MODEL AND RESULTS OF A STRESS TEST ON PUBLIC FINANCE – ANALYSIS AND COMPARISON WITH THE MODEL OF THE MINISTRY OF FINANCE

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Abstract: The article presents a model for calculating the production gap to obtain the cyclically-adjusted budget balance (CAB), which is then used to conduct a stress test with the production gap values to track the reaction of CAB in terms of the Impulse-Response Function in EViews.

Keywords: public finance, output gap, cyclically-adjusted budget balance, stress test, impulse-response function

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1. Introduction

The main parameter that shows how balanced the central government's fiscal policy is and to what extent this policy corresponds to the cyclical development of the economy is the cyclically-adjusted budget balance, which is the difference between the nominal budget balance and the output gap (OG) or the difference between the actual and the potential GDP of the country. There are different methods for calculating OG and in our research we used the method adopted by the EC because the same method is used by the government institutions (MoF, BNB, etc.) in Bulgaria as well. The obtained OG values were used to calculate the cyclically-adjusted budget balance (CAB) and using vector autoregression (VAR) in the EViews econometric software, a shock on the OG was simulated in order to establish the response of CAB to a change in macroeconomic conditions. The obtained results from our model were then compared with the results of the model used by the Ministry of Finance (MoF) to determine the similarities and differences between them.

The **object** of research are the main macroeconomic and fiscal parameters contained in the government's budget forecasts, on the basis of which the Consolidated Fiscal Program (CFP) of Bulgaria is prepared.

The **subject** of the research is to propose a model for calculating the CAB and its components and to analyse to what extent the results obtained with this model correlate with the results from the model of MoF. To test the hypothesis for sustainability of the fiscal CAB, a stress test was conducted on the main macroeconomic variable affecting its value, the OG, and again a comparison was made between the results of the used model and those of the MoF model.

The **working hypothesis** is that the proposed empirical model for calculating the CAB, despite its less sophisticated mathematical apparatus, provides a better basis for making rational political decisions regarding the fiscal policy of the country and when this model is used the said policy would be less pro-cyclical, especially during the upswing of the economic cycle and above all more lenient during the downswing of the cycle, which implies less strict and delayed consolidation fiscal decisions.

The research **objective** is, by applying a stress test on a model including economic and fiscal components and their lag shifts, to analyse to what extent the main fiscal variable, in terms of the CAB, reacts to a shock on the economic environment and how this shock affects in short-term and possibly long-term plan the CAB, and hence the nominal budget indicators.

The objective is to be achieved by performing the following **tasks**:

1. To propose a model for calculating CAB;
2. To subject CAB to a stress test with a shock on OG and to use the Impulse – Response Function to determine the response of CAB to this shock.
3. To verify the accuracy of the proposed model by comparing it to the model used by the MoF and to determine the similarities and differences between the two models.

2.Approach and stage in the process of stress-testing the public finance

Public finance accumulate risk in many different ways considering that an unbalanced budget balance directly affects the public debt - a dynamic variable, the level of which depends on the difference between budget expenditures and budget revenues (Захариев, 2012). One of the ways to accumulate risk, for example, is through the influence of the tax burden on the government debt. There is a relationship between the two indicators, and the level of taxation has a continuous effect on the government debt in the long run (Лилова & Благоева, 2012). An interesting approach for evaluating debt management is the use of Support Vector Machines (SVM). SVM is an advanced technique for digital econometric analysis of time series. It provides a unique solution for flexibility in choosing the shape of threshold levels, good classification of results in case of irregular data and minimization of statistical error. (Zahariev, et al., 2020)**.**

The cyclically-adjusted budget balance (CAB) is a key indicator of the state and sustainability of the budget. It shows the extent to which the state of the budget balance is due to discretionary decisions in the exercise of the government's fiscal policy, in contrast to the cyclical component, which reflects the influence of the action of the automatic stabilizers laid down in the legislation.

Overall, there are **two possible approaches to calculating the CAB. The first one,** which was used by the European Commission until 2002**, is purely statistical** and is based on the Hodrick-Prescott filter for smoothing of time series (Hodrick & Prescott, 1997). **The second approach to calculating CAB is to use economic models** of two different types. The first type of economic models (used by the EC) use the production function and various filters to smooth the trend of cyclic time series.

The second type of models are the models of dynamic stochastic general equilibrium (DSGE). The main advantage of these models is the way they represent structurally the main fiscal policy components while the models of the first type, according to the EC methodology, aim to determine empirically the transmission mechanism of the fiscal policy in an unstructured way.

There is no institution in Bulgaria that uses a dynamic stochastic general equilibrium (DSGE) model, although such models have been developed by the academia (Iordanov & Vasilev, 2008). This is why, for the purposes of this study, we chose to follow an evaluation approach that subjects to a stress test only the CAB and included in the formula for its calculation the output gap (OG), applying a variant of the EC model with the Cobb-Douglas production function. The stress test on the CAB was implemented in the vector autoregression (VAR) model created with the specialized econometric software EViews using the built-in Impulse–Response Function.

3. Calculating the output gap[1]

The cyclically-adjusted budget balance is calculated using the following formula:

$$CAB_t = BB_t - CC_t = BB_t - \varepsilon OG_t, \qquad (1)$$

Where BB is the budget balance to GDP and CC is the cyclic component of the budget balance. The latter is the product of the budget semi-elasticity (ε) and the deviation of the actual GDP from its potential or long-term trend, i.e. the output gap (OG).

