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Second Thoughts on Estimating Expansionary Fiscal Policy Effects in the United States

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Abstract

This paper revisits mixed findings of the expansionary fiscal spending effect in the United States. An array of standard Vector-Autoregressive (VAR) models has been implemented to capture inconsistent effects of the fiscal expansion. Findings in this paper consistently reveal that without considering the influence of transfer payments, state and local government spending, and the timing of sample, measuring the effect of expanded government purchases alone would result in an upward bias of the comprehensive fiscal stimulus effect. This paper questions the validity of using government purchases alone to precisely evaluate the effect of fiscal expansion.

Keywords: Fiscal Expansion; Government Spending; the Great Recession; Vector-Autoregressive Model; Cholesky Decomposition; Impulse Response Function

JEL Classification: E21; E32; E62; H30; H50.

1 Introduction

The magnitude of expansionary fiscal effects on the economy has long been a heated debate in macroeconomics. After the implementation of the American Recovery and Reinvestment Act (ARRA) in 2009, an extensive literature has grappled with this debate. For those studies that are mainly the echoes of the new Keynesian approach, the gist of their arguments are primarily about the positive stimulating effect of the fiscal expansion, for example, Rotemberg and Woodford (1992), Devereux, Head, and Laphan (1996), Fatás and Mihov (2001), Blanchard and Perotti (2002), Perotti (2005), Galí, López-Salido, and Vallés (2007). Other studies tend to find either limited or negative influences of expansionary fiscal policy, for example, Aiyagari, Chiristiano, and Eichenbaum (1992), Hall (1986), Ramey and Shapiro (1998), Edelberg, Eichenbaum, and Fisher (1999), Burnside, Eichenbaum, and Fisher (2004), Cavallo (2005), Mountford and Uhlig (2009), Ramey (2012), Owyang, Ramey, and Zubairy (2013), and Kim and Jia (2018). In general, estimates of expansionary fiscal effects are quite varied across studies, and a definitive consensus has not been reached thus far.

Regardless of those inconclusive arguments about fiscal expansion effects, this paper questions the validity of using government purchases alone to conclude the comprehensive effect of fiscal expansion. For example, I am wondering if the expanded government purchase alone is an ideal proxy of a stimulating fiscal policy? Then, how do federal purchases and state and local spending affect the economy differently? Also, does the intervention of 2007 recession change the effectiveness of expansionary fiscal policy thereafter?

It's well-known that many papers estimate the fiscal effect by primarily focusing on government purchases—the sum of the government consumption and the gross investment, usually end up with conclusions that the expansionary fiscal policy has positive influence on economic activities, such as output, consumption and real wages (Baxter and King (1993), Fatás and Mihov (2001), Blanchard and Perotti (2002), McGrattan and Ohanian (2008), Hall (2009), Pappa (2009), Monacelli, Perotti and Trigari (2010), Auerbach and Gorodnichenko (2012), Leeper, Traum and Walker (2015), and Fishback and Kachanovskaya (2015)). However, such conclusion suffers two major cursoriness: first, it omits the influence of expanded transfer payment, which is often an important component of the fiscal stimulus package. For example, Giambattista and Pennings (2017) uncovered that 75 % of the increase in the U.S. government spending during the Great Recession (2007-2009) consisted of transfers; Oh and Reis (2012) find the median share of transfer payments in the increased government spending could be as high as 64% in their sample of countries, including the U.S. Cogan and Taylor (2012) even question how much of government purchase is actually multiplied by expansionary fiscal packages? The second cursoriness is the fact that most government purchases used in previous studies were including the state and local government purchase, which is not directly injected as the stimulating spending in the national fiscal stimulus package. So even if the expanded state and local government spending often positively affects economic activities, it does not fully guarantee a positive stimulation from the federal purchases.

In this paper, alternative identifications of the fiscal expansion shock have been identified based on a reduced-form VAR model. Following the recursive Cholesky decomposition, I derive impulse responses to different government spending shocks. Simultaneously, I generate

such responses within two different sample periods to observe the influence of 2007 recession.

The major contributions of this paper are threefold. First, even if government purchases have a more positive influence on economic activities, the completed stimulus package often generates much less positive effect due to the intervention of expanded transfer payments. Second, over 50% of expanded government purchases are made by the state and local government, the federal purchase itself has a very limited stimulating effect. Third, with the intervention of the 2007 recession, fiscal expansion effects get significantly weaker in contrast to the pre-crisis period. All findings reinforce the risk of overstating the effect of the expansionary fiscal policy by focus only on the work of government purchases.

