

The Asymmetric Effect of Government Spending in the United States

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Abstract: In this paper, we test for the presence of asymmetric effects of government spending on output and employment rate using U.S. postwar states panel data. We estimate two “endogenous” asymmetry: (i) whether negative and positive government spending change has different multiplier impact on real output and employment; (ii) whether big or small change has different effects. Our empirical results show there are asymmetric effects in terms of positive and negative government spending, but the asymmetric effect of positive and negative government spending can vary for different dependent variables and there is no significant asymmetric effect on employment. For the asymmetry of big and small government spending, we observe the same asymmetric property for output and employment. In both cases, the differences of the effect of big and small change are non-significant. Our main results are robust to intersection of “endogenous” factors effects, alternative specification (or other additional controls) and longer change interval, but asymmetric effect might differ among different production sectors.

Keywords: Government Spending; Asymmetric Effects; USA.

1. Introduction

This paper tests for the presence of asymmetric effects of government spending on output and employment rate using U.S. postwar states panel data. We are interested in two types of asymmetry: (i) whether negative and positive government spending change have different multiplier impact on real output and employment; (ii) whether big or small change have different effects.

Reviewing the empirical literatures, the effect of government spending can be asymmetric, depending on a number of factors. For example, by Hakan Berument (2004), if wages and prices are sticky downward, a contractionary government spending shock decreases output more than expansionary government spending shock increases it. And when prices and wages are perfectly flexible and output is equal to near full employment level, then an increase in government spending does not increase output but a decrease in government spending decreases output. Also, the response of interest rates and private agents would be different to the expansionary and contractionary shocks, which can have different effects on aggregate macroeconomic variables (Kandil, 2001).

Besides the asymmetric effect depending on the price stickiness and interest rate, the effect of government spending can vary among different regions (Davide and Sousa, 2011), and be state-dependent (recession or expansion) (see Ramey, 2011; Nakamura and Steinsson, 2013; Auerbach and Gorodnichenko, 2012). As for the country level analysis, the impact of government expenditure shocks can depend crucially on key country characteristics, such as the level of development, exchange rate regime, openness to trade, and public indebtedness (Ilzetzi, Mendoza and Vegh, 2013), as well as the status of public finances, and the health of the financial system (Corsetti, Meier and Muller, 2010).

In theory, traditional RBC model tells us that a shock might have different effects on the economy, based on whether it is permanent or transitory. In this sense, the economic outcome might be affected and changed by the perceptions and

expectations of the public. If it is perceived to be permanent by the public, then the expansionary shock will increase aggregate demand, but if it is perceived to be temporary by the public, then the expansionary government spending shock will not affect aggregate demand very much. Thus, if the increase in government spending is perceived as permanent but the decrease in government spending is perceived as transitory, the effect of expansionary and contractionary fiscal policy on economic outcome will be asymmetric. In standard new-Keynesian models the government-spending multiplier can be somewhat above or below one depending on the exact specification of agent's preferences (see Gali, López-Salido, and Vallés (2007) and Monacelli and Perotti (2008)). Based on the new-Keynesian model setting, Christiano, Eichenbaum and Rebelo (2009) find that the larger is the fraction of government spending that occurs while the nominal interest rate is zero, the larger is the value of the multiplier.

To sum up the above empirical and theoretical literatures, we can find that even though there are many factors inducing the asymmetric effect of government spending, none of them are “endogenous” determinants such as increases and decreases in government spending itself or the size of government spending shocks. We call these factors endogenous since they are properties of government spending itself, rather than other “exogenous” factors like the environment of the economy or the other macro variables, such as interest rate and expectation of the public.

There are several researches highlight the potentially important nexus between the “endogenous” properties of shocks (or policies) and their effects. Kaplan and Violante (2014) set a model featuring a marked size asymmetry with respect to small vs. large lumps of transitory income, and find that the rebate coefficient decreases with the decline of stimulus payment size. Cover (1992) examines whether positive and negative money-supply shocks have asymmetric effects on output. In this sense, can the effects of government spending on output and employment be different (asymmetric) with respect to positive and negative (big and small) change of government spending? Our work contributes to the

literature by trying to answer these questions.

A traditional way to estimate the government multiplier is relying on VAR (SVAR) methods. However, these VAR systems are almost based linear or linearized models, leading it hard to estimate the asymmetric effect of government spending. We analyze the effects of government spending in a monetary and fiscal union – the United States. We estimate the effects that positive (negative) or big (small) change in government spending in one region of the union relative to another has on relative output and employment. Following Nakamura and Steinsson (2013), we refer to this as the “open economy relative multiplier”, but we mainly focus on the effects of these “endogenous” factors on the multiplier rather than the comparison of our multiplier with the results of other models. We use variation in regional military procurement associated with aggregate military build-ups and drawdowns to estimate these effects.