The OG is calculated as:

$$OG_t = \frac{Y_t - Y_t^p}{Y_t^p} \quad , \qquad (2)$$

where $Y_t and\ Y_t^p$ are the actual and the potential GDP at moment t.

The OG in this study was calculated using the formula proposed by Kaloyan Ganev (Ganev, 2015) and based on the Cobb-Douglas production function.

$$Y = L^{\alpha} K^{1-\alpha} TFP, \qquad (3)$$

Where TFP is total factor productivity, which takes into account both the degree of use of the input factors and their technological level (D'Auria, et al., 2010). The calculation is based on the Hodrick-Prescott (HP) filter to smooth the cyclical component from the dynamic time series, i.e. this is a variant of the EC model, which is used by the central government institutions in Bulgaria to calculate forecasts and the main macroeconomic parameters (of course, with certain modifications in terms of the applied econometric filters, e.g. in its model for some of the variables, the EC applies the Kalman filter for trend calculation.)

3.1. Calculating the capital input

The physical capital input is calculated as:

$$K_t = I_t + (1 - \delta)K_{t-1}, \qquad (4)$$

where δ is the depreciation rate of the capital calculated as

$$\delta = \frac{CFC}{K}, \qquad (5)$$

where CFC is consumption of fixed capital. Usually, the depreciation rate is assumed to be constant. For his calculations, K. Ganchev assumed $\delta = 5\%$. The model used by the MoF uses a depreciation rate of 5.5% and this is why we assume the same value for a more consistent comparison of the obtained results.

[1] The time series used in the calculation will be submitted upon request.

To guarantee full depreciation of the physical capital at some point (since the discount factor is $(1-\delta)^t$ and although it approaches 0 with the increase of t, it in fact will never reach 0) the formula for calculating the physical capital is modified as:

$$K_t = \sum_{i=0}^{n-1}(1 - i\delta)I_{t-1} + (1 - n\delta)K_{t-n}, \quad n=1,\ldots,t \qquad (6)$$

3.2. Calculating the potential employment and potential unemployment rates

The normal level of labour is obtained by mechanically removing the trend – the cyclical component of the employed as a percentage of the change in the current population using an HP filter.

The potential employment rate is calculated through three successive steps. First, we have to calculate the economic activity coefficient (ψ_t), which is the ratio of the number of employees (L_t^S) to the number of all people of working age (N_t^ω). The number of employees is available from NSI's Labour Force Survey, and the number of working-age people are those in the 15-64 age group. Thus, the coefficient of economic activity is calculated as:

$$\psi_t = \frac{L_t^S}{N_t^\omega} \qquad (7)$$

The second step is to calculate of full employment ($L_t^{S,f}$) in the economy at full employment of the economically active population. To do this, we have to filter the coefficient of economic activity (ψ_t) with an HP filter in order to obtain its value at full employment (ψ_t^f). The economic activity coefficient thus obtained is used to calculate the number of employees at full employment:

$$L_t^{S,f} = \psi_t^f . N_t^\omega \qquad (8)$$

To determine the potential employment rate we need to take, one more (the final) step, which is to apply an HP filter to the unemployment rate (u_t), which is also taken from the NSI statistics study, in order to obtain the Non-Accelerating Inflation Rate of Unemployment (NAIRU) denoted as u_t^f. The potential employment is calculated as:

$$L_t^f = \left(1 - u_t^f\right). L_t^{S,f} \qquad (9)$$

3.3. Calculating the potential total factor productivity (TFP)

In general, total factor productivity, which is denoted as A as suggested in (Ganev, 2015), is calculated as the residual of the difference of the forecast GDP and the production factors in the Cobb-Douglas function, i.e. TFP represents the part of in GDP growth that happens beyond the simple growth of both labour and capital. Since this method was first proposed by R. Solow, it is known as "Solow residual", (Solow, 1957).

$$\ln A_t = \ln Y_t - \alpha \ln K_t - (1-\alpha) \ln L_t \qquad (10)$$

The potential total factor productivity ($\zeta_t = lnA_t^f$) is in fact the natural logarithm of the TFP trend and is calculated by applying the HP filter on the original time series. The values of α and β, which denote the production/factor elasticity of capital and labour, are assumed as α = 0.35 and β = 0.65 as these are the values used in the MoF model.

3.4. Calculating the potential GDP and the output gap

The potential GDP (Y_t^f) based on the output gap is calculated by including the potential values of the above factors in the formula, i.e. as:

$$Y_t^f = \exp(\zeta_t)(K_t)^{\alpha}(L_t^f)^{(1-\alpha)} \qquad (11)$$

The output gap is the ratio of the actual GDP to the potential GDP. As it is expressed as a percentage, its interpretation is that OG represents the deviation of GDP from its potential level at full employment:

$$\gamma_t = \frac{Y_t - Y_t^f}{Y_t^f} . 100 \qquad (12)$$

A positive OG means that the actual GDP is above the potential level and the economy is overheating. Conversely, a negative OG means that the actual GDP is below the potential level and therefore the economy is underperforming or is in recession.

