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THE EFFECTS OF FISCAL POLICY ON EMERGING ECONOMIES. A TVP-VAR APPROACH

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Abstract
This study seeks to analyze the effects of government expenditure shock and tax revenue shock on economic activity by applying a time-varying parameter vector autoregressive methodology. The advantage of this approach is that it allows for fiscal policy shocks to vary over time according to the changes in the economic activity and permits us to capture the non-linear nature of the fiscal multiplier's size. This paper provides an evaluation of the effects of fiscal policy in Romania, using quarterly data for three variables: GDP, government expenditure and tax revenues, from 2001q1 to 2013q3. The main results show that fiscal policy has a small effect on economic activity and that for the period considered the estimated coefficients do not show much time variation.

JEL Classification: C32, E62
Key words: fiscal policy, time-varying parameters, Bayesian estimation

1. Introduction

There has always been an interest in analyzing the role of fiscal policy in economic activity, but fiscal policy has received less attention compared to the empirical literature on monetary policy. With the recent economic recession fiscal policy was

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regarded with more interest since it was expected to be effective in economic recovery. Given the limited capacity of monetary policy to provide additional stimulus, fiscal policy has become the most important tool for stabilizing business cycles. The developed economies implemented fiscal stimulus packages as a measure for economic recovery while the developing economies adopted consolidation fiscal measures imposed as a consequence of a pro-cyclical policy adopted before the economic crises.

The empirical studies have not reached a consensus about the effects of fiscal policy (or their magnitude) on macroeconomic variables. Most of the studies on the output effects of fiscal policy, especially before the recent crisis, are based on linear vector autoregressive (VAR) models, with a different scheme of fiscal policy shocks identification. The linear models portray the economy in a simplified way and do not capture the non-linear nature of the multiplier's size. Time-varying para-meter vector autoregressive model (TVP-VAR) −the approach used in this study− allows instead for fiscal policy shocks to vary over time according to the changes in economic activity. Besides TVP-VAR models, there are alternative methodologies that provide evidence for a relationship between the size of the fiscal multiplier and the underlying state of the economy, including threshold VAR models (Baum and Koester 2011, Baum *et al*. 2012) or smooth transition VAR models (Auerbach and Gorodnichenko 2011). There are several studies for developed countries that used the TVP-VAR approach (Kirchner *et al*., 2010, Gerba and Hauzenberger, 2012) but the empirical literature on emerging markets is meagre.

The aim of this paper is to contribute to the analysis of the macroeconomic effects of fiscal policy by providing a range of estimates for fiscal policy effects in Romania. The TVP-VAR model includes quarterly data for government expenditure, GDP and government revenues, from 2001q1 to 2013q3 and is estimated using the Bayesian technique.

The rest of the paper is structured as follows: the next section provides an overview of the related literature, section 3 briefly presents the methodology used for measuring the effects of fiscal policy and describes the data used in the empirical study, section 4 presents the results while section 5 presents the concluding remarks.

2. Literature Review

The most widely used approaches for assessing fiscal policy are the empirical estimates based on vector autoregressive (VAR) models. These approaches have some advantages compared to structural models such as DSGE models because they are unrestricted by a predetermined theoretical construction, but on the other hand VAR estimates of fiscal multipliers are dependent on the type of identification scheme, especially with respect to the output effects of tax changes, as shown by Caldara and Kamps (2008) for the US economy.

A relatively new approach used to assess the effects of fiscal policy shocks on GDP is TVP-VAR. This approach was put forward by Cogley and Sargent (2005) and Primiceri (2005) to evaluate different monetary policy regimes for the US since the post-war period. In particular, the paper focuses on the role of monetary policy in the dynamics of inflation and unemployment. The time variation derives both from the coefficients and the variance covariance matrix of the model's innovations. There is evidence of time variation in the U.S. monetary policy. They observe some deviation in the impulse responses during the oil-shocks and early Volcker period, most of the variation being attributed to the variance of the residuals.

Kirchner *et al*. (2010) have used a TVP-VAR to examine the effect of fiscal policy shocks providing new evidence on the effects of government spending shocks and the fiscal transmission mechanism in the euro area for the period 1980-2008. The results indicate that the effectiveness of spending shocks in stimulating economic activity has decreased for the analyzed period; in particular spending multipliers increased until the late 1980s when they reached values above unity and started to decline to values closer to 0.5 in the current decade. Their results also indicate that higher government debt-to-GDP ratios have negatively affected long-term fiscal multipliers.

Pereira and Lopes (2010) estimate a TVP-VAR for the US over the 1965:q2-2009:q2 period and find that fiscal policy has lost some capacity to stimulate output. What they particularly investigate is whether there has been an increase in policy effectiveness in the course of recessionary episodes, but they find only modest support for it.

Karagyozova (2013) provides a range of estimates for the fiscal multipliers in Bulgaria using linear VAR models with different identification schemes for fiscal shocks and TVP-VAR models. The main findings are that the effectiveness of fiscal policy in stimulating economic activity is generally low, the cumulative government

spending multiplier is considerably larger in the years after the introduction of the currency board (0.3) compared to the period just before the 2008 crisis (0.15) but does not exceed 0.4, in line with most of the studies on the emergent EU Member State.