The remainder of this paper is organized as follows. Detailed information of the empirical model is provided in [Section 2](#). Data description and the primary findings are discussed in [Section 3](#). In order to comparatively study findings in this paper with those in previous literature, an extensive discussion is developed in [Section 4](#). Finally, [Section 5](#) provides the concluding remark.

2 Empirical Model

In order to capture the fiscal expansion shock, a standard Vector Auto-Regressive (VAR) model is applied. The basic setting of this model is:

$$\mathbf{x}_t = \mathbf{A}(\mathbf{L})\mathbf{x}_{t-1} + \mathbf{e}_t, \quad (1)$$

where \mathbf{x}_t is an $(n \cdot 1)$ vector containing n variables in the system; $\mathbf{A}(\mathbf{L})$ is the vector of lag operator polynomials, see equation 2, which includes up to p lags. \mathbf{e}_t is the vector of reduced form error terms. The coefficient matrix of this VAR is identified by \mathbf{A} . The right-hand side of equation 1 includes all predetermined variables, and the error terms are assumed to be serially uncorrelated.

$$\mathbf{A}(\mathbf{L}) = \sum_{i=1}^p \mathbf{A}_i \mathbf{L}^i \quad (2)$$

This paper is particularly interested in variables as it's listed below ¹:

$$\mathbf{x}_t = [g_t \ y_t \ snt_t \ tax_t \ ints_t \ money_t]' \quad (3)$$

g_t alternatively denotes different types of government spending: government expenditures², government purchases³, transfer payments, and state and local government spending. In

¹The order of variables is subject to the change of government spending type.

²The sum of “government purchases” and “transfer payments”, or the sum of “federal government expenditures” and “state & local government expenditures”.

³According to the [NIPA Guide of the United States](#), it stands for government consumption expenditures and gross investment, “the measure of government sector final demand, consists of two major components: Current consumption expenditures by general government and gross investment by both general government and government enterprises”.

which,

$$\text{Government Expenditures} = \text{Government Purchases} + \text{Transfer Payments}$$

and,

$$\begin{aligned} \text{Government Purchases} &= \text{Government Consumption Expenditures} \\ &+ \text{Government Gross Investment} \end{aligned}$$

y_t is a scalar (or vector) of interested variables, such as total GDP ($rgdp_t$), consumption (con_t) and investment (ivt_t). The sign “|” denotes the possible ordering shuffle between g_t and y_t . I am trying to incorporate the influence of business cycle into the calibration of the fiscal expansion effect, so g_t is only ordered first when it does not include the automatic stabilizer⁴, otherwise, it will be ordered after the business cycle variable y_t . Besides, I have snt_t denotes a scalar of consumer sentiment index; $taxr_t$ is the federal government current tax receipts as a share of nominal GDP; $ints_t$ is the secondary market 3-month treasury bill yield, and $mony_t$ is the M2 money stock. For the purpose of stationarity, all the data is demeaned and detrended prior to the estimation⁵.

In order to compare the fiscal expansion effect, two VAR(p) identification schemes have been employed in this paper. The first identification scheme (**TGDP model**) is employed when the y_t is defined as total GDP. This setting of model is motivated by Fatás and Mihov (2001), Blanchard and Perotti (2002), Bachmann and Sims (2012), and Corsetti, Meier and Müller (2012a). The second identification scheme (**CI model**) focuses on the private sector, similar with Galí, López-Salido and Vallés (2007), Fishback and Kachanovskaya (2010), Ramey (2011, 2012), and Perotti (2014), private consumption (con_t) and private investment (ivt_t) are treated as y_t in equation 3. For details, please see the equation group below.

$$\begin{aligned} \text{TGDP} : \mathbf{x}_t &= [g_t \text{ } rgdp_t | \text{ } snt_t \text{ } taxr_t \text{ } ints_t \text{ } mony_t]' \\ \text{CI} : \mathbf{x}_t &= [g_t \text{ } con_t \text{ } ivt_t | \text{ } snt_t \text{ } taxr_t \text{ } ints_t \text{ } mony_t]' \end{aligned} \quad (4)$$