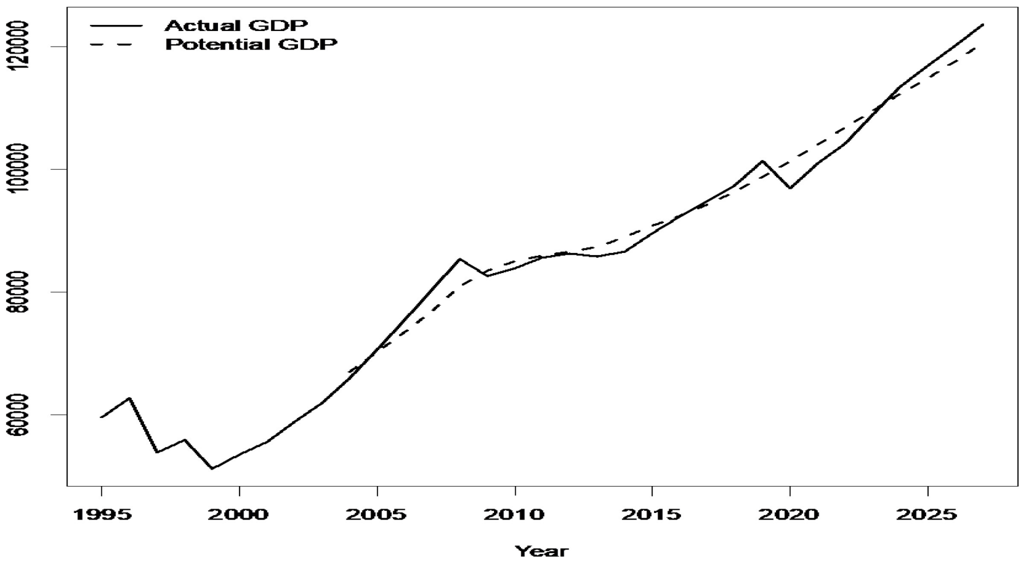
3.5. Methodological characteristics, modifications and specifics of calculating the potential GDP and the output gap

It should be noted that the HP filter is a symmetric weighted average with equal weight to all values included in the calculation of the respective trend, no matter how far back in the past or forward in the future they are. From this point of view, the first one or two values of the results should not be taken into account in the calculations, or at least should be approached with a great deal of scepticism in their evaluation. Secondly, it is important to make the forecast for future values with at least one more time value after the end of the forecast period in order to prevent the inclusion of misleading values in the final results. Since the forecast period includes the years up to 2026, the forecast value for 2027 is included in the calculations.

All raw data used in the calculations was taken from the NSI database whereas the GDP and fixed capital investment data are based on constant prices from 2015. The values of the exogenous variables, such as the projected nominal values of GDP until 2027 and the unemployment rate are taken from the IMF's World Economic Outlook (WEO) database (April 2022).

3.6. Results from the calculations of the potential GDP and OG

For the period 2005–2008, the Bulgarian economy performed above its potential, and significantly so, considering the positive OG values, which at the beginning was about ½ percentage point, but at the end of the period reached the impressive 5.5 p.p. During this period, the economy achieved some of its highest growth rates (above 5% or 6%) in its recent history, with distinct characteristics of overheating. The average annual inflation for 2008 reached 12% and the reported budget revenue significantly exceeded the forecasts, a symptom of a widening output gap.



Source: MoF and author’s calculations with R Studio.

Figure 1. ***Bulgaria’s actual and potential GDP (BGN mln.)***

Over the period 2009–2016, the polarity of the OG values is reverse, i.e. the annual values are invariably negative although their deviation amplitude is significantly smaller and varies from 0.1 to 2.7 p.p., which denotes that the economy was performing significantly below its potential.

The improved for a brief period (from 2017 to 2019), when OG values became positive again and the Bulgarian economy performed above its potential economic growth. The output gap widened rapidly from 0.6 p.p. in the first year to 2.6 p.p. in 2019. The overheating of the economy is also clearly expressed in the change of macroeconomic indicators, which are starting to improve again above the forecast expectations, which positively affects budget revenues and the overall status of the fiscal indicators.

