Alabama	5.06	5.15	5.12	3.35	4.13	3.13
Alaska	9.74	8.00	12.21	6.74	5.27	8.06
Arizona	5.54	6.29	5.89	7.29	7.78	6.22
Arkansas	9.80	9.42	8.95	3.44	4.47	1.24
California	2.38	2.69	2.75	3.56	4.23	3.73
Colorado	2.97	3.14	3.83	5.67	5.97	5.00
Connecticut	0.18	0.85	0.08	0.47	1.05	0.26
Delaware	0.92	0.64	1.56	3.92	3.27	3.63
Florida	3.84	3.87	4.04	3.01	3.42	2.91
Georgia	6.28	5.54	5.82	8.15	7.88	6.57
Hawaii	2.68	2.81	3.10	1.99	2.72	2.33
Idaho	3.87	4.78	5.31	3.89	6.30	4.57
Illinois	4.15	4.39	4.11	4.41	5.08	3.88
Indiana	4.20	4.36	4.21	4.79	4.78	3.59
Iowa	5.50	5.09	6.38	2.67	4.27	2.12
Kansas	5.36	4.75	5.67	4.72	5.32	4.43
Kentucky	5.97	6.13	6.11	7.14	7.69	6.16
Louisiana	6.13	5.73	6.11	4.42	5.07	4.76
Maine	2.66	2.29	3.10	1.34	1.46	1.64
Maryland	1.51	0.91	2.58	2.84	2.74	2.57
Massachusetts	2.53	2.61	3.22	2.02	3.67	1.82
Michigan	9.62	9.16	9.00	10.14	9.47	9.20
Minnesota	4.59	5.15	5.33	5.06	6.27	4.71
Mississippi	5.52	6.42	6.55	6.63	9.19	6.57
Missouri	4.82	4.56	4.72	5.49	5.64	4.42
Montana	6.28	6.14	7.22	3.62	5.39	4.01
Nebraska	5.65	5.29	6.67	2.75	4.60	3.35
Nevada	3.95	4.19	4.13	6.41	6.53	5.96
New Hampshire	4.28	4.35	3.74	6.36	6.62	4.26
New Jersey	2.93	3.04	3.10	1.33	1.69	1.42
New Mexico	3.88	3.72	3.92	4.65	5.71	4.52
New York	3.59	3.54	3.86	1.51	1.84	1.33
North Carolina	1.90	2.09	1.95	3.24	3.90	2.75
North Dakota	11.17	9.28	14.24	3.24	4.68	4.24
Ohio	4.55	4.54	4.39	5.24	5.32	4.83
Oklahoma	4.63	4.52	5.41	4.62	4.71	4.58
Oregon	5.48	5.73	5.06	4.84	5.37	4.07
Pennsylvania	3.23	3.37	3.62	1.66	2.01	2.09
Rhode Island	4.10	3.76	4.28	4.78	4.87	3.68
South Carolina	3.95	3.35	3.30	4.88	4.84	3.10
South Dakota	5.48	5.34	8.00	3.06	4.48	2.89
Tennessee	5.86	6.14	4.88	5.29	6.15	3.31
Texas	3.98	3.69	4.35	5.24	5.03	5.11
Utah	3.91	3.19	3.57	3.07	3.34	2.68
Vermont	2.75	3.21	3.98	3.66	4.45	3.50
Virginia	2.11	1.84	2.38	4.14	3.94	3.95
Washington	-0.06	0.67	0.22	0.54	1.17	-0.90
West Virginia	5.73	5.17	5.74	3.84	4.99	3.75
Wisconsin	4.87	4.78	5.04	3.75	3.73	3.56
Wyoming	-2.83	-0.35	0.28	0.46	2.72	1.06

Results for the response of personal income and employment to a federal spending shock. The table reports the cumulative percentage change in the two variables under various specifications, which is given by $\sum_{i=1}^{20} \Delta pi_{t+i}$ for personal income and similarly for employment.

Covariate data description and sources

Variable	Mean	St. Dev.	Min	Max
Industry shares				
Agriculture share	3.56	3.34	0.59	15.29
Manufacturing share	20.17	7.67	4.48	34.38
Retail share	9.58	0.89	7.15	11.39
Oil share	2.05	4.82	0.00	21.45
Construction share	4.84	0.72	3.35	7.19
Finance share	14.71	3.51	8.40	25.07

The industry shares are computed as the average of industry shares of state GDP for 1963-2001. Manufacturing share is the sum of durable and non-durable goods production. Finance share refers to the finance, insurance, and real estate share of state GDP. Source: Bureau of Labor Statistics.

Variable	Mean	St. Dev.	Min	Max
Demographic variables				
Population density	71	97	2	438
Median income	47,403	7,029	35,261	64,168
Median age	35.59	1.89	27.1	38.9

Population density is person/km^2, for the year 2000. Median age is also year 2000 values. Median income is the average over years 2005-2007 from the U.S. Census Bureau Population Survey. Source: U.S. Census Bureau.