The calibration of equations 4 could capture the contemporaneous influence from the change of business cycle on automatic stabilizers and further generate more realistic impulse responses to the government spending shock. This framework is also applied by previous literatures, such as Kim and Roubini (2008), and Kim and Jia (2018). To clarify the logic, I rewrite the benchmark equation 1 into the format of equation 5. See details below:

$$\begin{bmatrix} g_t \\ y_t \\ Z_t \end{bmatrix} = \begin{bmatrix} \bar{g}_t \\ \bar{y}_t \\ \bar{Z}_t \end{bmatrix} + \sum_{i=0}^P \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ \Gamma_{31} & \Gamma_{32} & \Gamma_{33} \end{bmatrix}^i \begin{bmatrix} e_{g_{t-i}} \\ e_{y_{t-i}} \\ E_{Z_{t-i}} \end{bmatrix} \quad (5)$$

⁴In this paper, the primary proxy of automatic stabilizer is the transfer payment, tax is one of the control variables

⁵According to Sims and Watson (1990), data in VAR system does not need to be detrended since it might remove important information of the comovements among endogenous variables. However, following the majority view, Enders (2004) points out that the data in VAR should mimic the true data generating, especially if the major purpose is to estimate a structure VAR model.

Where Z_t stands for the vector of control variables,

$$Z_t = [snt_t \ taxr_t \ ints_t \ mony_t]' \quad (6)$$

and Γ is a (4×4) coefficient matrix for each control variable. The intercept vector $[\bar{g}_t \ \bar{y}_t \ \bar{Z}_t]'$ can be dropped due to the primarily demeaned and de-trended data set.

In order to understand the initial ordering shuffle between g_t and y_t , I will only focus on those two variables start from equation 7. The error terms $[e_{g_{t-i}} \ e_{y_{t-i}}]'$ could be composited by primitive shocks $[\varepsilon_{g_{t-i}} \ \varepsilon_{y_{t-i}}]'$. Knowing that γ_{12} captures the contemporaneous effect of y_t on g_t , and γ_{21} captures the current effect of g_t on y_t .

$$\begin{bmatrix} e_{g_t} \\ e_{y_t} \end{bmatrix} = \frac{1}{1 - \gamma_{12}\gamma_{21}} \begin{bmatrix} 1 & -\gamma_{12} \\ -\gamma_{21} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{g_t} \\ \varepsilon_{y_t} \end{bmatrix} \quad (7)$$

For only g_t and y_t , after integrated with 7, equation 5 could be rewritten as:

$$\begin{bmatrix} g_t \\ y_t \end{bmatrix} = \begin{bmatrix} \bar{g}_t \\ \bar{y}_t \end{bmatrix} + \frac{1}{1 - \gamma_{12}\gamma_{21}} \sum_{i=0}^P \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}^i \begin{bmatrix} 1 & -\gamma_{12} \\ -\gamma_{21} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{g_t} \\ \varepsilon_{y_t} \end{bmatrix} \quad (8)$$

Eventually, I could derive the impulse response element η_i as:

$$\eta_i = \frac{B^i}{1 - \gamma_{12}\gamma_{21}} \begin{bmatrix} 1 & -\gamma_{12} \\ -\gamma_{21} & 1 \end{bmatrix} \quad (9)$$

where,

$$B^i = \sum_{i=0}^P \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}^i \begin{bmatrix} \varepsilon_{g_t} \\ \varepsilon_{y_t} \end{bmatrix} \quad (10)$$

According to the derivation of equations above, in order to address the underlying ‘‘under-identification’’ issue of the impulse response function, I implement the recursive Choleski Decomposition and add a restriction as $\gamma_{12} = 0$. This is turning off the contemporaneous influence from y_t to g_t , which makes practical sense if g_t denotes the government purchase and ranks the first. The reasons are, first, government purchases do not include transfer payments, which would often be influenced by the current economic fluctuation; second, wheels of fiscal policy often spin slowly and deliberately due to the implementation lag⁶, government purchases usually can not quickly respond to the change of economic activities within one quarter.

However, if g_t stands for other types of government spending that include the automatic stabilizer, in order to incorporate the instantaneous impact from the business cycle variable y_t , I put y_t in front of g_t when I am testing the impact of fiscal expansion. One limitation of this identification is that the initial response of economic activities to the shock of fiscal expansion would be recorded as zero, due to the coefficient constraint.

⁶The time lag between when government decides to implement a new fiscal policy and when it’s actually enacted through the market.

3 Empirical Findings

3.1 Data Description

All the data in this paper is on a quarterly basis, and most data is collected from the Federal Reserve Economic Data⁷ with one exception: the consumer sentiment index ($sent_t$). The quarterly consumer sentiment index is collected from the Survey of Consumers⁸ of the University of Michigan. For data transformation, a natural logarithm has been applied to this index.

