Effects of government spending on consumption Dynamics

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Abstract

The effects of fiscal policy on the economy is increasingly popular in the literature of empirical macroeconomics and factor-augmented vector autoregressive (FAVAR) models have become a popular tool in explaining how economic variables interact over time.This paper focused on the effect of fiscal policy on aggregate and disaggregated consumption by applying the factor-augmented vector autoregression (FAVAR) model. The study specifically estimated the FAVAR model using the computationally simpler principal component method. The results of the study showed that government spending increases aggregate consumption; and there exists heterogeneity within durable, nondurable, and service consumption variables.

Keywords: FAVAR model, Fiscal Policy, Government Spending Shocks, Aggregate Consumption

JEL Codes: C11, C32, E21, E62

Introduction

Most macroeconomics research are interested in how government policies affect economic activity and how these effects are transmitted because this is important in formulating economic policy decision. Specifically of interest is the effects of fiscal policy on consumption. Several studies tried to quantify the effects of government spending on consumption, but there is no widespread agreement on the effects of government spending on consumption. The standard RBC model generally predicts a decline in consumption in response to a rise in government purchases. In contrast, the IS-LM model predicts that consumption should rise, hence amplifying the effects of the expansion in government spending on output. Several empirical papers tried to answer this question but, their findings differ based on the identification assumptions on the exogenous government spending variable.

Competing macroeconomic models make different predictions about effects of fiscal policy and consumption, hence determining the appropriate model is very important. There exists several empirical research, which focused on the effect of government spending shocks on consumption, but there are controversies surrounding the findings of some of these studies. The lack of consensus arises from the type of identification scheme and the model used. With the issue of identification, Blanchard and Perotti (2002) used recursive identification approach and found positive consumption responses. However, this approach uses strong identifying assumptions and assumes that government spending is contemporaneously unaffected by the business cycle. This method is implemented via a recursive VAR with government spending ordered first. The result of Blanchard and Perotti (2002) is in line with the study by Fisher and Peters (2010), Fragetta and Gasteiger (2014) and Ben Zeev and Pappa (2017), which supports the New Keynesian model.

Alternatively, the narrative approach followed by Ramey and Shapiro (1998), Burnside, Eichenbaum and Fisher (2004) and Ramey (2011b) found that consumption decreases in response to a government spending shock and these results support the neoclassical theories. The problem with Blanchard and Perotti approach is that recursive identification relies on strong assumption that government spending is contemporaneously unaffected by the business cycle and government spending variable is ordered first. Ramey's defense news assumes that the narrative time series generated is a direct measure of the latent shock series, but macro econometric literature has recently recognized that these news defense shocks should be viewed as instruments rather than as perfect measures of the latent structural shock series.

The main focus of the study is to estimate consumption responses to government spending shocks. Specifically, the study seek answer the following questions. First, what are the effects of changes in government purchases on aggregate consumption. Second, does consumption components respond differently to government spending shocks? This combines the standard VAR analysis with factor analysis because recent research in dynamic factor models suggests that a relatively small number of estimated factors can be used to summarize the information from a large number of time series. Studies such as Stock and Watson (2002), Bernanke et al., (2005) suggests that factors perform better than the small vector autoregressions, and leading indicator models in simulated forecasting exercises. Since traditional VAR models suffer from fiscal foresight problem, an alternative approach to consider in the case of high-dimensional models with large information sets is a Bayesian FAVAR model, which uses more variables than the traditional VAR models.

The main assumption of this model is that a small number of factors summarizes the dynamics of the large information set. According to the literature, a large data set contains information about agents' expectations can be captured by the factors in the FAVAR model, which break the misalignment between the information sets of economic agents and the econometrician, and overcomes the fiscal foresight problem. I will also employ traditional sign restrictions for identification. Traditional sign restrictions only restrict the sign of a subset of impulse response functions, which represent the set of joint predictions of theoretical models, and therefore, have strong theoretical foundations.