Variable	Mean	St. Dev.	Min	Max
Fiscal variables				
Federal assistance	40,264	53,875	2,929	300,357
Federal tax burden	43,773	52,490	3,829	289,627
Fiscal capacity index	99.67	17.96	64	141

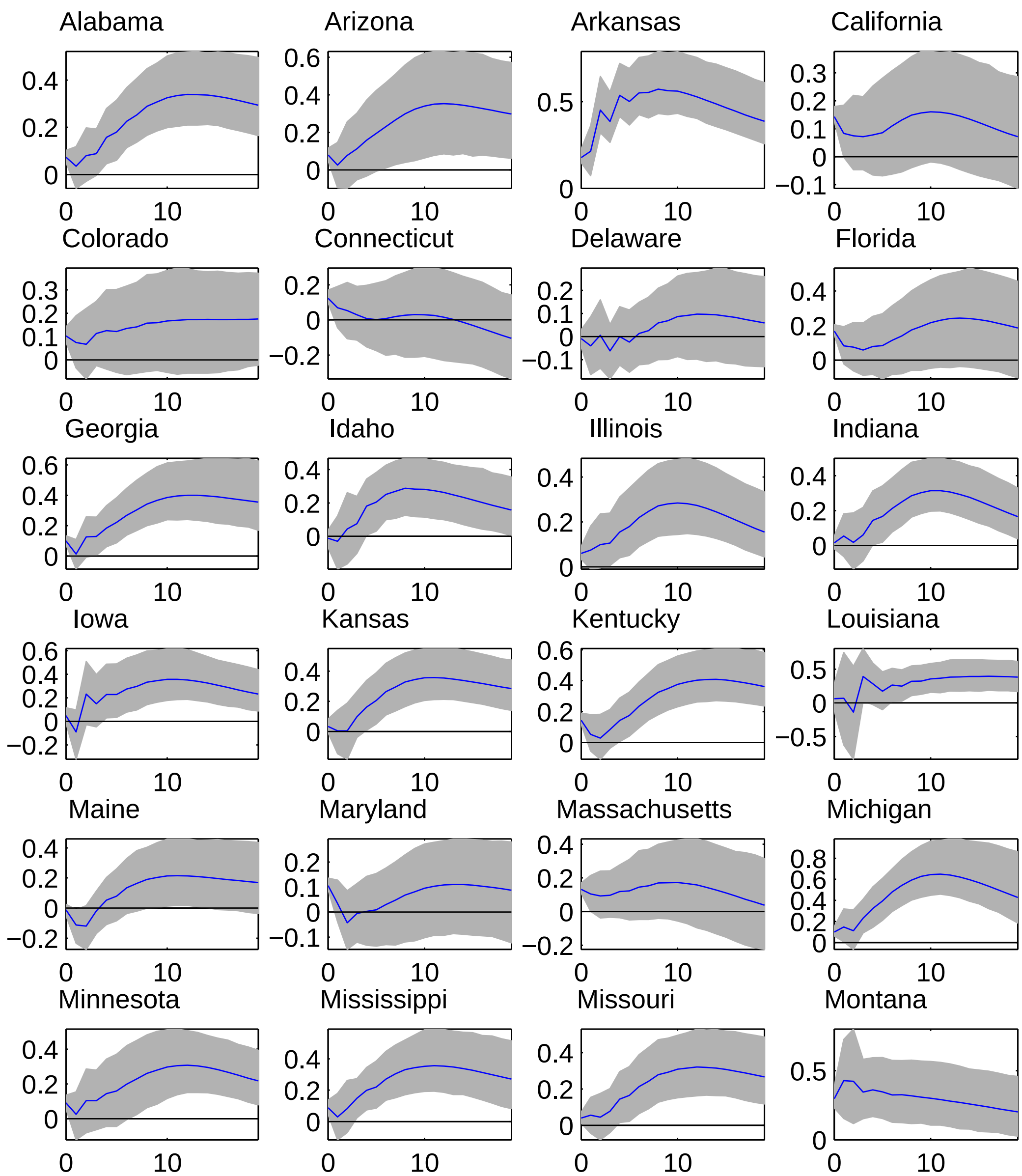
Federal assistance data are in millions and are averages for years 2000-2006. Federal tax burden data are also in millions, for 2005. Fiscal capacity index is for the fiscal year 2002. Source: The federal assistance data is from Federal Assistance Award Data System (FAADS), and federal tax burden data are the Northeast-Midwest Institute staff calculations based on statistics from the Census Bureau and the Tax Foundation. The fiscal capacity index is computed in **?**

Military prime contracts are the average value of military prime contracts from 1967-1995 in millions of 2000 dollars. Source: Military prime contract data are from **?** and the military personnel data are from the U.S. Department of Defense.