The full sample period in this paper is stretching from 1960Q1 to 2017Q3, which includes the Great Recession period that started in 2007. All public and private spending variables such as the multiple types of government spending, total GDP ($tgdp_t$), private consumption (con_t), and private investment (ivt_t) are in the format of real value per capita. Additionally, they are all in logarithmic format.

Under the VAR model, multiple types of government spending variables have been plugged in alternatively. This includes not only the total government expenditures, but also the disaggregated spendings, for example, government purchases, transfer payment, and state and local government spending.

3.2 Primary Results

3.2.1 Fiscal Expansion and Total GDP

In order to study fiscal policy effects on the total output, Figure 1 displays impulse responses of total GDP to various government spending shocks. The solid line traces down the impulse responses in the full sample, which considers the Great Recession of 2007 as an intervention. The dash-dot line is the response of total GDP in the sub-sample (“pre-crisis”), which depicts how the fiscal shock works before the Great Recession period.

Figure 1 around here

Given a quick glance of results in Figure 1, government purchases are positively stimulating the total GDP. Transfer payments, on the other hand, constantly generate negative impact on the total GDP. Total expenditures normally do not exhibit as much positive influence as the government purchases do. Because government expenditures are the sum of government purchases and transfer payments, and expanded transfer payments are often much greater than expanded government purchases (see Figure 3). So it makes sense that the effect of expansionary expenditures would be more influenced by transfer payments and running less stimulating effect than the purchases.

⁷Federal Reserve Economics Data: <https://fred.stlouisfed.org/>

⁸University of Michigan: Consumer Sentiment, retrieved from <https://data.sca.isr.umich.edu/data-archive/mine.php>.

As to the timing issue, in Figure 1, the total GDP almost always has a more positive response to fiscal expansion shocks before the 2007 recession, regardless of which specific government spending variable is utilized. This result reveals that the 2007 recession has substantially muted the positive influence of the expansionary fiscal policy thereafter.

3.2.2 Fiscal Expansion and Consumption

As long as I am interested in the stimulating effect of fiscal policy, the private sector should not be overlooked. Except for total GDP, private consumption is another important target to be stimulated. Similarly, the gross government expenditures have much less positive effect on consumption, see Figure 2. This again is due to the negative influence of transfer payments and how big a proportion has been shared by transfer payments in the government total expenditures.

Figure 2 around here

If I shift the focus on time-variant estimates in Figure 2, again, consumption is more responsive before the great recession of 2007, which indicates a weaker expansionary fiscal effect due to the intervention of the Great Recession.

4 Extensive Discussion

4.1 Is Expanded Government Purchases A Good Proxy?

Across previous studies, papers that often find very positive effect of expansionary fiscal policy usually treat government purchases as the primary proxy of expanded fiscal spending. For example, with government purchases, Baxter and King (1993) states that the fiscal multiplier could be greater than 1 in the long run; this strong positive influence is also possible to be observed in the short run, as long as labor supply is highly elastic. Following this, Auerbach and Gorodnichenko (2012) estimates the government purchases multiplier could be as large as 1.5. Later, Fazzari, Morley and Panovaska (2015) also estimated a high purchases multiplier around 1.6 for the “low-capacity” regime.

However, government fiscal stimulus is not only about expanding purchases, but also about increasing transfer payments (Oh and Reis (2012), Mehrotra(2018), Giambattista and Pennings (2017)), let alone transfer payments often expand much greater than government purchases (see Figure 3) in total expanded spending. Especially during the “in-crisis” period, in Figure 3, transfers increase more than 65% , while purchases are only expanded by about 20%. Unlike government purchases, transfer payments constantly generate negative impacts on economic activities (Churchill and Yew (2017)), see Figure 1 and Figure 2. Apparently, while purchases have positive stimulating effect on the market, the expanded transfer payments would attenuate this positive effect simultaneously. So using government

purchases alone would very likely generate a result that is overvaluing the comprehensive fiscal expansionary effect.

Figure 3 around here

4.2 Intervention of State and Local Government Spending

As long as people study effects of expanded government purchases on the economy, they should be careful about which purchase variable has been used. Many previous studies often use total government purchase instead of federal purchase alone to measure the expansionary fiscal effect (Baxter and King (1993), Fatás and Mihov (2001), Blanchard and Perotti (2002), Galí, López-Salido, and Vallés (2007), McGrattan and Ohanian (2008), Hall (2009), Mountford and Uhlig (2009)), in which state and local government spending is also included. However, according to Hubbard and O’Brien (2015), spending policies implemented by state and local governments are not directly affecting the national economy, whereby the *fiscal policy* only refers to actions of the federal government.

