Articles

Effects of Government Debt on Macroeconomic Activity (The Case of Bulgaria)

Nikolay Velichkov*

Summary:

This paper studies the short-term and long-term impact of government debt on the macroeconomic activity in Bulgaria. The study is based on an econometric analysis that uses various estimation techniques to reveal the characteristics, the significance, and the quantitative expressions of the studied relationships. The empirical results show that short-term government debt increase stimulates real GDP growth. When long-term impact is considered, however, the stimulating effect of government debt growth on GDP dynamics is observed only up to a certain threshold level, beyond which debt increase produces adverse effects on macroeconomic activity.

Key words: government debt, macroeconomic activity, econometric analysis

JEL Classification: E62, H63

1. Introduction

The recent global economic crisis prompted a number of countries to implement expansionary fiscal measures in the form of various incentives aimed at counteracting the recessionary trends and speeding up economic recovery (e.g. Velichkov, 2015). Furthermore, such policies have an impact on government debt level and dynamics. That leads to numerous academic and policy debates with regard to the role of government debt in macroeconomic dynamics.

There are multiple channels of government debt influence on macroeconomic activity. The traditional Keynesian concepts focus on the positive impact of expansionary fiscal measures on aggregate demand, including measures related to the increase of government debt. At the same time, the Keynesian approach sidelines the long-term macroeconomic problems and consequences associated with the implementation of government policies. Keynesianism furthermore considerably underestimates the role of economic agents in the economic system dynamics and the existing relationships. In practice the additional dimensions of the relationship between government debt and macroeconomic activity can have a substantial effect on the way fiscal policy impacts GDP dynamics. This logically raises the question of the degree of manifestation of these additional dimensions.

The impact of government debt dynamics on interest rate and risk premium can influence the macroeconomic effects of fiscal policy. This is associated with the

* Asst. Prof., University of National and World Economy, Department of Economics, email: nn_velichkov@unwe.bg

restriction of private spending resulting from interest rate increase associated with debt growth. The risk premium at high levels of government debt is capable of enhancing the crowding out effect. The rational expectations assumption is a significant factor in strengthening that effect. The theory of rational expectations focuses on the microeconomic foundations for macroeconomic analysis and assumes that in the presence of complete and well-processed information, economic agents follow rational behavior that protects their personal interests (Lucas, 1972; Muth, 1961; Sargent and Wallace, 1975; Woodford, 2000). Consequently, the long-term effects of the implemented fiscal policy largely determine the short-term results, which considerably limit the macroeconomic effects of the expansionary fiscal policy and can neutralize them. This neutrality is best exemplified by the so called Ricardian Equivalence which states that deficit financing of budget expenditures and tax increase have the same effect on macroeconomic activity (Barro, 1974). This can be accounted for by the fact that economic agents respond rationally to deficit spending. The response takes the form of an increase in current savings due to expectations of future tax increases aimed at paying debt principal and interest.

It should be noted that the opportunity for continued government debt servicing without substantial adjustments to the budget revenue and expenditure is an important prerequisite to favorable economic development. This is the reason why many studies focus on the need for ensuring sustainability of public finances. In that respect, an emphasis is placed on the fact that a restrictive fiscal policy aiming at limiting government debt can stimulate macroeconomic activity. Conversely, implementing fiscal incentives that threaten the sustainability of fiscal positions due to excessive government debt growth has adverse consequences on macroeconomic dynamics. These views are supported by the hypothesis of the so called non-Keynesian effects of fiscal policy. In view of the fact that fiscal policy effects depend on the specific level of government debt, many studies assume the manifestation of both Keynesian and non-Keynesian effects. Therefore, the literature on the topic often uses the more generic term of ‚nonlinear effects'.

The existing empirical literature on the effects of government debt on the macroeconomic dynamics is overwhelmingly diverse. Reinhart and Rogoff (2010) prove the nonlinearity of the relationship between government debt and economic growth by noting that beyond a certain threshold debt level (above 90% of GDP), the impact of government debt growth on macroeconomic dynamics becomes adverse. A number of other empirical studies also validate the concept of threshold values beyond which a negative debt growth effect is observed, while values under the threshold have a neutral or positive effect on growth (e.g. Afonso and Jalles, 2013; Baum et al., 2013; Caner et al., 2010). However, the results vary considerably with respect to the particular levels. This heterogeneity is related to both the used methodology approaches and the samples of studied countries.

The available empirical information for Bulgaria with regard to consistency and length of time series allows for a comprehensive econometric study of the relationship between government debt and macroeconomic activity. In that sense, the objective of the paper is to derive short-term and long-term relationships between government debt and real economy dynamics in Bulgaria using various econometric models and estimation techniques.