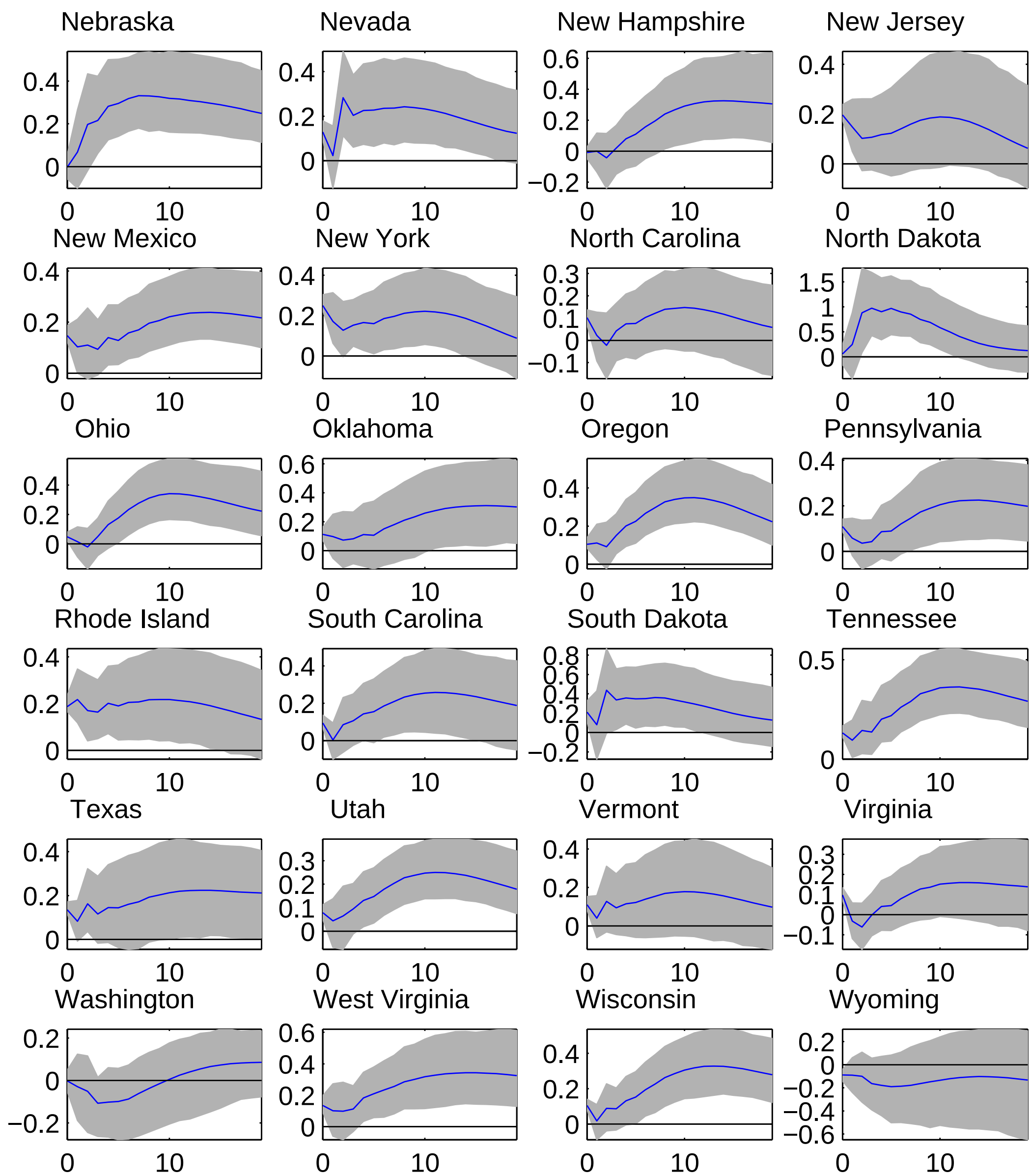
Variable	Mean	St. Dev.	Min	Max
Military variables				
Military prime contracts	2803.9	4449.8	64	27381
Military personnel	44,982	45,242	5,125	212,800