We know that military spending is political and thus likely to be endogenous to regional economic conditions (Mintz, 1992). We, therefore, use the instrumental variables approach to estimate the multipliers in different settings (For the details about how to constructing the instrument variables and the reason why it is reasonable, please see Nakamura and Steinsson (2013)). Also, we need to note that, by including time fixed effects, we are able to control for aggregate shocks and policy that affect all states at a particular point in time, such as changes in distortionary taxes and aggregate monetary policy. Our specifications enable us to eliminate many “exogenous” factors that can affect the relative multiplier such as interest rate and other macro variables, thus we can estimate the effects of “endogenous” factors more precisely.

To preview our results, several interesting findings emerge from the empirical investigations. First, there are asymmetric effects in terms of positive and negative government spending. The impact of positive and negative military spending on output is quite different, and this gap is significant. The positive government spending can have a huge significant multiplier effect on real output, while negative spending has little effect. Second the asymmetric effect of positive and negative government spending can vary for different dependent variables and there is no significant asymmetric effect on employment. Third, for the asymmetry of big and small government spending, we observe the same asymmetric property for output and employment. In both cases, the differences of the effect of big and small change are non-significant. Our main results are robust to intersection of “endogenous” factors effects, alternative specification (or other additional controls), and longer change interval. And the asymmetric effect might differ among different production sectors.

The remainder of this paper is organized as follows: Section 2 describes the data used in the empirical work; Section 3 presents the model specification and measurement methods; Section 4 provides the estimation results and discusses about implications; Section 5 provides some further estimation and discussion for different sectors of production and longer change periods; and Section 6 concludes the paper and gives some ideas about future researches.

2. Data

We use the same data set as Nakamura and Steinsson (2013) did. The main source for military spending data is the electronic database of DD-350 military procurement forms available from the US Department of Defense. The reason of

using military spending is because other types of government spending are rarely exogenous, but the military spending associated with wars, might be unrelated to macroeconomic conditions, enabling us to estimate the multiplier. Our research focuses on military procurement spending, as opposed to total military expenditure; mainly due to the evidence that state procurement spending is exogenous to state economic conditions, whereas other types of military spending (especially base closures) may not be. In this paper, we have used the DD-350 database to compile data on total military procurement by state and year for 1966-2006.

Our primary measure of state output is the GDP by state measure constructed by the U.S. Bureau of Economic Analysis (BEA), which is available since 1963. For the employment rate, we will use the Bureau of Labor Statistics (BLS) payroll survey from the Current Employment Statistics (CES) program. Besides, we also give results for the BEA measure of state employment rate available since 1969. State population data are from the Census Bureau. We obtain our data on oil prices (annual average spot price of West Texas Intermediate) and the Federal Funds rate (annual average) from the St. Louis Federal Reserve’s FRED database for some robust tests.

3. Measurement of the Relative Multiplier and Mode Specifications

The aim of our empirical model specification is to investigate the multipliers of positive and negative, or big and small (%) change of government spending on real output. Following the basic specification in Nakamura and Steinsson (2013), we propose our basic specification:

$$\frac{Y_{it}-Y_{it-2}}{Y_{it-2}} = \alpha_i + \gamma_t + \beta \frac{G_{it}-G_{it-2}}{G_{it-2}} + \varepsilon_{it} \quad (1)$$

where Y_{it} is per-capita output in region i in year t , G_{it} is per-capita military procurement spending in region i in year t , and α_i and γ_t represent state and year fixed effects. (Both regional output and military procurement spending are deflated by the national CPI for the United States.) We include state fixed effects, implying that we are allowing for state specific time trends in output and military procurement spending. As stated before, we include time fixed effects, such that we can control for aggregate shocks and aggregate policy—such as changes in distortionary taxes and aggregate monetary policy. We measure all the data in the regression to be in per capita term.

As explained in Nakamura and Steinsson (2013), for the interval of changes, we choose 2-year change, as a way to capture dynamics in the relationship between government spending and output. In the later section, we also consider a longer change interval: a 4-year change to account for longer effect. We use annual panel data on state and regional output and spending for 1966-2006 and account for the overlapping nature of the observations in our regression by clustering the standard errors by state or region. In (1), what we are interested in is the coefficient β , which can be regarded in this case as the “open economy relative multiplier.”