3. Methodology and Data

The method used in this analysis is a TVP-VAR model that allows for variation over time in the estimated coefficients of the model and in the variance-covariance matrix of residuals, following the methodology used by Primiceri (2005). Allowing for time variation both in the coefficients and the variance-covariance matrix leaves it up to the data to determine whether the time variation of the linear structure derives from changes in impulse shock or from changes in the response to impulse shock. This is an advantage over fixed-parameters because it allows us to capture any gradual shift that might occur in the economy.

The following model of lag order k is considered:

$$y_t = C_t + B_{1,t}y_{t-1} + \cdots + B_{k,t-k} + u_t \quad \textbf{(1)}$$

where the vector y_t ($n \times 1$) includes the observed endogenous variables, C_t is an $n \times 1$ vector of time varying coefficients that multiply constant terms, the $B_{i,t}$, i = 1,…k, are matrices of time varying coefficients and u_t are unobservable shocks with variance covariance matrix R_t.

The innovation variance covariance matrix R_t can be decomposed using a triangular factorization of the form:

$$A_t\, R_t A_t' = \sum_t \sum_t' \quad \textbf{(2)}$$

where A_t is lower triangular matrix with ones on the main diagonal and $\sum_t$ is the diagonal matrix.

The first equation becomes:

$$y_t = C_t + B_{1,t}y_{t-1} + \cdots + B_{k,t-k} + A_t^{-1}\sum_t e_t, V(e_t) = I_n \quad \textbf{(3)}$$

where I_n is an *n*-dimensional identity matrix.

The dynamics of the model's time varying parameters are specified as in Primiceri (2005):

$$\beta_t = \beta_{t-1} + \mu_t \quad \textbf{(4)}$$

$$\alpha_t = \alpha_{t-1} + \gamma_t \quad \textbf{(5)}$$

$$\log(\sigma_t) = \log(\sigma_{t-1}) + \eta_t \quad \textbf{(6)}$$

where β_t is the vector of coefficients of the VAR model stacked by rows, α_t is the vector of non-zero and non-one elements of the matrix *At* stacked by rows and σ_t is the vector of the diagonal elements of the matrix $\sum_t$. The equation 4 and 5 describes a random walk process and standard deviations σ_t in equations 6 are assumed to evolve as geometric random walks. Thus β_t elements, α_t elements and σ_t elements can vary over time, allowing for changes in the contemporaneous relations among the endogenous variables.

All the innovations in the model are assumed to be jointly normally distributed: $[e_t\ \mu_t\ \gamma_t\ \eta_t]'$ ~ NID (0, V_t), where V_t is block diagonal with blocks I_n, Q, S and W (Q, S and W are positive definite matrices).

The model is estimated by Bayesian methods, the identification scheme of response impulses being a recursive one. Bayesian technique requires prior distributions to be imposed on the parameters of interest in order to estimate the posterior distribution, given the data. As for the identification scheme of impulse responses, a drawback is the sensitivity to the ordering of variables.

The type of priors[1] is assumed to be independent inverse-Wishart for hyperparameters (Q, S, W) and Normal Distribution for the initial states of the time varying coefficients. The inverse-Wishart prior distribution of the hyperparameters requires degrees of freedom and scale matrices to be set. The degrees of freedom are set as one plus the dimension of each matrix and k_Q, k_S, k_W are calibrated so that the priors obtained are diffuse and uninformative and not flat (k_Q=0.01, k_S =0.1 and k_W= 0.01). The initial values of parameters in the model are set using ordinary least squares estimates over the first 27 observations of data sample.

The choice of endogenous variables follows the empirical literature, thus the vector of endogenous variables consists of variables commonly used to assess the effects of fiscal policy. The variables are government spending (G), GDP (y) and government revenues (T), and are used in estimation as ordered above. The standard data sets used in fiscal VAR models include two more variables-inflation and interest rate, but I choose the minimal set of endogenous variables listed above because the use of TVP-VARs requires a reduced number of endogenous variables and lags to keep the set of parameters manageable. The data are seasonally adjusted with

1. See Primiceri (2005) "Time Varying Structural Vector Autoregressions and Monetary Policy".

Tramo/Seats. Government spending and revenues and GDP are deflated by GDP deflator. The deflated series are then expressed in log. All the variables are used in first differences. Although the Bayesian approach does not necessarily require the data to be stationary, the series used are stationary due to estimation in first differences. Summary statistics for data used in estimation are provided in the first table. A TVP-VAR with two lags is estimated.

The TVP-VAR was estimated in Matlab, based on codes developed by Gary Koop, while the BVAR model was estimated using Dynare.