Impulse response functions

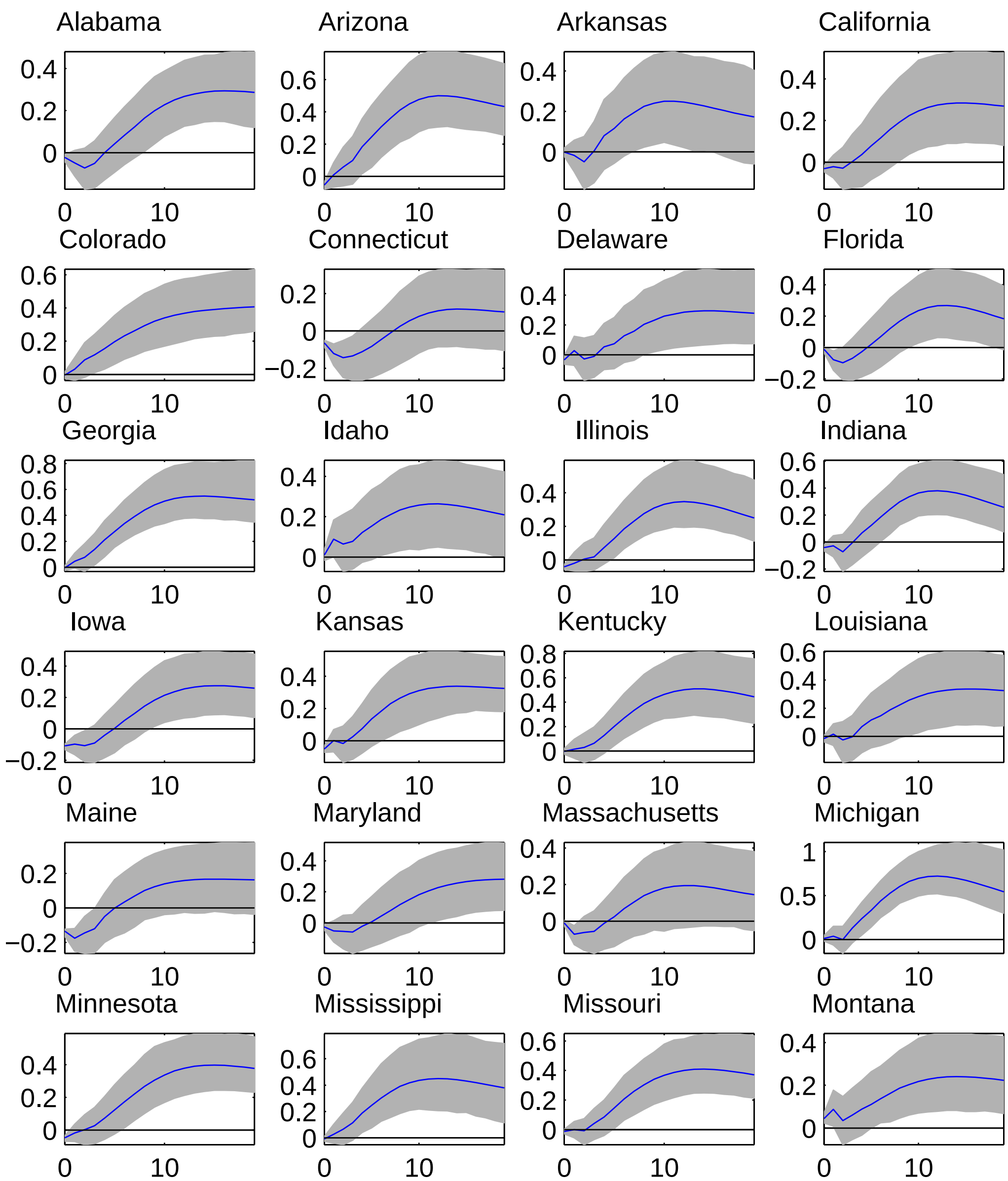
The following figures show the impulse responses for state-level personal income and employment across the different states to a one standard deviation federal spending shock and a military spending shock. The shaded areas indicate the 95% confidence bands constructed by Monte Carlo simulations.