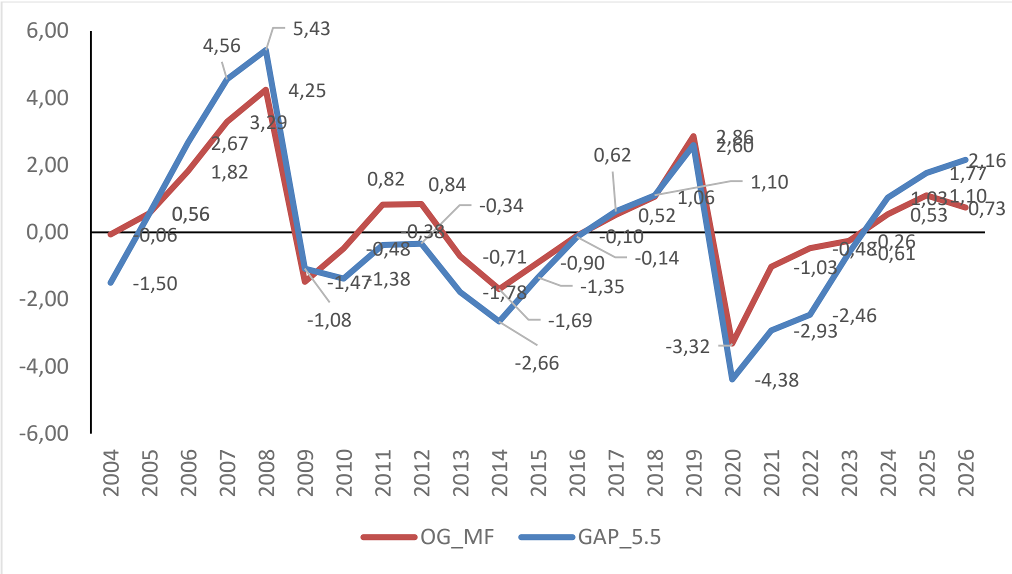
Another turning point in economic development was 2020, when the momentum of economic development was interrupted and the economy plunged into crisis once again. These processes continued in 2021. During these two years, significant negative values of OG were reported, and in 2020, the highest negative value of -4.38 p.p. for the entire studied period since 2004 was achieved. In 2021, despite the slight improvement, the output gap of -3 pp. was the second lowest negative one. The macroeconomic indicators of unemployment and fiscal revenue worsened significantly while inflationary pressures eased, although after mid-2021 the situation began to deteriorate seriously due to the onset of the energy crisis and the associated significant inflationary pressures.

This clear change at the end of 2021 is difficult to cover with the forecasting method used, and according to the forecast data, the negative trend of development of the Bulgarian economy below its potential will continue in 2023. At present, such an expectation is not ungrounded, given the drastic increase in interest rates by the leading central banks in the world, which foreshadows a very strong slowdown in the world economy, including the fall into recession of some of the leading countries in the EU, which, at the same time, are Bulgaria's main trading partners.

From this point of view, the logic of the forecast results is preserved, because, according to the calculations, Bulgaria will continue to develop below its potential for economic growth in 2023 as well as for the last three years of the forecast period and in 2024 through 2026 it will be overheating with the output gap becoming positive again and exceeding 2 p.p. at the end of the period.

3.7. Comparison of the calculated output gap and the MoF forecast

The comparison between the OG values calculated using the proposed model and the values from the model of the MoF is quite interesting.

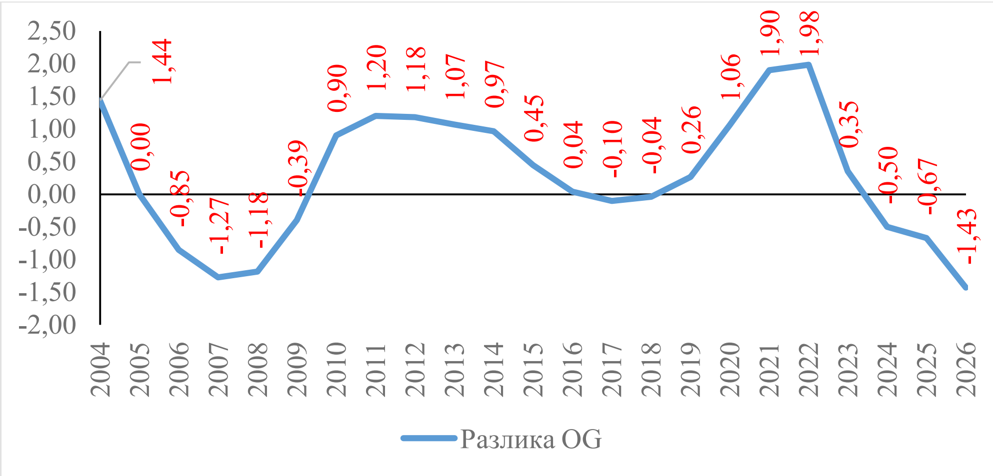


Source: MoF and author's calculations with R Studio.

Figure 2. ***Comparison of the OG values calculated using the model and those of the MoF***

It is obvious that, although the results of the two models move in unison, there are certain noticeable differences which can be formulated as trends. First, the results calculated with the two models are absolutely identical for 2005, for the period 2016–2019, and, to a certain extent, for 2009. Second, the proposed model reports larger values of OG in periods when the economy shows symptoms of overheating and at the same time reports lower values in periods when the economy develops below its growth potential. The specific values of the differences between the OG values of the two models are presented in Figure 3.

If we disregard the difference of the OG value calculated for 2004, which is due to the characteristics of the HP filter used in the proposed model, there is no difference in the calculated value for 2005 from the two models. For the period 2006–2008, the difference in the calculated values from the two models began to increase, and the specified period was marked by one of the fiercest cyclical overheatings of the Bulgarian economy. In this respect, the higher values of OG calculated by the proposed model for the specified period is actually a positive feature and an advantage of the model, since such a higher value means that the overheating was actually greater than the one calculated by the MoF for that period, which in turn could trigger a more adequate countercyclical policy response by the government.



Source: MoF and author's calculations with R Studio.

Figure 3. ***Differences of OG values calculated with the two models***

After the trend of economic development of our country as well as of the global economy, suddenly changed its direction in 2009, the difference in the values calculated with the two models decreased significantly and once again reached zero.