The goal of our research is to estimate the multiplier effect of positive (negative) and big (small) change in government on some key variables. Based on baseline model (1), we can estimate the following regression,

$$\frac{Y_{it}-Y_{it-2}}{Y_{it-2}} = \alpha_i + \gamma_t + \beta_p \frac{G_{it}-G_{it-2}}{Y_{it-2}} * Dump_{it} + \beta_n \frac{G_{it}-G_{it-2}}{Y_{it-2}} * (1 - Dump_{it}) + \varepsilon_{it} \quad (2)$$

$$\frac{Y_{it}-Y_{it-2}}{Y_{it-2}} = \alpha_i + \gamma_t + \beta_p \frac{G_{it}-G_{it-2}}{Y_{it-2}} + (\beta_n - \beta_p) * \frac{G_{it}-G_{it-2}}{Y_{it-2}} * (1 - Dump_{it}) + \varepsilon_{it} \quad (3)$$

$$\frac{Y_{it}-Y_{it-2}}{Y_{it-2}} = \alpha_i + \gamma_t + \beta_b \frac{G_{it}-G_{it-2}}{Y_{it-2}} * Dumb_{it} + \beta_s \frac{G_{it}-G_{it-2}}{Y_{it-2}} * (1 - Dumb_{it}) + \varepsilon_{it} \quad (4)$$

$$\frac{Y_{it}-Y_{it-2}}{Y_{it-2}} = \alpha_i + \gamma_t + \beta_b \frac{G_{it}-G_{it-2}}{Y_{it-2}} + (\beta_s - \beta_b) * \frac{G_{it}-G_{it-2}}{Y_{it-2}} * (1 - Dumb_{it}) + \varepsilon_{it} \quad (5)$$

where Dumpit is an indicator for a period in which $\Delta G/Y$ is positive, and the effects of positive government spending change and negative change are given by β_p and β_n respectively. In the similar way, Dumbit is an indicator for a period in which $\Delta G/Y$ is big and the effects of big and small government spending are given by β_b and β_s respectively. We define positive and negative change in government spending in terms of the sign of $\Delta G/Y$, if it >0 , we call it positive percent change of government spending in output, otherwise, we call it negative.

As for the big and small change, we mimic the definition of Hooker and Knetter (1997) (In their setting, they construct 3 dummy variables that interact with change of military spending: one for $\Delta MIL < \$-100/\text{capita}$ (a large negative change), one from $\$-100$ to $\$100$ (a small change), and one for $>\$100$ (large positive change), and are interested in the coefficient estimated on the product of change in military spending and each of the three dummy variables.) by dividing the sample based on 25% and 75% percentiles of $\Delta G/Y$, creating 2 dummy variables: Dumbit=0 if $\Delta G/Y$ is between the 25% and 75% percentiles of $\Delta G/Y$ (small change), and =1 if it $>75\%$ percentiles of $\Delta G/Y$ (large positive change) or $< 25\%$ percentiles of $\Delta G/Y$ (large negative change). Then, we are also interested in combining these two “endogenous” factors together, so we can investigate the effect of big positive change. We can then estimate the following regression:

$$\frac{Y_{it}-Y_{it-2}}{Y_{it-2}} = \alpha_i + \gamma_t + \beta_{other} \frac{G_{it}-G_{it-2}}{Y_{it-2}} + (\beta_{bp} - \beta_{other}) * \frac{G_{it}-G_{it-2}}{Y_{it-2}} * Dumb_{it} * Dump_{it} + \varepsilon_{it} \quad (6)$$

For estimation method, we can estimate the baseline model (1) by 2SLS, since the government spending can be potentially endogenous in this case. Following Nakamura and Steinsson (2013), we can use the variation in the sensitivity of military spending across regions to national military build-ups and drawdowns to identify the effects of government spending shocks. Our baseline approach is to instrument for state or region military procurement using total national procurement interacted with a state or region dummy. In this sense, the “first stage” in the two-stage least squares interpretation of this procedure is to regress changes in state spending on changes in aggregate spending and fixed effects allowing for different sensitivities across different states. These yields scaled versions of changes national spending as fitted values for each state. For the instruments of product of change in government spending and dummy variables, we just use the product of IV in baseline model and correspond dummy variables to be the new IV.

We also estimate the effects of military spending on employment in an analogous way. For employment, the regression is like equation (1) except that the left-hand side variable is $(Lit - Lit-2)/Lit-2$ —where Lit is the employment rate (employment divided by population).

Then, we do some robust test regressions by considering alternative specifications. For example, we report the output multiplier when per-capita output is constructed by a measure of the working age population rather than total population. And we also add the price of oil interacted with state dummies as control for price change; add real interest rate interacted with state dummies as control for monetary policy, and substitute BLS’s employment rate with BEA’s employment rate.