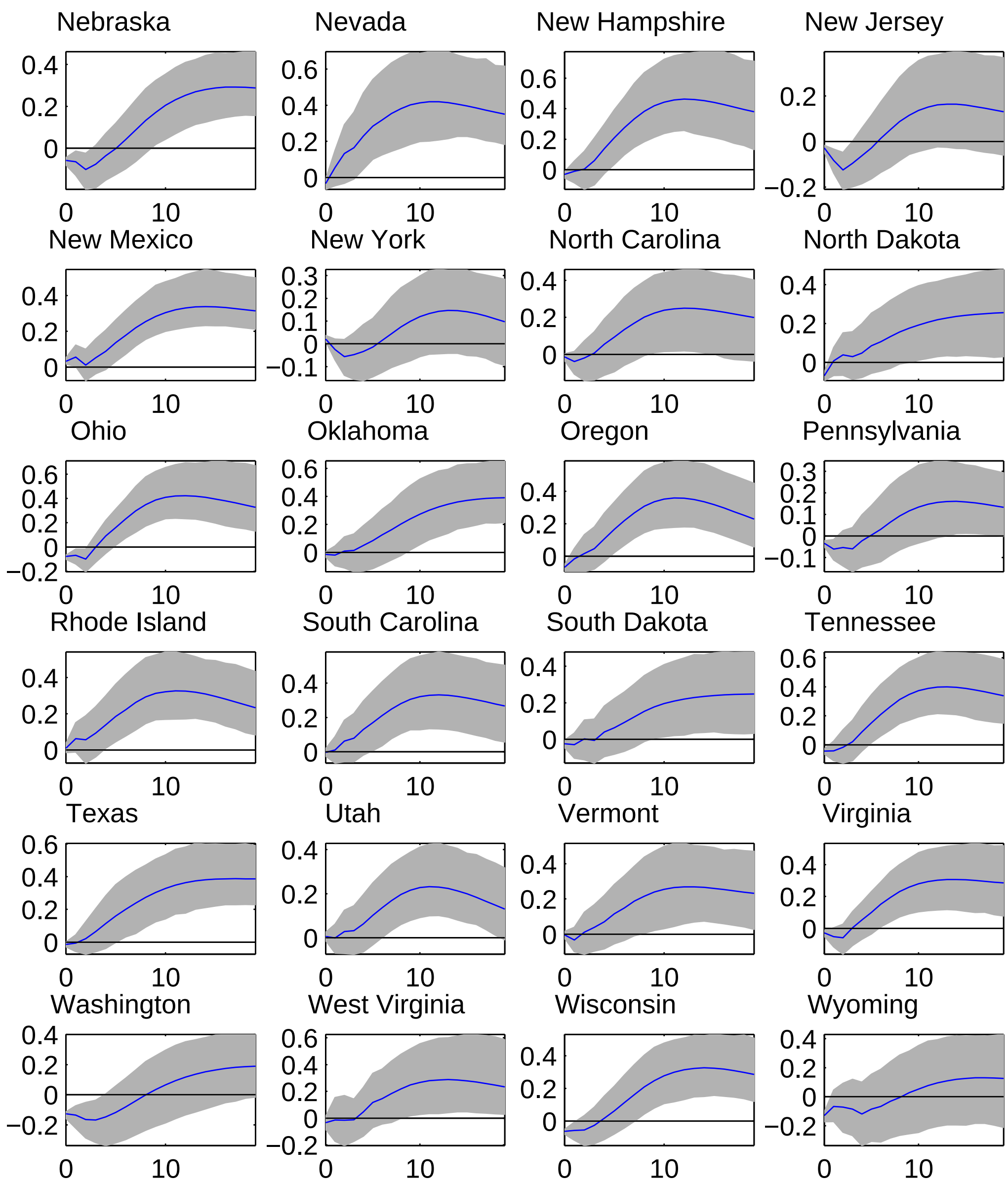
Response of personal income to a federal spending shock. The shaded areas indicate the 95% confidence bands constructed by Monte Carlo simulations.



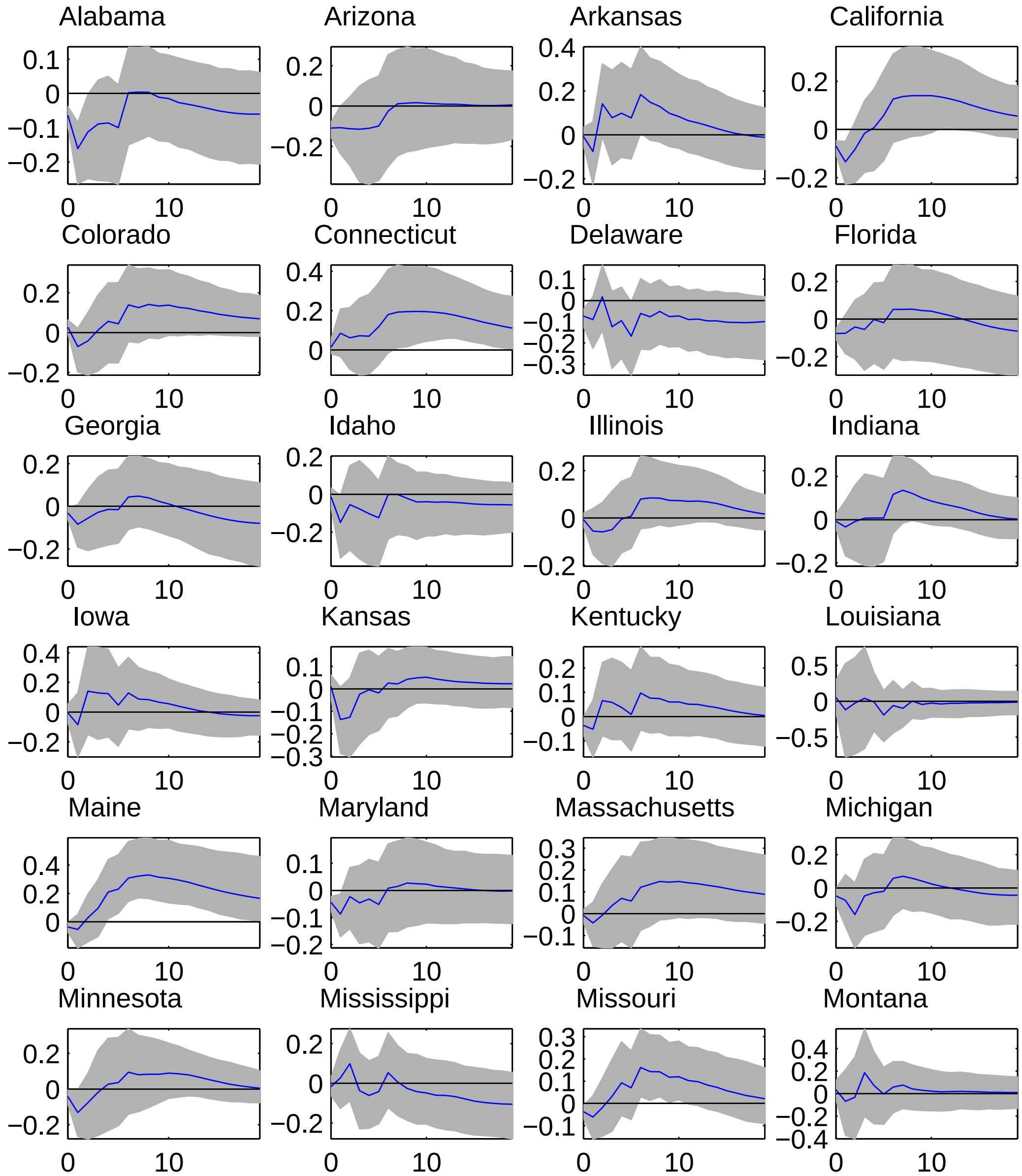
Response of personal income to a federal spending shock. The shaded areas indicate the 95% confidence bands constructed by Monte Carlo simulations.