In the subsequent economic slowdown cycle of 2010–2015, characterized by a below-potential economic development, the difference in the OG values estimated with the two models began to increase again, reaching its highest levels in 2011 and 2012. During this period, the OG calculated by the proposed model is wider compared to that of the MoF model, which again can be seen as a positive feature of the proposed model since a wider negative OG would cause a more severe countercyclical response from the government, which at that time unfortunately, by freezing pensions and wages, was actually pursuing a pro-cyclical and pro-crisis policy while producing overly optimistic economic forecasts.

As the economy begins to catch up in 2015, the difference in estimated OG from the two models also began to decrease significantly, and for the period 2016–2019, this difference is almost zero. In 2020, as a result of the outbreak of the health crisis, the difference increased seriously again and reached its highest values in 2021 and 2022 for the entire period and for 2022 the value is already based on forecasts.

For the first two years of the forecast period (2022 and 2023), the OG values estimated with our model are lower than those of the MoF model, suggesting that the government will have to make more serious efforts to catch up than they intended considering their fiscal policy. Of course, such an argument is valid in principle, but the upcoming changes in the economic situation, which are currently still unknown, should also be taken into account.

The two models forecast almost the same OG values (very close to zero) for 2024, which is also the year when the economic situation will change again and the economy will start to show signs of overheating. In the last 3 years of the forecast period, the difference between the values calculated with the two models increases again whereas the higher output gap values are calculated with the model being approbated.

The conclusion that can be drawn from the present comparative analysis of the output gap results from the two models is that the approbated model, although perhaps not as sophisticated as that of the MoF, produces OG results that are closer to the real situation. If they are taken into account, they are likely to stimulate the government to pursue a better targeted and more calibrated fiscal countercyclical policy than it implemented or is about to implement.

4. Approach and specifics of CAB calculation

The OG values were calculated based on the model described in Section 3 and the values of the budget balance (BB) for the investigated period from 2004 to 2026 were taken from the annual fiscal reports and the updated macroeconomic forecasts of the Ministry of Finance.

4.1. Calculating the budget semi-elasticity

Budget semi-elasticity (ε) (also known as the budget sensitivity parameter (η) as it is used in the MoF model) is a constant. It has a corrective function in relation to the budget balance, removing the influence on it of the cyclical effects of the development of economic processes assuming that the economy is operating at its potential level. By definition, semi-elasticity measure the change of BB to the value of OG.

The budget semi-elasticity is equal to the difference between the semi-elasticities of budget revenue and expenditure, and more specifically between the weighted average cyclical elasticities of revenue (η_R) and expenditure (η_G) as a ratio to OG.

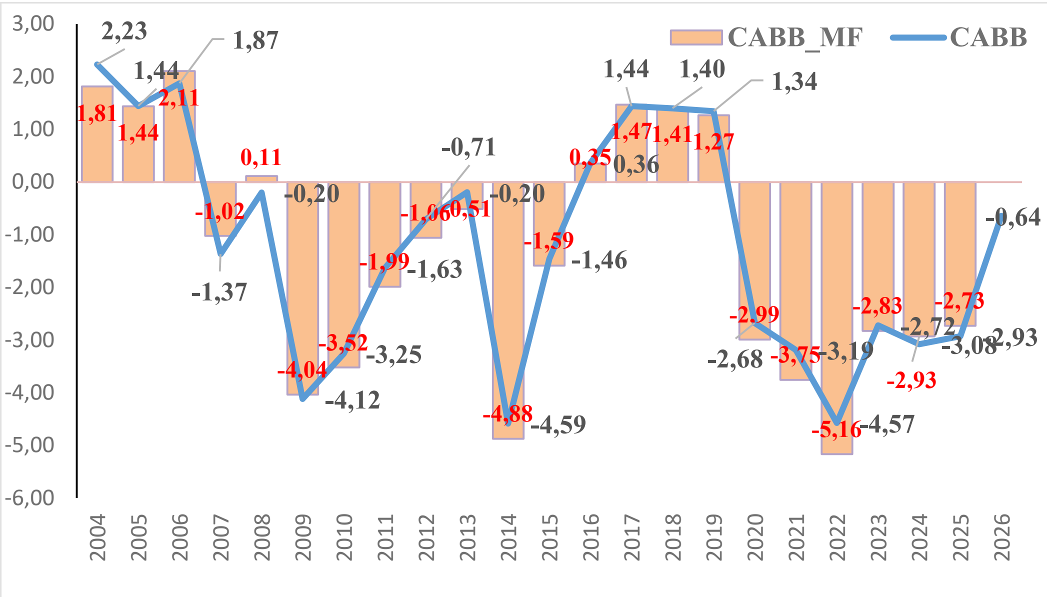
The approach for calculating ε is to weigh the publicly disclosed revenue and expenditure elasticities by the country-specific average shares of the relevant groups in the income and expenditure over a ten-year period. The resulting average elasticities of revenue and expenditure are multiplied by the average share of revenue and expenditure in GDP and the corresponding coefficients of elasticity of revenue and expenditure as a ratio to GDP are obtained. The semi-elasticity of the budget balance is the difference between the two coefficients.

The values thus obtained are used to calculate of the cyclically adjusted budget balance of Bulgaria. For a revenue sensitivity of -0.077 and expenditure sensitivity of -0.3749 the semi-elasticity of the budget balance is 0.298 [-0.077-(-0.3749)].