Finally, to see if our results are robust with respect to different production sectors (for the dependent variable) and to the interval of changes of government spending, we run regressions using real product of detailed sectors as dependent variables, and try to extend the change interval from 2 years to 4 years.

4. Main Results and Interpretations

This section reports the estimation results of Model (1) to (6) using 2SLS estimation method. Table 1 reports the regression results pertaining to the effects of positive and negative military spending on output and employment. We can find that the point estimate of β_n for the output is -0.11 (near 0), and is not significant, implying that the negative military spending (cut of spending) almost has little effect on the real output. However, the positive military spending exerts a significant effect on output with a multiplier of 4.17. Also, the difference between positive and negative military spending is significant. In terms of the effect on employment rate, we can find a different pattern with the results for output. In specific, both the multiplier of positive and negative military spending is significantly differing from zero. The point estimate of β_n for the employment is 0.97 and the estimate of β_p is 1.85. Unlike the results for output, the difference between positive and negative military spending for employment is non-significant, which means the direction of change of government spending makes little difference in their effects on the labor market.

Table 1. The Effects of Positive and Negative Military Spending

	Output	Output	Employment	Employment
β_n	-0.11		0.97*	
	(0.729)		(0.517)	
β_p	4.17***	4.17***	1.85**	1.85**
	(1.559)	(1.559)	(0.875)	(0.875)
$\beta_n - \beta_p$		-4.28**		-0.88
		(2.141)		(1.235)
Num. Obs.	1,989	1,989	1,989	1,989

Note: β_n is the multiplier of negative military spending, β_p is the multiplier of positive military spending, and $\beta_n - \beta_p$ is the difference of these two multipliers; regressions include state and time fixed effect and are estimated by 2SLS. The sample period is 1966-2006 and output is state real GDP per-capita, employment is from the BLS payroll survey; robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 2 reports the regression results about the effects of big and small military spending on output and employment.

Unlike what we find in table 1, the effects of big and small military spending is quite different. The point estimates of β_s for output and employment are both bigger than the multiplier of bigger spending, though not significant. The effects of big spending on output and employment are quite the same, both of which are near 1.5 and are significant. If we turn to the difference between big and small military spending, we can see it is non-significant for both output and employment.

In a summary of Table 1 and Table 2, several interesting results merit discussion. First, there are asymmetric effects in terms of positive and negative government spending. We can see from table 1, the impact of positive and negative military spending on output is quite different, and this gap is significant. The positive government spending (or it is like expansionary government spending) can have a huge significant multiplier effect on real output, this finding is consistent with the Keynesian theory, which suggests that increased government spending stimulates aggregate demand and increases output.

Table 2. The Effects of Big and Small Military Spending

	Output	Output	Employment	Employment
β_s	3.50		6.82	
	(6.209)		(4.693)	
β_b	1.46***	1.46***	1.37***	1.37***
	(0.406)	(0.406)	(0.361)	(0.361)
$\beta_s - \beta_b$		2.04		5.45
		(5.965)		(4.388)
Num. Obs.	1,989	1,989	1,989	1,989

Note: β_s is the multiplier of small military spending, β_b is the multiplier of big military spending, and $\beta_s - \beta_b$ is the difference of these two multipliers; regressions include state and time fixed effect and are estimated by 2SLS. The sample period is 1966-2006 and output is state real GDP per-capita, employment is from the BLS payroll survey; robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Note that in Nakamura and Steinsson (2013), the overall military spending multiplier they estimated is 1.43, which is less than the point estimation of β_p in our case, which means the general government spending multiplier is between the negative government spending multiplier and positive government spending multiplier. The near zero and non-significant negative spending multiplier is kind of striking, since with the decrease of military spending, there can be a decline in the total demand and then a decrease of total output, if we just repeat the logic of Keynesian theory. However,

obviously in this case, the effect is asymmetric. This result is consistent with finding of Hooker and Knetter (2001), who find that the multiplier coefficients are not significantly different from zero, indicating that closures have no statistically reliable impact on per-capita income. One of the explanation they give is the civilian job losers who choose to remain in the county may be older, more experienced workers who are capable of earning higher wages than others. Although the shock they consider is military base closure, we are talking about military procurement spending, some ideas are the same. We think when the military procurement decreases, it is possible for these military factories to stay open or be transformed into other types of factories, such that the labor demand and good demand might not shrink that much, which might help to explain our results.

Second, the asymmetric effect of positive and negative government spending can vary for different dependent variables. In our case, we find that there is no significant asymmetric effect in terms of the effect of positive and negative spending on employment. From this perspective, it is likely that positive and negative government spending can have different asymmetric property for different macro variables.