Recall what has been presented in Figure 4, state and local purchases often takes up a larger proportion of total government purchases than the federal purchase does. In order to have a more precise estimate for the effect of expansionary fiscal policy, it’s important to isolate federal purchases from state and local spending, then observe how would output respond to federal purchase and state and local spending differently. Results are presented in Figure 5.

Figure 4 and Figure 5 around here

Apparently, state and local government spending accounts for most of the positive stimulation, because total output has more positive response to the expansion of state and local spending. The federal government purchases, on the other hand, have very limited stimulating effect. This reinforces that using total government purchases to measure the effectiveness of expansionary fiscal policy would end up overestimating the stimulating effect.

5 Conclusion

Facing various arguments about the fiscal expansion effect among previous studies, this paper questions the validity of using government total purchases alone to conclude the comprehensive effect of fiscal expansion. I start this argument asking a few questions such as whether the expanded government purchase alone is an ideal proxy of a stimulating fiscal

package? How does federal purchases and state and local spending affect the economy differently? Does the great recession in 2007 change the effectiveness pattern of expansionary fiscal policy overall?

In order to address the first question, this paper distinguishes “*government purchases*” from “*government expenditures*”. It turns out that government purchases alone generate very dissimilar stimulating effect on the economy in contrast to government expenditures. The main driver of such divergence is the *transfer payment*. According to empirical results in this paper, expanded transfer payments almost always have negative impact on economic activities, and this negative impact is quite robust across different identification schemes. This provides the clue that why the expansion of government expenditures often generates less positive influence than the expanded purchases, because the negative impact of transfer payments erode the positive stimulating effect from government purchases. This finding reveals that by using government purchases alone would easily generate an overstated stimulating effect of fiscal expansions.

Another noteworthy finding is that state and local government spending often has a stronger stimulating effect than the federal purchases. Due to the fact that spending policies implemented by state and local governments do not directly affect the national economy, using total government purchases to evaluate the effectiveness of fiscal expansion could result in an upward bias.

As to the timing issue, the Great Recession of 2007 plays an important role to intervene the fiscal stimulus effect. Empirical results in this paper present a fact that with the intervention of the Great Recession, the effectiveness of fiscal stimulus would be prominently weakened.

Following all the empirical findings in this paper, I don't deny the fact that government purchases often exhibit a positive influence on total output and consumption in the United States. However, by only using government purchases to measure the effectiveness of fiscal stimulating package is not quite precise. Base on all the concerns discussed in this paper, when policymakers plan to adjust the fiscal policy in order to stimulate the economy, it's important that transfer payments will not be overlooked and the state and local government spending will not be mixed in.