The paper is organized as follows. Section 2 presents the indicators used in the

study, Section 3 introduces the methodology of the econometric analysis, Section 4 deals with stationarity testing of the time series, Section 5 describes the empirical results pertaining to the significance and quantitative expressions of the long-term and short-term relationships, and finally Section 5 summarizes and provides some policy implications.

2. Indicators and construction of dynamic series

This study includes indicators that provide the necessary representativeness for econometric estimation of the relationship between government debt and macroeconomic activity.

The *government debt* indicator take into account the scale of economy (debt_sh). It is calculated according to the formula:

$$debt\_sh_t = debt_t / gdpn_t * 100,$$

where:

$debt_t$ refers to the government debt in period t;

$gdpn_t$ refers to the level of current price GDP in period t.

There are four indicators of macroeconomic activity and their choice is based on how well they serve the goals, tasks, and scope of this study.

The first indicator of macroeconomic activity is *real GDP* (gdpr). The purpose of including this indicator in the analysis is to present in a maximally aggregated way the state of economy and its inherent fluctuations. The concrete case makes use of data on the real value of GDP by eliminating price changes over time. Calculation of real GDP is carried out at constant basis with valuation being performed in the same year, namely 2005.

The second indicator is the *relative share of personal consumption expenditures in GDP* (cons_sh). Personal consumption expenditures include the final consumption expenditures of households and the final consumption expenditures of non-profit institutions serving households (NPISH). The indicator is calculated using the following formula:

$$cons\_sh_t = (hfcons_t + npishfcons_t) / gdpn_t * 100,$$

where:

$hfcons_t$ refers to the final consumption expenditures of households in period t;

$npishfcons_t$ refers to the final consumption expenditures of NPISH in period t;

$gdpn_t$ refers to the level of current price GDP in period t.

The third indicator in this group is the *relative share of investment in GDP* (inv_sh). Investment refers to gross fixed capital formation in the form of tangible and non-tangible assets acquisition expenditures, but does not include changes in inventories of raw materials, finished goods, work in progress, etc. The investment indicator is calculated according to the following formula:

$$inv\_sh_t = gcf_t / gdpn_t * 100,$$

where:

gcf_t refers to the gross fixed capital formation in period t;

$gdpn_t$ refers to the level of current price GDP in period t.

The fourth and final real-economy indicator is the *ratio of net export to GDP* (x_sh). The indicator is calculated using the formula:

$$x\_sh_t = (exports_t - imports_t) / gdpn_t * 100,$$

where:

$exports_t$ refers to the export of goods and services in period t;

$imports_t$ refers to the import of goods and services in period t;

$gdpn_t$ refers to the level of current price GDP in period t.

Quarterly data is used for all given variables as this is the shortest periodicity that official statistics report. The alternative use of annual data is inapplicable due to insufficient number of observations. All

empirical data refers to the period from the first quarter of 2000 to the fourth quarter of 2013 and is reported by the National Statistical Institute (NSI) and the Ministry of Finance (MF).

When working with quarterly data, it is necessary to take into account its intra-annual cyclicality, i.e. its seasonality, which can affect the analysis results and should thus be eliminated. In order to eliminate seasonality in the dynamic series of variables, a seasonal adjustment procedure using the Census X12 model preset in the EVIEWS 7 econometric product is employed, which is indicated by adding the designation ‚sa' to each variable. Then the seasonally adjusted series are converted to logarithmic form and the designation ‚lg' is placed in front of each abovementioned variable. Converting to logarithmic form is a standard procedure in econometric analysis and is performed to mitigate the sharp variations in the different variables, a necessary step for obtaining better analytical results.

3. Methodology

The analysis is based on various econometric techniques and models using the following logical schema:

First, having designed the study variables and constructed the time series, they are tested for stationarity. This is achieved by performing the Augmented Dickey – Fuller Test (ADF) and the Phillips – Perron Test (PP). The tested null hypothesis is for the presence of a unit root. The stationarity test in this study is performed based on both the Akaike Info Criterion (AIC) and the Schwarz Info Criterion (SIC).

Second, a test for the presence of systematic long-term relationships between government debt and macroeconomic activity is carried out. In this regard, the same series variables are tested for cointegration. The study achieves this by performing the Johansen Cointegration Test, which is applied to a system of equations within a Vector Autoregression Model (VAR). Determination of the lag length to be included in the model is done by applying the Akaike Information Criterion (AIC), the Schwartz Criterion (SC), and Hannan – Quinn Information Criterion (HQ), as well as the Final Predictor Error Criterion (FPE) and the Sequential Modified LR Test Criterion (LR). The thus determined lag length is used to test for cointegration by performing the Trace Test and the Maximum Eigenvalue Test.