The rest of the paper is as follows: I introduce the FAVAR model in section 2, section 3 explains the estimation Method and identification. Section 4 describes the estimation method and data. Section 5 presents the results. Section 6 concludes.

The FAVAR Model

Following Bernanke et.al.(2005), we have the following transition equations:

$$\begin{pmatrix} F_t \\ Y_t \end{pmatrix} = \beta(L) \begin{pmatrix} F_{t-1} \\ Y_{t-1} \end{pmatrix} + v_t, \quad (1)$$

where Y_t is an M x 1 vector of observable economic variables and contains the policy variable, F_t is a Kx1 vector of unobservable factors which represents the additional economic information which is not fully captured by Y_t, $v_t \sim N(0, \Sigma)$, $\beta(L)$ is a conformable lag polynomial in the KxK coefficient matrices β, where K represents the total number of factors in the model. Equation (1) cannot be estimated directly because the factors F_t are unobservable.Here, t represents time from $t = 1, 2, ...T$. The informational time series X_t is related to the unobservable factors F_t and the observed variables Y_t by an observation equation of the form:

$$X_t = \lambda^f F_t + \lambda^y Y_t + \epsilon_t, \quad (2)$$

where X_t contains large amount of information about the current state of the U.S. economy, F_t denotes a matrix that includes K latent factors that summarize the comovement among the underlying series, Λ^f is an NxK matrix of factor loadings, λ^y is NxM matrix of factor loadings of the policy variables and $\epsilon_t \sim N(0, R)$. The FAVAR model contains reduced form errors v_t and, ϵ_t are idiosyncratic shocks such as measurement errors or industry-specific shocks.The economy is assumed to be driven by the set of structural shocks u_t, which are related to the reduced-form shocks via a structural matrix A_0. Following the approach of Bernanke et al. (2005), the upper KxK block of λ^f was set to the identity matrix while the upper KxM block of λ^y was set to zero to achieve factor identification. According to Bernanke, Boivin, and Eliasz (2005), one can identify statistical factors are up to an invertible rotation. This means that if Λ and F_t is a solution to the estimation problem, then any rotation of these two objects will also be a solution.

Model Estimation

To estimate the unobservable factors, Bernanke et al., (2005) stated that the computationally complex likelihood-based Gibbs-sampling technique does not necessarily produce better results as compared to the two-step Principal Component approach. Therefore,the study will be limited to the two-step PC estimation which is popularised by Stock and Watson (2002b). In order to perform the two-step PC estimation, the variables are grouped into two sets of categories; a "slow-moving" and a "fast-moving" group. The variables that are assumed to be unaffected by contemporary shocks in Y_t are classified as slow-moving variables and fast-moving variables on the contrary, variables that are instantaneously affected by the contemporaneous shocks. In two-step PC estimation, the first step is to identify common factors extracted from Y_t and X_t. In the second step, variables included in X_t are divided into slow-moving and fast-moving variables and according to Bernanke et al. (2005), this is done based on economic theory.

Following the two-step principal component approach, the common components C_t are estimated using the first $K + M$ principal components of X_t, and this estimation includes the observed variable Y_t. In the second step, the FAVAR equation (1) is estimated with F_t being replaced by F_t. The two-step approach is computationally simple and easy to implement. I perform a bootstrap procedure to obtain accurate confidence intervals on the impulse response functions, which is based on Kilian (1998), and accounts for the uncertainty in the factor estimation.