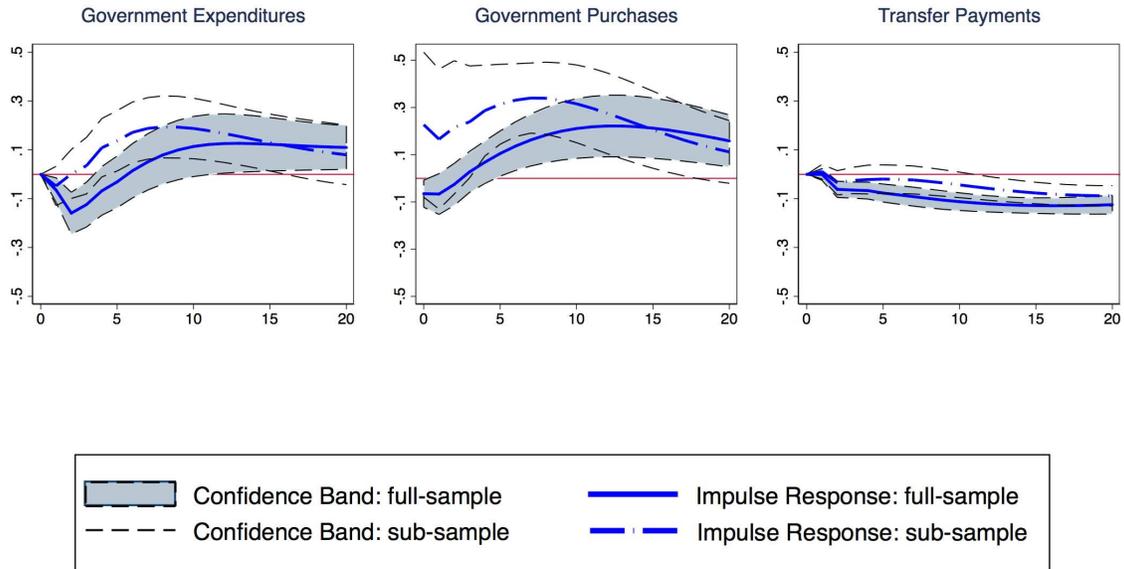
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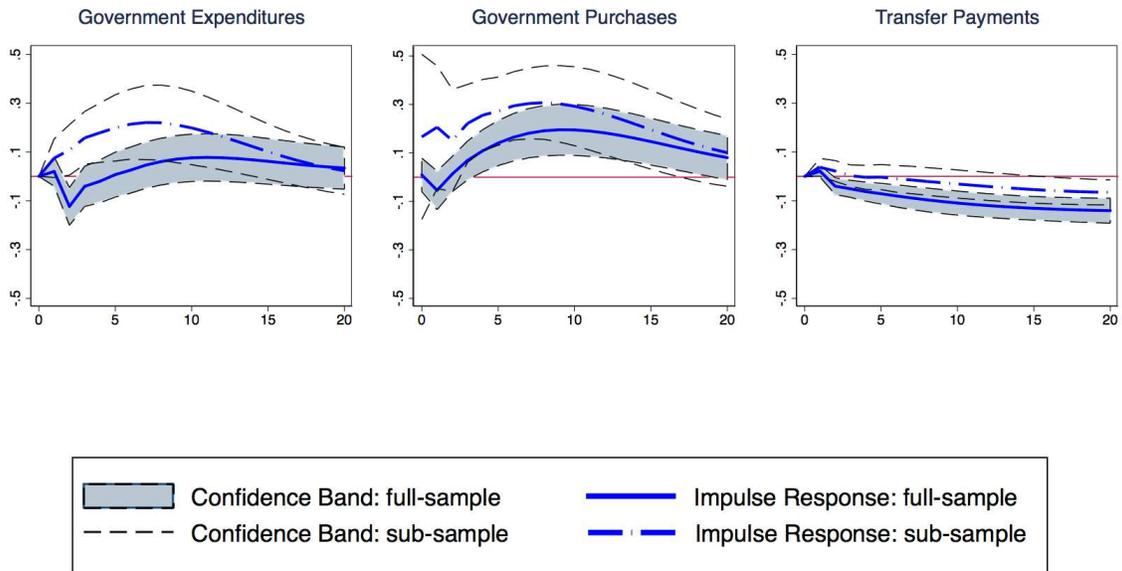
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Figure 1: Government Spending Shocks on Total GDP