Third, after establishing a long-term relationship between the variables, a Vector Error Correction (VEC) model is constructed. These types of vector autoregression constructions model the studied system long-term equilibrium in such a way that breaching the equilibrium triggers mechanisms that restore it. The VEC model includes all selected macroeconomic variables as well as the government debt variable. In the econometric modeling process, variables that are statistically insignificant at levels of 10% are excluded and the model is reevaluated. In this way, included are only the results for which the probability of the regressor preceding coefficient being zero is less than 10%.

4. Test for stationarity of variables

The results of the unit root within the dynamic series tests are presented in Table 1. In order to apply the most suitable test model, the presence or absence of a deterministic time trend and drift is established beforehand.

Testing of the variables at the *levels* demonstrates that they are in general non-stationary. In the cases of government debt, investment, and net export series, the two independent unit root tests return the same result which demonstrates non-stationarity of the time series.

Table 1. Results of the Augmented Dickey-Fuller test (ADF) and the Phillips-Perron (PP) unit root test

Variable	ADF-statistic		PP-statistic	
	AIC	SIC	AIC	SIC
At the Level				
lgdebt_sh_sa	-1.982644 (3)	-1.982644 (3)	-1.562193 (3)	-1.562193 (3)
lggdpr_sa	1.261793 (3)	-2.770138 (0)*	-1.837231 (3)	-2.770138 (0)*
lgcons_sh_sa	-2.760138 (4)	-3.840096 (0)**	-4.117498 (4)**	-3.840096 (0)**
lginv_sh_sa	0.173950 (5)	-0.097222 (0)	-0.069431 (5)	-0.097222 (0)
lgx_sh_sa	0.126647 (2)	0.277988 (0)	0.281056 (2)	0.277988 (0)
At the First Difference				
Δlgdebt_sh_sa	-1.411274 (2)	-1.411274 (2)	-10.84442 (2)***	-7.538415 (0) ***
Δlggdpr_sa	-1.632644 (2)*	-5.200850 (0)***	-5.129866 (2)***	-5.200850 (0)***
Δlgcons_sh_sa	-4.485244 (3)***	-9.998764 (0)***	-12.10476 (3)***	-9.998764 (0)***
Δlginv_sh_sa	-2.806902 (4)***	-10.15279 (0)***	-12.56189 (4)***	-10.15279 (0)***
Δlgx_sh_sa	-4.521378 (1)***	-9.294372 (0)***	-9.942224 (1)***	-9.294372 (0)***

*The lag length as per the Akaike information criterion and the Schwarz information criterion is given in brackets. ***, ** and * indicate the statistical significances at 1%,5 %, and 10%.*

For the real GDP dynamic series, the Phillips-Perron test and the Augmented Dickey-Fuller test reject the null hypothesis for unit root presence as per the Schwarz criterion at 10% significance level. At the same time, both tests as per the Akaike criterion show that for the this variable, there is no sufficient justification to adopt the alternative hypothesis, which is why in this analysis the real GDP time series is assumed to be non-stationary at the levels. The tests performed for the constructed personal consumption data series demonstrate lower PP statistics in comparison to the MacKinnon critical value at 5% significance level. The Augmented Dickey-Fuller test check assumes presence of stationarity only as per the Schwarz criterion at 5% significance level, while unit root presence is proven as per the Akaike criterion.

When testing the first differences (Δ), it turns out that the null hypothesis for unit root presence is rejected for all data series as per the Phillips-Perron Test according to both the Akaike and Schwarz criteria. This stationarity is confirmed at high levels of statistical significance of 1%. The Augmented Dickey-Fuller test check also proves unit root absence as per

both information criteria with government debt being the only exception. In view of the contradictory results with respect to the government debt series, an additional check is performed using the Ng – Perron Test, which rejects the null hypothesis for non-stationarity. That strengthens the confidence of the drawn conclusions with regards to stationarity and the subsequent econometric estimations.

Estimation results

The search for long-term relationships between government debt and macroeconomic activity is performed using the Johansen Cointegration Test which demonstrates that there are long-term relationships between the constructed dynamic model variables. When interpreting the cointegration vector coefficients, one has to consider that, since one is dealing with a vector rather than an equation, the respective variable negative coefficient is interpreted as a proof of its positive impact on the dependent variable, while the negative coefficient demonstrates a negative impact.

Table 2. Cointegration vector

lggdpr_sa	lgcons_sh_sa	lginv_sh_sa	lgx_sh_sa	lgdebt_sh_sa	lgdebt_sh_sa^2
1.00	-1.78	-0.44	-1.76	-0.64	0.08
	(0.37)	(0.12)	(0.39)	(0.18)	(0.02)
	[-4.86]	[-3.54]	[-4.52]	[-3.62]	[4.38]

Standard errors in ( ); t-statistics in [ ].