Table 1. Descriptive Statistics of data

	Y	G	T
Mean	0.007995	0.007619	0.007804
Median	0.012022	0.004600	0.006000
Maximum	0.051824	0.255878	0.031000
Minimum	-0.081267	-0.167013	-0.014000
Std. Dev.	0.020253	0.078834	0.010606
Skewness	-1.503243	0.682152	0.083080
Kurtosis	8.874737	4.678136	2.323435
Jarque-Bera	92.54692	9.939624	1.031368
Probability	0.000000	0.006944	0.597092
Sum	0.407762	0.388584	0.398000
Sum Sq. Dev.	0.020508	0.310741	0.005624

4. Results

Figure 1 reports the estimated impulse responses due to the identified government spending shocks to the three endogenous variables, together with their 10% and 90% probability bands. Figure 2 plots the estimated impulse responses after government revenues shocks with their 10% and 90% probability bands. The main interest is to analyze the impact of a government expenditure shock on an endogenous variable, especially on real output.

As is shown in similar studies, the impact of a government spending shock on emergent economies is small. After positive government expenditure shock real output rises but its intensity is reduced. The fiscal multiplier is very small, less than 1 if it were to be compared with fiscal multipliers obtained in empirical studies, for developed economies. The response of government spending after a positive shock

of government spending is not persistent and the effect of the shock is almost zero from the second quarter.

The GDP responds to a tax revenues shock as in the case of government expenditure shock but with greater intensity. The credible intervals accompanying the response of GDP contains zero, thus the reaction of GDP to the spending shock is not estimated precisely, at least for the first periods.

Figure 1. Responses of the variables after a government spending shock

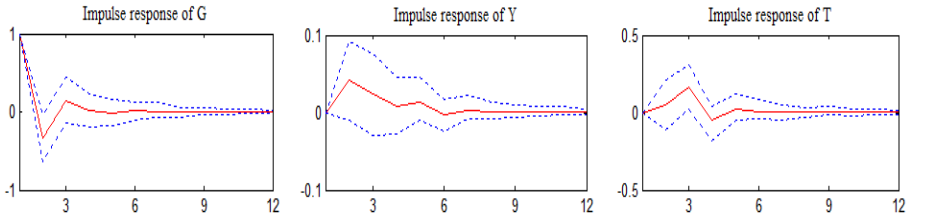
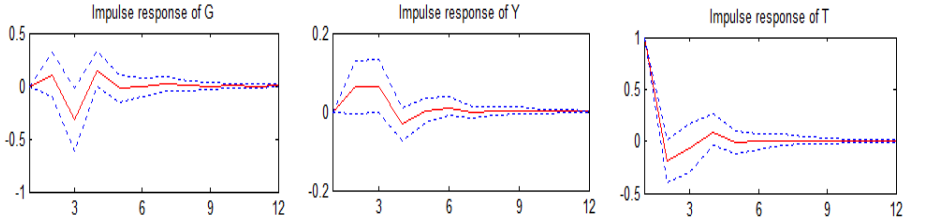
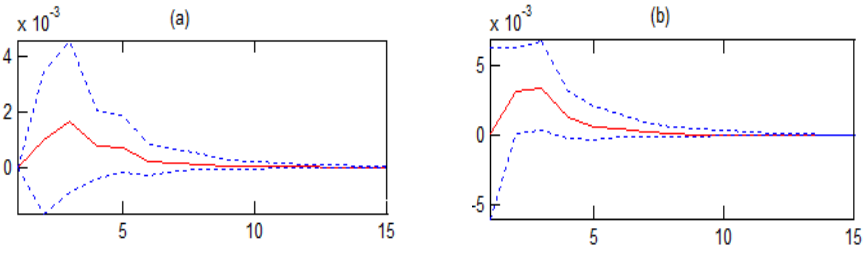


Figure 2. Responses of the variables after a government revenues shock



The response of GDP to fiscal policy shocks is also estimated using Bayesian estimation without time varying specification. Non-informative flat priors were considered. The results of the Bayesian VAR model are presented in the third figure.

Figure 3. (a) Response of GDP after a government spending shock;(b) Response of GDP after a government revenue shock



The effects on GDP of fiscal policy shocks, as has been identified in this approach, are more reduced compared to the previous approach. A high uncertainty is associated with the responses of GDP to a government revenues shock. The effect on GDP is, rather, very weak.

5. Conclusions

This paper estimates the effect of fiscal policy shocks using a TVP-VAR approach. The model is estimated using the Bayesian technique, based on recursive approach as the identification scheme of the structural shocks. The advantage of this approach is that it allows for fiscal policy shocks to vary over time according to changes in economic activity. The specification of the model allows for variation over time in the estimated coefficients and in the variance-covariance matrix of residuals.

According to the impulse response functions I can mention the following: the real output shows a weaker response to fiscal shocks, the fiscal multipliers are positive and small meaning the economic activity is not significantly influenced by fiscal policy in an emergent country. These findings are in line with most of the studies on fiscal policy effects in small open economies. The results obtained using the TVP-VAR approach indicate a larger effect of government spending shock on GDP than the approach without time variation parameters.

In view of the reduced effect of fiscal policy to support economic growth, the fiscal policy makers should concentrate on enhancing the quality of the government expenditure structure. Further investigations closely related to this approach that can improve the results obtained might consist in using different identification sche-mes for the fiscal shock.

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