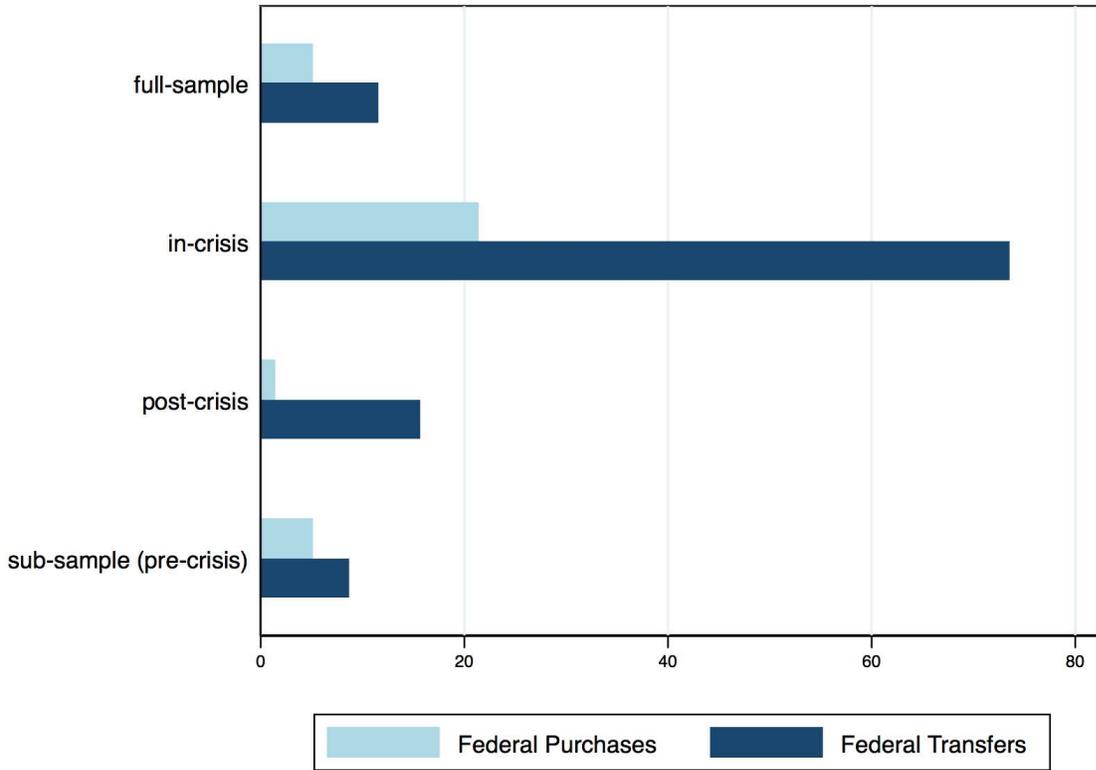
Note: Data source is US. Bureau of Economic Analysis, selected series are retrieved from FRED, Federal Reserve Bank of St. Louis. The result is based on the 1-standard deviation confidence band (68% CI) and 100 times non-parametric bootstrap simulation. Time span of full sample is 1960Q1-2017Q3, and 1960Q1-2007Q3 for sub-sample.

Figure 2: Government Spending Shocks on Consumption



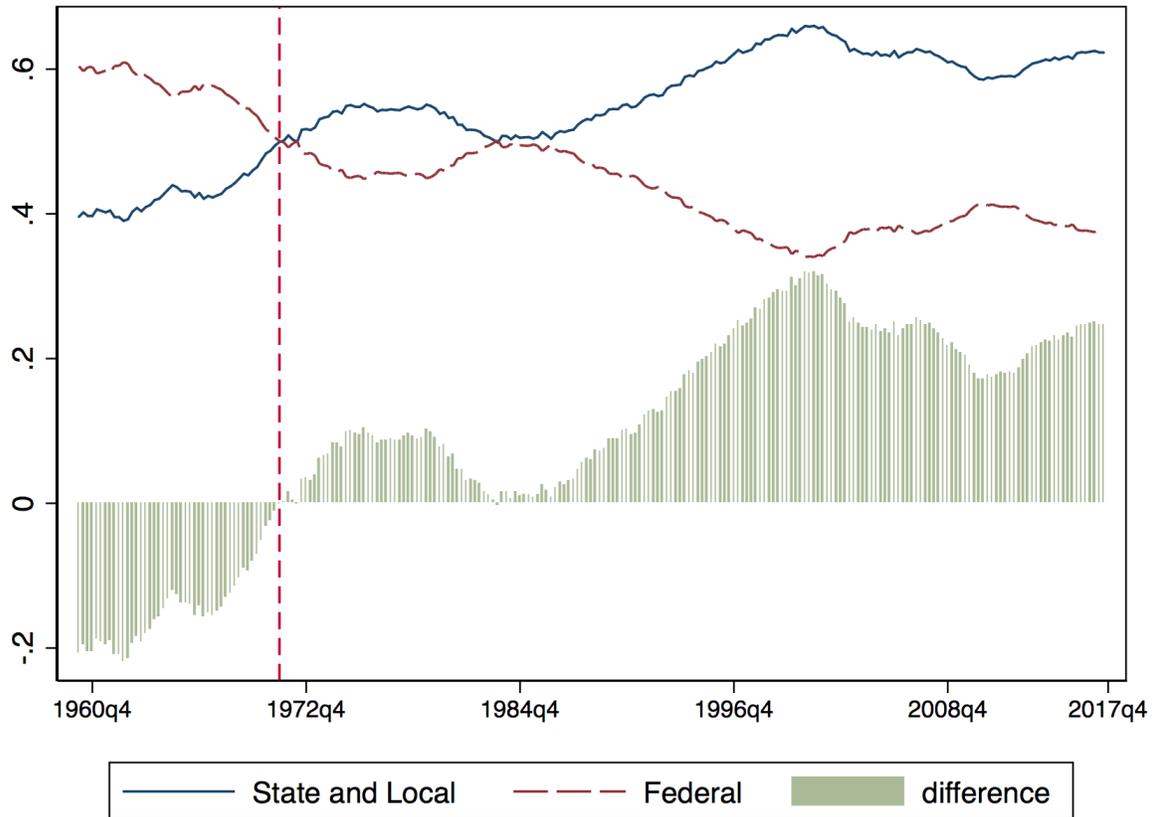
Note: The data source is US. Bureau of Economic Analysis, selected series are retrieved from FRED, Federal Reserve Bank of St. Louis. The result is based on the 1-standard deviation confidence band (68% CI) and 100 times non-parametric bootstrap simulation. Time span of the full sample is 1960Q1-2017Q3, and 1960Q1-2007Q3 for the “*pre-crisis*” period.