Third, for the asymmetry of big and small government spending, we observe the same asymmetric property for output and employment. In both cases, the differences of the effect of big and small change are non-significant. And the results of point estimation of β_s and β_b are quite the same. The big sized government spending takes a dominant position in multiplier effect, since it is significant. However, we think the results are not so precise due to the property of data itself. We know by definition of big and small size, the variation (variance) of big military spending is bigger than that of small military spending. Due to little variation (small variance) of small size spending, it is possible that small spending can generate huge estimated coefficients. Also, note that the presence of measurement error in our procurement-spending variable would cause the signal-to-noise ratio to be smaller for small spending changes than for large ones. This might explain the lack of statistical significance on the small changes, although not on the large changes.

Our results also suggest that the relationship between changes in military spending and output (employment growth) may be nonlinear, supported by empirical finding of Hooker and Knetter (1997).

5. Robust and Extended Tests

Table 3. The Multiplier Effects of big positive and big negative Military Spending

	Output	Output	Employment	Employment
β_{bp}	2.69***		1.07**	
	(1.037)		(0.493)	
β_{bn}	0.50		1.12***	
	(0.464)		(0.341)	
$\beta_{other} = -\beta_p$		1.92		-0.39
		(1.503)		(0.845)
$\beta_{bp} - \beta_{other}$		0.72		1.43***
		(0.619)		(0.495)
Observations	1,989	1,989	1,989	1,989

Note: β_{bp} is the multiplier of big positive military spending, β_{bn} is the multiplier of big negative military spending, and β_{other} is overall multiplier except for the big positive spending, $\beta_{bp} - \beta_{other}$ is the difference of multipliers between big positive and other spending; regressions include state and time fixed effect and are estimated by 2SLS. The sample period is 1966-2006 and output is state real GDP per-capita, employment is from the BLS payroll survey; robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

In this section, we propose some robust and extended tests based on the specification on section 3. Then I plan to check the intersection effect of big and positive (negative) military spending

First, since the asymmetric patterns of positive (negative) and big (small) government spending are different, it is worth to look at their intersection effect. We conduct regressions to test the multiplier effect of big positive and big negative government spending on output and employment based on (6).

From Table 3, we can find that the multiplier of big positive government spending is far larger than the multiplier of big negative spending, even though they are all big changes, the sign of the military spending (whether increase or decrease) dominant the effect for output. And for the employment rate, since both negative and positive military spending can significantly affect employment, with the multiplier of big change being more significant, it is expected to see both significant coefficients for β_{bp} and β_{bn} . Then, we turn to the specification including β_{bp} and β_{other} , we find that for the employment, the difference between multiplier effect of big positive military spending and others is significant, while it is not true for the case for output. It is wired, since from Table1 and Table2, we know the difference between multiplier of positive and negative, or of big and small are both insignificant. On the contrary, for the output, positive spending significantly differs with negative military spending. This tells us that the intersection of endogenous “factors” might be more complicated than we thought.

6. Conclusion and Further Research

In this paper, we test for the presence of asymmetric effects of government spending on output and employment rate using U.S. postwar states panel data. We are trying to investigate two types of “endogenous” asymmetry: (i) whether negative and positive government spending change have different multiplier impact on real output and employment; (ii) whether big or small change have different effects. Using military procurement spending data instrumented by the variation in the sensitivity of military spending across regions to national military build-ups and draw-downs, by 2SLS, we estimate the multiplier effect of positive (negative) and big (small) change in government on output and employment.

Our main findings are as follows: (1) There are asymmetric effects in terms of positive and negative government spending. The impact of positive and negative military spending on output is quite different, and this gap is significant. The positive government spending can have a huge significant multiplier effect on real output, while negative spending has little effect. (2) The asymmetric effect of positive and negative government spending can vary for different dependent variables and there is no significant asymmetric effect in terms of the effect of positive and negative spending on employment. (3) Third, for the asymmetry of big and small government spending, we observe the same asymmetric property for output and employment. In both cases, the differences of the effect of big and small change are non-significant. Our main results are robust to intersection of “endogenous” factors effects, alternative specification (or other additional controls), longer change interval. And the

asymmetric effect might differ among different production sectors.

Our findings might have significant implication for future research about the effect of government spending. In particular, models that assume a linear relationship between government spending and the economic activity might significantly misestimate the impact of government spending on the economy when actually some of the “endogenous” factors can affect the impact of government spending. We hope to explore the possible mechanisms that might generate nonlinearities in future research.

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