In view of the theoretical-empirical assumptions for optimal level of government debt, an empirical test for the presence of nonlinearity between government debt and real GDP is carried out without numerical assessment of the threshold value. The nonlinear model results show that government debt increase stimulates real GDP dynamics provided that the debt has not reached the threshold level (Table 2). Beyond that critical point, its increase has adverse effects on the macroeconomic activity. The cointegration relationships further show that an increase in personal consumption, investment, and net export also has a positive effect on GDP dynamics.

These results highlight the need for targeted policy of fiscal authorities to ensure long-term fiscal sustainability with respect to government debt, which implies that it should not exceed its threshold level. The reason is that public finances sustainability is a major factor in the country's macroeconomic stability and an important condition for a favorable economic development.

The established long-term relationships between government debt and macroeconomic variables are a precondition for a long-term equilibrium between them. That equilibrium can be modeled by constructing a Vector Error Correction model (VEC). This type of model is constructed in a way that assumes that disruption of such equilibrium triggers mechanisms that recover it and in fact consideration is given to both long-term and short-term influences of one variable over another within the constructed system. Construction of the VEC model follows the logical schema described in the Methodology section.

The VEC model empirical explication is presented in Table 3. The negative and statistically significant error correction term (ECT) coefficient shows that for each passed quarter, there is an adjustment of the model disequilibrium. That proves the existence of long-term causality of the independent variables – government debt, consumer expenditures, investment and net

Table 3. VEC Model: The Estimates

Dependent Variable: Δ(lggdpr_sa)			
Independent Variables	**Coefficient**	**Standard Error**	**t-Statistic**
ECT(-1)	-0.13	0.07	-1.79
constant	0.01	0.00	2.85
Δ(lggdpr_sa(-1))	0.16	0.09	1.70
Δ(lggdpr_sa(-3))	0.46	0.12	3.67
Δ(lgcons_sh_sa(-4))	0.15	0.06	2.66
Δ(lginv_sh_sa(-3))	0.04	0.02	2.42
Δ(lgx_sh_sa(-1))	0.06	0.02	3.27
Δ(lgdebt_sh_sa (-5))	0.05	0.03	1.83
trend	-0.00	0.00	-2.59
N adj.	50		
R^2	0.54		
adj.R^2	0.45		
DW stat.	1.87		
Jarque-Bera Test	0.67*		
Breusch-Godfrey Ser. Corr. LM Test	0.41*		
White Test	0.41*		

** Probability of null hypothesis acceptance.*

export, with respect to the dependent GDP variable.

In the short run, a positive effect of past GDP values in the first and third lag is observed. The estimated model results also show that in the short run real GDP growth is positively influenced by personal consumption, investment, and net export with lags of respectively four, three and one quarters.

The government debt coefficient is positive, which is a reason to conclude that its growth stimulates GDP dynamics. This is far from surprising, considering the relatively low level of government debt in Bulgaria. It is precisely the low government debt level that is an important prerequisite to undertaking discretionary fiscal measures. At the same time, it is expected that at a low debt level, the effects of fiscal incentives will be pronouncedly of Keynesian nature. It should be stressed, however, that we are looking at short-term debt growth. Cointegration coefficients analysis shows that in the long run, after a certain threshold debt level is surpassed, debt growth has adverse impact on macroeconomic dynamics.

These results prove the need for flexibility in government debt management. On one hand, it is necessary to provide a long run stable government debt level, which would ensure a favorable economic environment. On the other hand, however, fiscal authorities can increase government debt if needed, to ensure expansionary fiscal policy associated with implementation of temporary and reversible fiscal incentives to counter economic downturns. Of course, the macroeconomic effects of such discretionary measures will depend on the direction of fiscal incentives in view of the different macroeconomic impact of individual budget categories.

The presented VEC model replicates well observable outcomes. The adjusted determination coefficient is 0.45, indicating that the constructed model explains around half of the dependent variable dispersion. The checks performed using residual diagnostics as per the Jarque-Bera Test, the LM Test, and the White Test show that there is respectively normality of distribution, absence of serial correlation, and also absence of heteroscedasticity. Moreover, the DW statistics value demonstrates an acceptable deviation of results. This ensures sufficient reliability of the resulting econometric estimates.

Conclusions

On the basis of the performed econometric analysis, two types of empirical conclusions related to the short-term and long-term relationships between government debt and macroeconomic activity can be drawn. Short-term government debt increase has a positive impact on real GDP growth which shows that fiscal authorities can increase government debt in order to implement expansionary fiscal measures to stimulate economic growth. When long-term impact is considered, however, the stimulating effect of government debt on GDP dynamics is observed only up to a certain threshold level, beyond which debt growth produces negative effects on macroeconomic activity. That calls for the pursuit of a flexible policy that should take into account the various economic impacts of government debt.

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