It should be pointed out that the budget semi-elasticity thus calculated differs from that used in (Mourre, Astarita, & Princen, 2014), which is 0.31 for the period after 2014. The main reason for the difference is the different elasticity of expenditure, which is calculated as -0.39, while that of revenue is a slightly larger -0.07. These minimal differences are not decisive for the final result of the calculations, but since a budget semi-elasticity of 0.298 is used in the MoF model, this value was also used in the calculations in the proposed model.

4.2. Calculating the cyclically adjusted budget balance (CAB)

The CAB values are calculated using the obtained OG values, the values of BB for the period 2004–2026 and taking into account the value of ε,. Figure 4 presents a comparison of the CAB values calculated using the proposed model and those from the MoF model.



Source: MoF and author's calculations.

*Figure 4. **Comparison of CAB values with those of the MoF model***

As can be seen from the figure, the CAB calculated using the proposed model changes almost completely in sync with the values from the MoF model, preserving the established trend in the movement of the two OG models, but the differences in the CAB values are significantly smaller and in certain periods the values of the two models coincide completely. However, the values from the current model are generally slightly lower in periods of economic growth and overheating and lag behind the values from the MoF model in periods of economic slowdown and negative output gap.

This result of the comparison between the two models once again shows that the result of the proposed model allows for a more complete countercyclical policy, since in moments of lag it presents slightly less negative values of the CAB, allowing for a looser fiscal policy, while in periods of economic overheating allows a less rapid consolidation of public finances, although in an economic boom the values of the two models are almost completely identical.

5. CAB lag modelling and stress testing

The lag modelling of the equations of the cyclically-smoothed budget balance and its stress test was carried out with the EViews econometric software by building a vector auto regression (VAR) model and using the Impulse - Response Function (IRF).

The equation used to construct the VAR model and to conduct the stress test is equation (1). Note that equation (1) is an equivalence relation. Including all the variables in the VAR model creates a singular matrix of the variables. Thus, the least squares technique that is used to solve the VAR system cannot be applied. The solution is to exclude any of the variables. Since the objective is to determine the impact of the economic cycle on CAB, it is important to examine the impact of OG on CAB, especially in the analysis of the response function of CAB due to a shock change in OG, which represents an unexpected change in macroeconomic conditions.

Secondly, we investigated the influence of OG on SAB, but the analysis was made with the MoF data for the variables. Thus, a direct comparison between the outputs of the two models becomes possible.

5.1. Determining the optimal lag of the model

There is no strict rule for choosing the length of the lags. This is essentially an empirical question (Gujarati & Porter, 2009). The main criterion that should be taken into account when choosing the number of lags is that their number is inversely related to the degrees of freedom in the system of equations. The more lags are included in the calculations, the fewer degrees of freedom remain, making the statistical inferences somewhat unstable. According to some authors (Wooldridge, 2012), the number of lags for dynamic time series is usually small (1 or 2 lags), so as not to lose degrees of freedom. Having sufficiently long series is a privilege of developed economies, where statistics have been collected for decades and even centuries. However, this is not the case with Bulgaria, and in the current calculations the dynamic series are actually too short.

The first requirement for the complete specification of the models is to determine the optimal lags the variables can have and that will be used to perform the relevant calculations. The results for both models, based on the Akaike Information Criterion (AIC) in EViews, show that the optimal number of lags is one.

5.2. Checking for cointegration of the CAB and OG variables using the Johansen Cointegration Test

The tests to check whether the variables are cointegrated (i.e. whether they converge in the long run to each other or their interaction is only in the short run) matters for the correct specification of the models used. Autoregressive vector models, such as VAR, are suitable for examining the relationships between non-integrated variables in the short run. In the presence of cointegration, which means long-term dependencies between variables, the use of a vector error correction model (VECM) is appropriate.

The results of the Johansen Cointegration Test show that, according to the two criteria included in it (Trace and Maximum Eigenvalues), the variables in the model proposed in this study are not cointegrated, which means that they are appropriate for research with a VAR model in the short run. In principle, economic logic also leads to such a result, since CAB is affected by the size of OG, but it is clear that in the long term there can be no cointegration between these two variables.

On the other hand, and somewhat surprisingly regarding the first criterion of the cointegration test, the variables in the MoF model turned out to be first-order cointegrated. However, according to the second criterion (Maximum Eigenvalues), there is no cointegration. In order to compare the two models using the same vector analysis, it is assumed that the variables in the MF model do not cointegrate as well.

5.3.VAR with one lag

The VAR models with the coefficient values in the equations for the two considered models are as follows:

Table 1.

***VAR** model with the coefficients value*

1. *Proposed model*

CABB = 0.602918205346*CABB(-1) - 0.149953270186*OG(-1) - 0.71057285722
OG = 0.0880331931342*CABB(-1) + 0.448039124378*OG(-1) + 0.191320269286

2. *MoF model*

CAB = 0.650532789728*CAB(-1) - 0.260789391251*OG(-1) - 0.579149265651
OG = 0.143732394822*CAB(-1) + 0.127611377027*OG(-1) + 0.486954540508

5.4.Model validity tests

In order to check whether the models are valid and represent the real mathematical relationships between the variables, it is necessary to run several diagnostic tests. The results from the autocorrelation test of residuals (**Autocorrelation LM test**) show that there is no serial correlation between the residuals or errors in the two models. According to the results of the **Multivariate Normality Test (Cholesky of covariance (Lutkepohl) Test)**, the joint distribution of the residuals in the models is normal. The results of the **heteroskedasticity** test show that the residuals are homoscedastic, which means that the residuals are the same and do not differ significantly with respect to the values of the independent variables.