Identification

Given that equation (1) cannot be estimated because it is unidentified, there is the need to impose two different sets of restrictions on equation (1) and (2). The first restriction is a the normalization restrictions on the observation equation (2), which is required to estimate the model. In addition to the normalization restriction, further restriction has to be imposed on the transition equation (1) and the observation equation (2). These restrictions are imposed on equation (1) and (2) to uniquely identify the factors and the associated loadings. In two-step estimation approach, the factors are obtained from the observation equation (2), and identification of the factors is standard. In most cases, either the loadings are restricted, i.e. $\Lambda^{f'}\Lambda^{f}/N = I$ or restrict the factors as $F^{'}F/T = I$. Both restriction approaches have the same common components and same factor space. Following Bernanke et.a., (2005), I impose the factor restriction, obtaining $\hat{F} = \sqrt{T}\hat{Z}$ where $\hat{Z}$ are the eigenvectors corresponding to the K largest eigenvalues of XX' arranged in ascending order. One advantage of this approach is that, it identifies the factors against any rotations.

The identification of the structural shocks in the transition equation requires further restrictions. The study will assume a recursive structure where all the factors entering (1) respond with a lag to change in the fiscal policy instrument, ordered last in Y_t. In that case, we do not need to identify the factors separately, but only the space spanned by the latent factors F_t.

Data

The dataset consists of a balanced panel of quarterly observations on 150 U.S. macroeconomic and financial time series spanning the period from 1960Q1 to 2019Q4, which cover a broad range of measures of real activity and income, employment, asset prices, interest rates and spreads, exchange rates, price indices and money aggregates. All the series have been obtained from the Bureau of Economic Analysis (BEA), the Bureau of Labor Statistics (BLS) and the FRED database. The dataset includes the government expenditure as the fiscal policy instrument and aggregate and disaggregated time series from which we extract the common factors. The variables have been appropriately transformed to induce stationarity and have been demeaned and standardized before estimation.

Results

In this section I present my findings. Results from figure 1 shows that government spending had a positive effect on aggregate consumption and this is shown in the impulse response functions. The impulse response functions are as a result of government spending shock. We also observed that real GDP, employment, government deficits and hourly earnings all have positive response to government spending shock. I include federal funds rate to control for the effect of monetary policy. The federal funds rate shows a negative response on impact but it became unresponsive in the long term. So, the main result implies that, an expansionary government spending shock, leads to positive effect on aggregate consumption. This result is consistent with the findings in Fatas and Mihov (2001), Gali et al. (2007), Fisher and Peters (2010) or Ben Zeev and Pappa (2017). Hence, the findings followed the Keynesian predictions. In addition, real GDP rises persistently in response to that shock, as predicted by the theory. The empirical result is in line with findings of Blanchard and Perotti (2002) but contradicts the findings of Ramey (2011) who found negative consumption response to government spending shock.

There is mixed results in the literature with regards to the responses of durable, nondurable, and service consumption. For Forni and Gambetti (2010), all components shows a positive response in the short-run, but the study by Fragetta and Gasteiger (2014) showed that durable consumption responds positively.