Figure 3: Growth of Federal Purchases v.s. Transfers: quarterly mean (%)



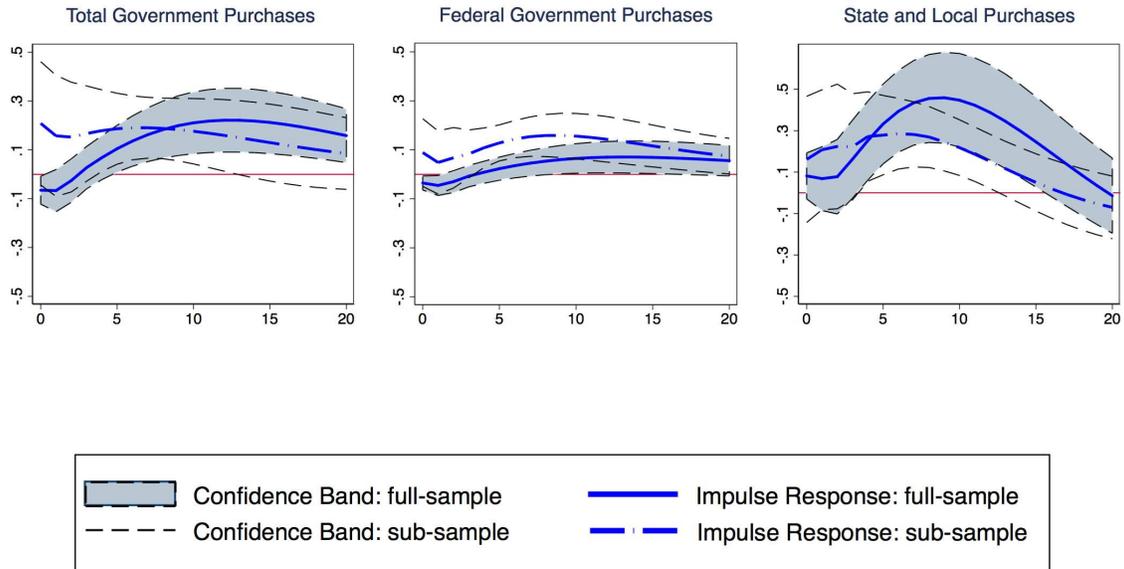
Note: The data source is originally from US. Bureau of Economic Analysis, selected series are retrieved from FRED, Federal Reserve Bank of St. Louis. The “in-crisis” period is particularly focus on the Great Economic Recession period: 2007Q4-2009Q2, which is defined by [NBER US Business Cycle Expansions and Contractions](#); “pre-crisis” is 1960Q1-2007Q3; “post-crisis” is 2009Q3-2017Q2; “full-sample” is 1960Q1-2017Q3.

Figure 4: The Share of Total Purchases by Governments:
Federal v.s. State & Local



Note: The *solid line* depicts the state & local government purchases share of total purchases. The *long-dash line* is the federal purchases share of total purchases. The *bar chart* shows the differences between federal and state and local shares. The *reference line in dash* is indicating the break-even point of the differences. Data source is US. Bureau of Economic Analysis, selected series are retrieved from FRED, Federal Reserve Bank of St. Louis. Time span is 1960Q1-2017Q3.

Figure 5: Government Purchases Shocks on Total GDP



Note: The data source is US. Bureau of Economic Analysis, selected series are retrieved from FRED, Federal Reserve Bank of St. Louis. The result is based on the 1-standard deviation confidence band (68% CI) and 100 times non-parametric bootstrap simulation. Time span of the full sample is 1960Q1-2017Q3, and 1960Q1-2007Q3 for the sub-sample.