5.5.Impulse-Response Function

The impulse response function (IRF) measures the system's response to a shock of a variable that is being investigated. It examines the effects of shocks on the future behaviour of the studied variable or system.

Figure 5 presents the impact response function in the current model, which shows the result of applying a one standard deviation shock to OG and what is the CAB response to this shock.

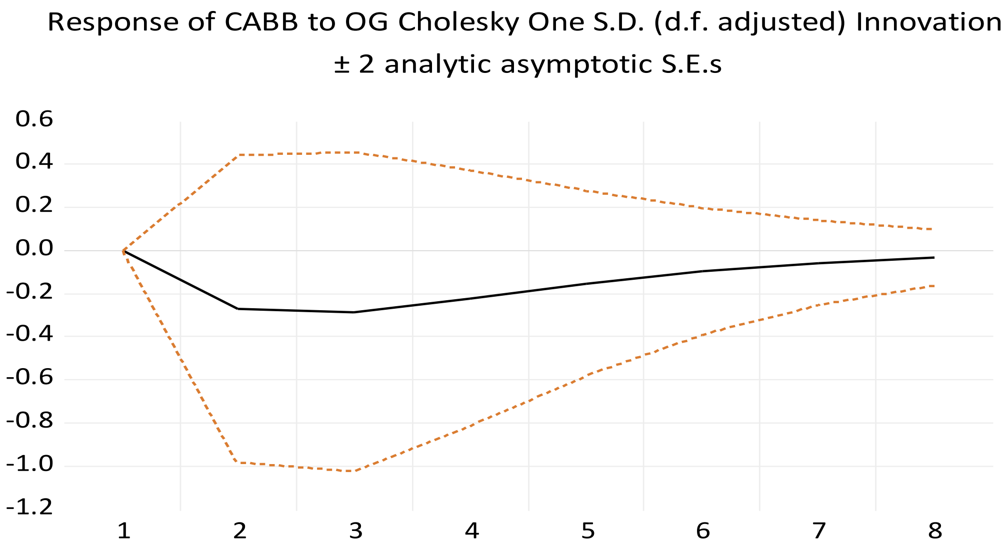


Figure 5. ***Response of CAB to OG impact – proposed model***

The black line in the figure shows the most likely response of CAB to a shock to the OG. Initially period, the cyclically-adjusted budget balance reacts negatively and goes into a serious deficit, which corresponds to the polarity of the coefficients of the variables in the VAR model. It reaches a certain level in the second period and remains in equilibrium at it until period 3, after which it begins to asymptotically decrease and returns to its initial state, which it almost reaches in period 8.

It should be noted, however, that the 95% confidence interval delineated by the dashed red line actually shows the possible response interval of CAB, which is quite wide at the beginning and lies almost equally on either side of the zero axis, although the negative part is relatively wider. This almost symmetric arrangement of the 95% confidence interval around the zero axis does not really provide a strong basis for concluding that CAB reacts significantly in one direction or the other after a shock to the OG.

Therefore, at least three conclusions can be drawn about the reaction of CAB to an impact on OG. The first is that the change in CAB is more negative when OG changes, and that this change appears, considering the available data, to be a consequence of discretionary government policy rather than autonomous change. This conclusion is due to the fact that, theoretically, CAB should change in both directions around zero during a shock to the OG since the change in the OG can be both positive and negative.

At the same time, the wide confidence interval does not reject the hypothesis that CAB changes in both directions, although the solid black line is only in the negative region. The probability that CAB will be above zero is not negligible at all.

Thirdly, it should be noted that VAR models require relatively long time series (of more than 100 observations). Our analysis was carried out with 23 observations and may thus be biased. Unfortunately, this is all the data available data for Bulgaria in our national statistics and that can be used in the models due to the fact that the values of the variables reported in in the 1990s are unreliable, there is a break in the time series due to a change of the methodology, and that several significant revisions have a negative impact on the length of the time series, as the revisions do not cover the whole period back to 1990 and are quite often shorter.

Finally, it should be pointed out that the length of the time series used in the proposed model are the same as those used by the MoF and other institutions, which in turn allows for comparability of the results. From this point of view, the results of the MoF model suffer from the same limitations and as can be seen, it is roughly the same as the proposed model bar some minor differences.

Figure 6 presents the IRF of CAB and OG in the MoF model. It is very similar in shape to the current model, but there are three main differences.

The first is that the response of the cyclically-adjusted budget balance (the solid black line) to the OG shock is more extensive, i.e. CAB reacts much more strongly in the negative direction than it does in the proposed model.