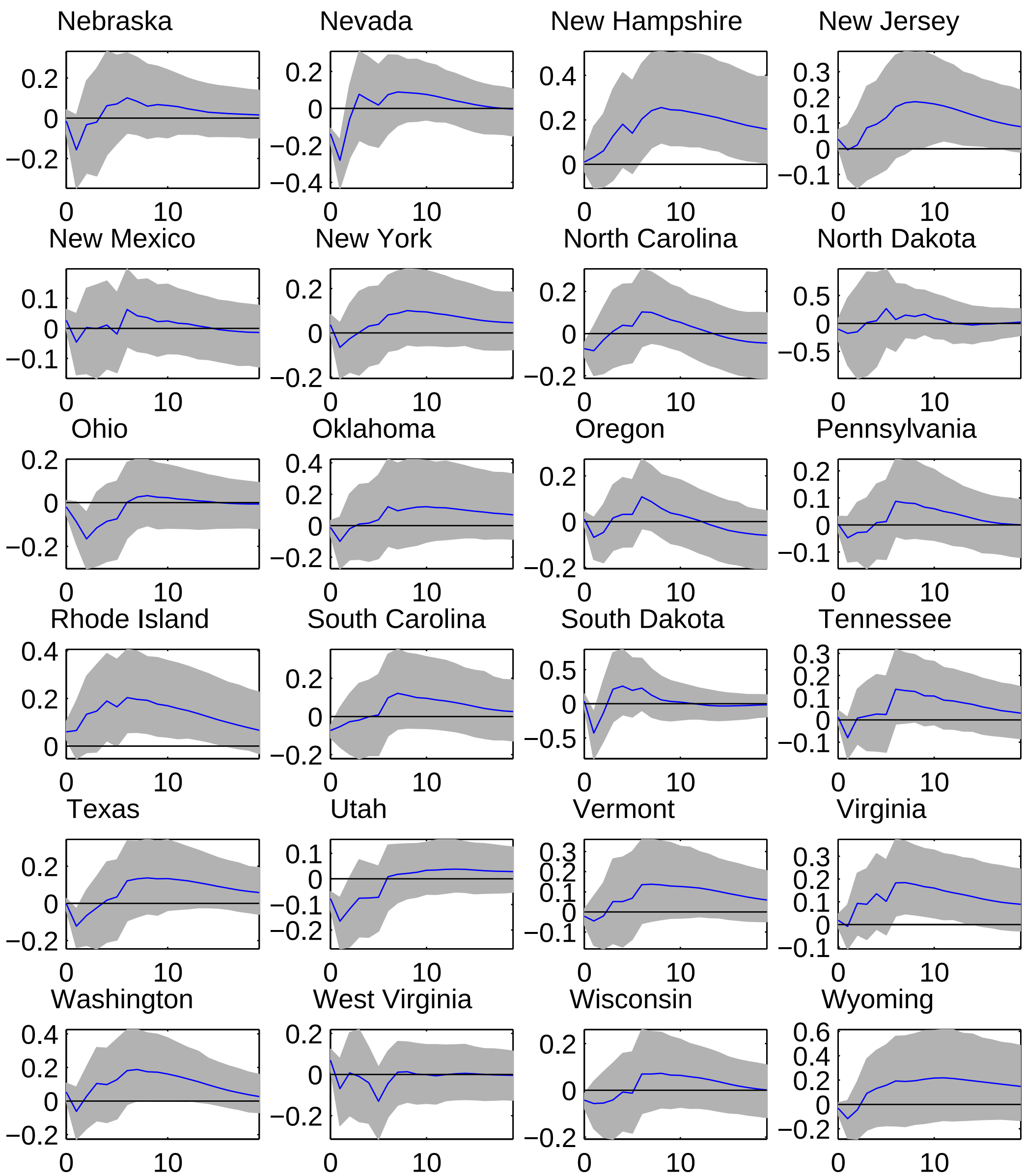
Response of employment to a federal spending shock. The shaded areas indicate the 95% confidence bands constructed by Monte Carlo simulations.