Response of Government Spending shock

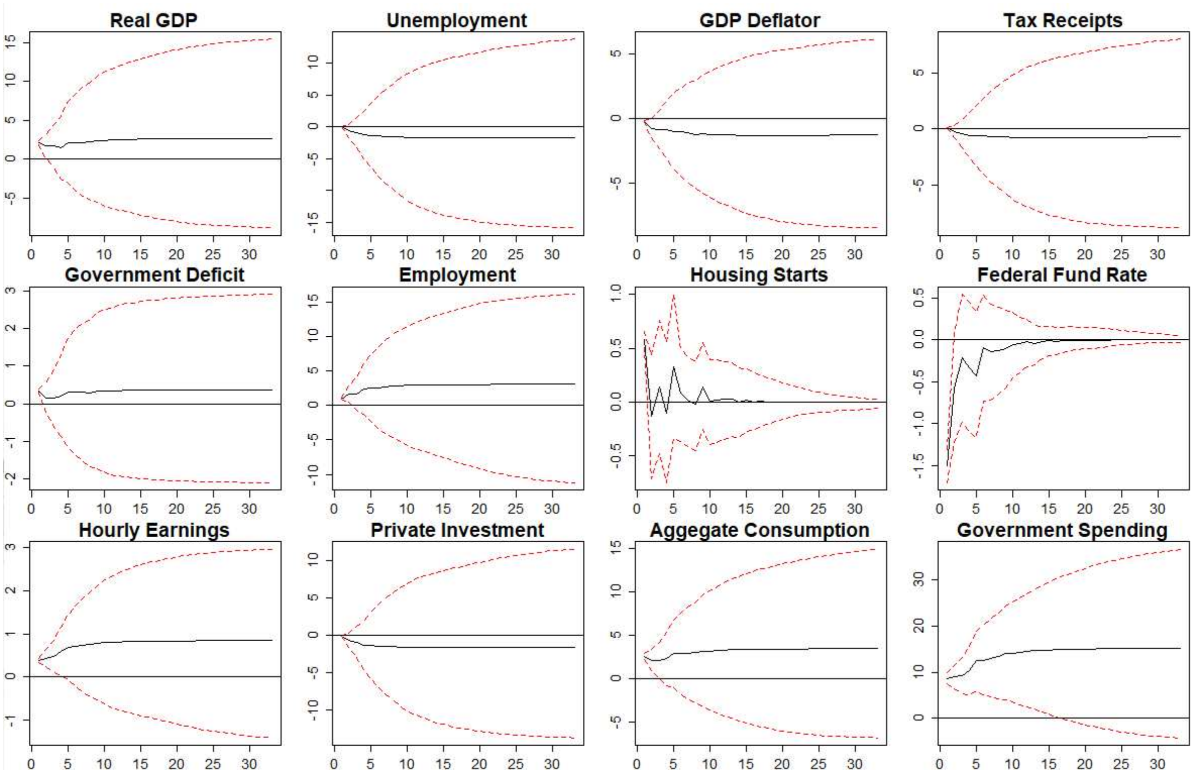

Figure 1: Impulse Response to a Government Spending shock on selected variables

Disaggregated Consumption Response

This section presents the estimation of disaggregated consumption response to government spending shock. This is done by replacing the replacing aggregate consumption by 12 disaggregated consumption variables in the FAVAR model. The results of the impulse response functions are presented in Figure 2. The results shows heterogeneous response of the disaggregated variables to government spending shock. We observed that after an expansionary government spending shock, households increases their purchases of motor vehicles, healthcare, clothing and transportation services but reduces purchases of food and accommodations,housing and utilities, and recreational services. The IRFs also shows that households increase purchases of transportation services in response to government spending shock. The response of food and beverages purchases is negative on impact for the period.