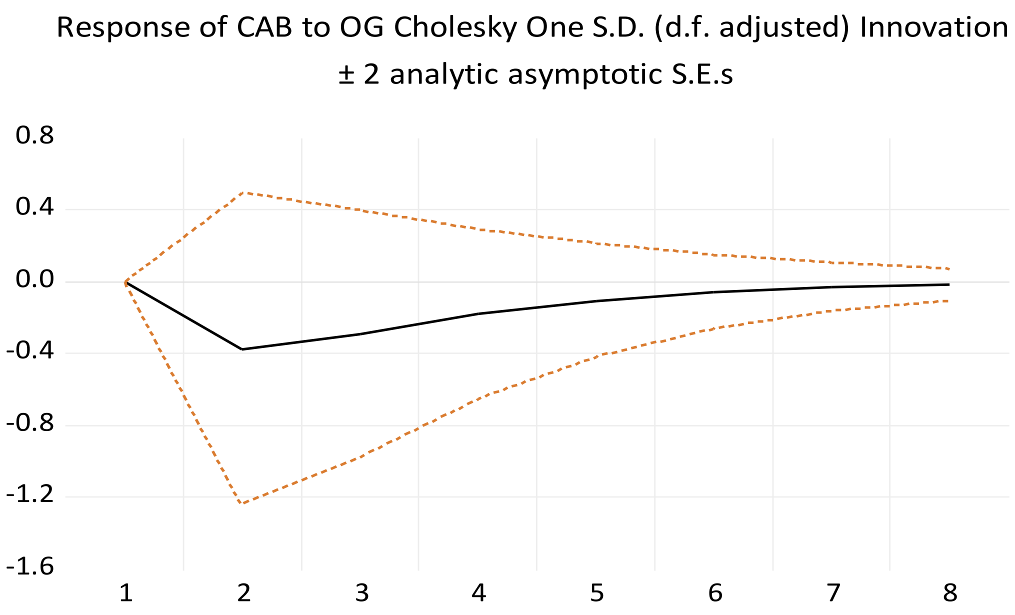


Figure 6. ***Response of CAB to OG impact – MoF model***

Secondly, unlike the equilibrium state of CAB between the second and the third period in the proposed model, the response of CAB in the MoF model is different in these periods and accelerates asymptotically to approach its initial state immediately after reaching its lowest level.

Thirdly, it can be seen that at the end of the period, CAB is almost at its initial level, while in the proposed model, at the end of the studied period, CAB remains, albeit minimally, below its initial state.

However, it should be noted that this stronger negative reaction of CAB in the MoF model in the initial period also implies a more conservative fiscal policy in periods of crisis. This to a certain extent limits the fiscal freedom of action of the government, which is forced in periods of economic decline to conduct a consolidation fiscal policy, which is pro-cyclical and deepens the adverse economic processes. Such an approach was observed during the financial and economic crisis of 2008–2009.

At the same time, the faster expected recovery from the economic shock implies more optimistic forecasts for economic recovery and growth, which in turn leads to an overestimation of budget revenues, a situation observed in the first years of the recovery from the economic crisis at the beginning of the second decade of the 21st century.

6. Conclusions

The cycle position of the economy has an impact on public sector finances. If the economy is operating below its potential, i.e. the output gap is negative, then spending increases because the government has to pay unemployment benefits. At the same time, tax revenues also decrease as economic turnover shrinks, demand weakens, and investment declines, ultimately affecting the incomes and profits of individuals and businesses.

In such a situation, the budget deficit increases, which in turn leads to an increase in the government debt. Thus, any deviation of the economy from its potential level leads to a negative or positive change in OG, which directly affects the state of public finances. Correcting this cyclical bias or calculating the CAB provides an estimate of the structural position of public finances after the temporary effects of the business cycle are eliminated.

In this study, a stress test was performed on the response of one of the main fiscal parameters concerning the state of the state budget and its proper management - the cyclically-adjusted budget balance - to a shock on the other main variable - the output gap. According to the impact response function, when OG changes by one standard point, CAB reacts negatively with a value of about

1/3 of the applied shock, remains in this state for two periods if everything else remains unchanged and then slowly returns asymptotically to its initial state.

The lag model for the vector autoregression (VAR) equations used in EViews econometric software indicates that the most appropriate number of CAB lags is one, and exactly one lag is also used in the VAR model.

The model used to calculate the analysed budget variables (CAB, OG and BB) is very similar to the one used in the MoF and makes it possible to directly compare the results of the two models. According to the results of the calculations, the model proposed here, although perhaps not as sophisticated compared to the one used by the Ministry of Finance, gives more consistent data from the point of view of conducting an optimal fiscal policy in the country and somewhat better explanations of the economic processes that mark the development of the Bulgarian economy.

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YEAR LXXVI, BOOK 2 – 2023

CONTENTS

Metodi Kanev
The Overall Factor of All Good – the Well-Behaved and Educated Person /3

Julian Voynov
Model and Results of a Stress Test on Public Finance – Analysis and Comparison with the Model of the Ministry of Finance /11

Ouhinou Mohamed Amine, Elhachimi Zineb, Kartobi Salah Eddine
Study of the Behavioural Determinants of Investment in the Era of the COVID-19 Pandemic Among Socially Responsible Investors in Morocco /31

Lyubomir Lyubenov, Anelia Lyubenova
Bulgaria's Financial Markets in Agribusiness – Size, Structure and Development Trends /48

Rosen Kolev
Industry 4.0 and Kaizen Costing 4.0 – Opportunities for Development of Cost Management Systems Towards Circular Economy /62