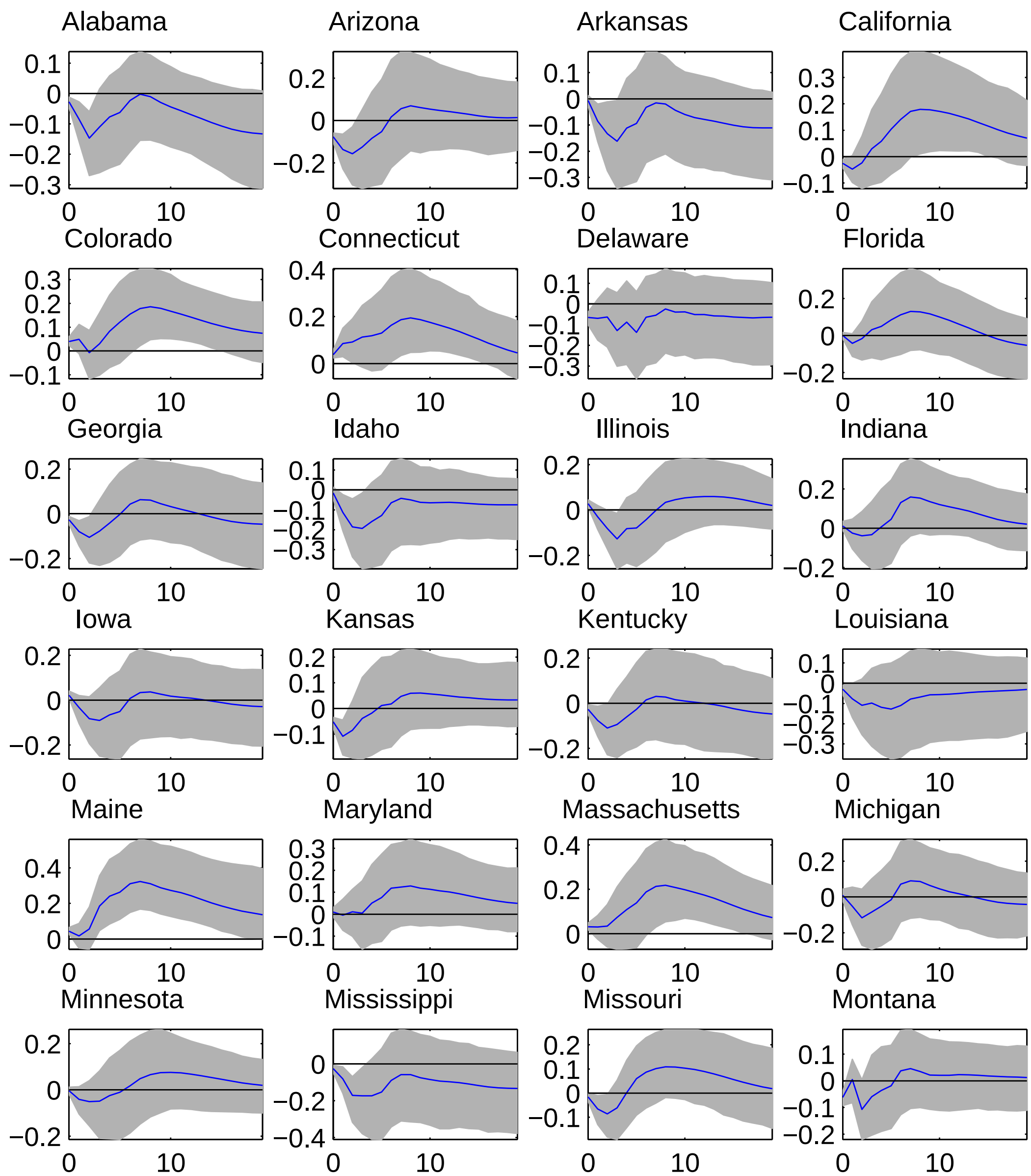
Response of employment to a federal spending shock. The shaded areas indicate the 95% confidence bands constructed by Monte Carlo simulations.