Response of consumption variables to government spending shock

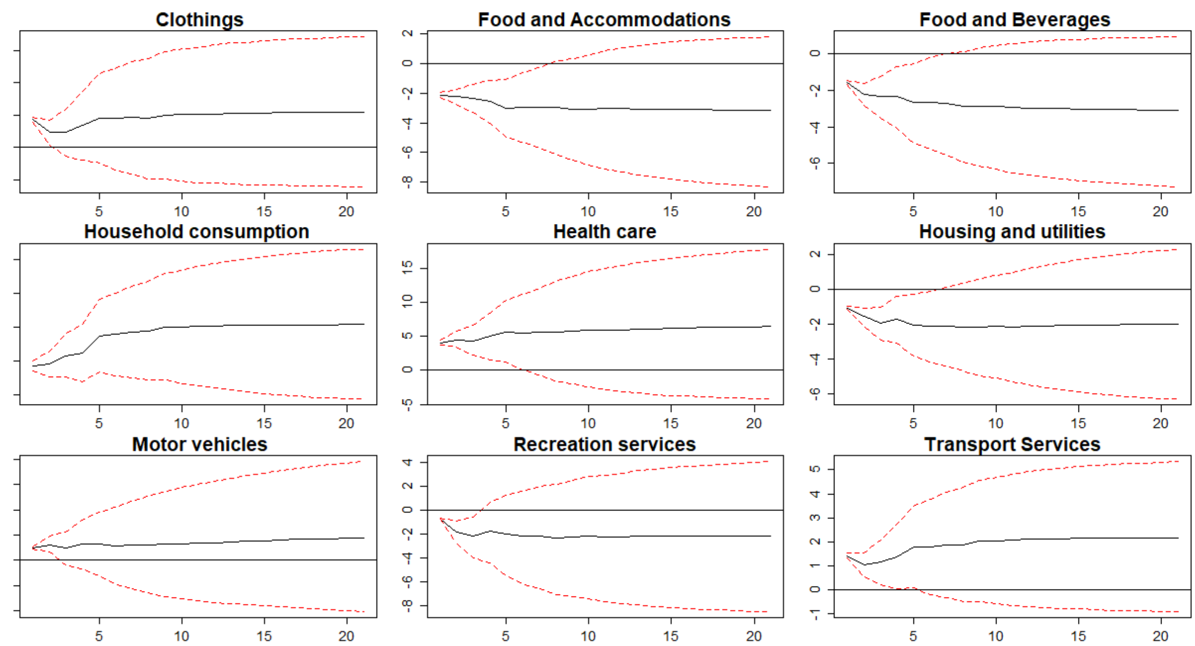

Figure 2: Response of disaggregated consumption to policy shock

Variance Decomposition

Apart from impulse response functions estimation, I performed the variance decomposition on the selected variables of interest which is usually typically performed in standard VAR model. This involves determining the proportion of the forecasting error of a variable,which is attributed to a particular shock at a given horizon.The result of the variance decomposition follow from the coefficients of the MA representation of the VAR system and the variance of the structural shocks. The fraction of $(Y_{t+k} - \hat{Y}_{t+k})$ resulting from fiscal policy is expressed as

$$\frac{var(Y_{t+k} - \hat{Y}_{t+k|t}|\epsilon_t^{FP})}{var(Y_{t+k} - \hat{Y}_{t+k|t})}.$$

The results in Table I shows the impulse response for the selected macroeconomic variables analyzed in the previous figures. The first column reports the contribution of the fiscal policy shock to the variance of the forecast error at the 20-quarter horizon.The second column contains the R^2 of the common component for each of these variables. The contribution of the policy variable, government spending is 0.62 which is quiet high but very low for real GDP, aggregate consumption and the remaining variables in the model.

In addition, the factors explain a sizable fraction of these variables, especially real GDP (73.4%) and private investment (67.8%). The factors explain 39.2% of Aggregate consumption.

Forecast Error Variance Decomposition of selected variables

Variables	*Contribution*	*R.Squared*
Government Spending	0.62	1
Real GDP	0.058	0.734
GDP Deflator	0.005	0.226
Tax Receipts	0.001	0.28
Government Deficit	0.002	0.045
Hourly Earnings	0.001	0.018
Private Investment	0.002	0.678
Aggregate Consumption	0.056	0.392

Table 1: Contribution of policy shock to variance in the common component

Conclusions

The goal of this paper is to investigate the impact of government spending shocks on aggregate and disaggregate consumption. This is because both neoclassical and new Keynesian economics have different theoretical predictions and empirical studies reach different conclusions too.

This study uses large datasets that contains information sets of economic agents in the economy and applied Two-Step Principal Component Approach to summarize a small number of factors and augment the factors in a standard VAR model. This approach has the advantage of obtaining the responses of a large set of variables to fiscal policy shocks.

The results from the analysis showed that expansionary government spending shock have positive impact on aggregate consumption. Also, I found that the effect of government spending have heterogeneous response to components of durable, nondurable, and service consumption. Specifically, we observed that after an expansionary government spending shock, households increases their purchases of motor vehicles, healthcare, clothing and transportation services but reduces purchases of food and accommodations,housing and utilities, and recreational services.

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