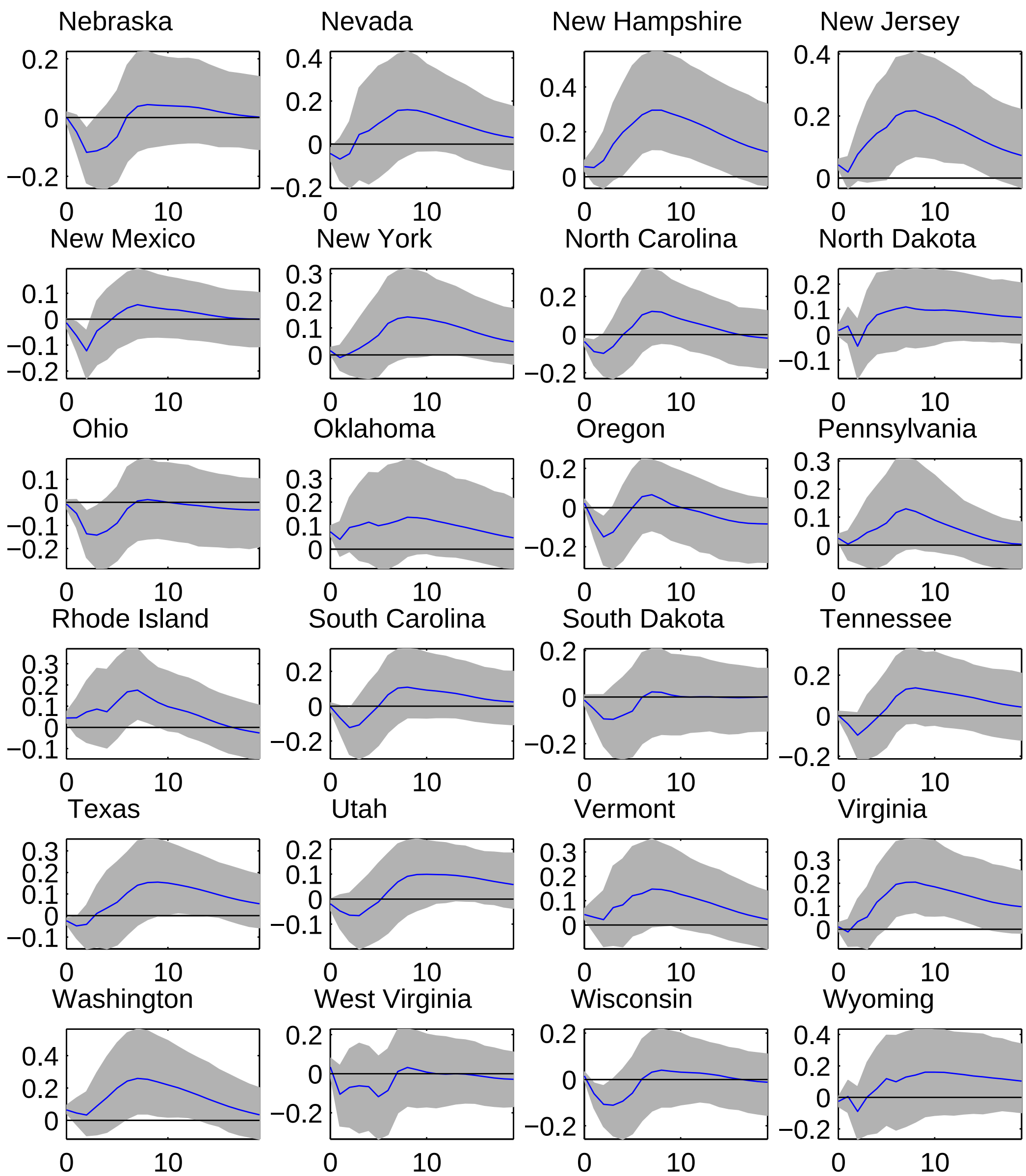
Response of personal income to a military spending shock. The shaded areas indicate the 95% confidence bands constructed by Monte Carlo simulations.



Response of personal income to a military spending shock. The shaded areas indicate the 95% confidence bands constructed by Monte Carlo simulations.



Response of employment to a military spending shock. The shaded areas indicate the 95% confidence bands constructed by Monte Carlo simulations.



Response of employment to a military spending shock. The shaded areas indicate the 95% confidence bands constructed by Monte Carlo simulations.