



Research Article

Methods of Estimating the Alternative Reference Values of Macroeconomic Fiscal Instruments in the Extraordinary Situations

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Abstract

The reference values of the deficit/GDP ratio and of the debt/GDP ratio are constant and they are equal 3% for the deficit/GDP ratio and 60% for the debt/GDP ratio in European Union countries. The occurrence of extraordinary situations, such as the financial crisis, economic crisis, military conflict or pandemic, often makes it impossible to meet the fiscal criteria when there are constant reference values for deficit/GDP ratio and for debt/GDP ratio. Then, a general escape clause may be activated in the European Union countries, allowing for a temporary deviation from EU Council's recommendations regarding budgetary policy, provided that such deviation does not threaten the sustainability of public finances in the medium term. Thus, the existence of constant reference values makes it impossible to take activities to support the economy in times of crisis. In this article, we present the selected methods of estimation of the alternative reference values that take into account the cyclical factor of estimating the reference values of macroeconomic fiscal instruments related to deficit/GDP and debt/GDP ratios. We suggest replacing the constant reference values with the variable reference values which can be alternative reference values. We present an empirical analysis for data for Poland. The proposed methodology allows determining the variable reference values that take into account the occurrence of different extraordinary situations, which will imply no necessity to activate an escape clause for fiscal rules and better control of the stability of public finances.

Keywords: reference value, financial crisis, pandemic, cyclical factor

Introduction

The extraordinary situations, such as the financial crisis, economic crisis or pandemic, lead to a decline in GDP, an increase in

inflation, an increase in general government debt and an increase in general government deficit in many countries.

One of the convergence criteria included in the Treaty on the Functioning of the European Union (TFEU) is the fiscal criterion concerning the situation of public finances of a given member state. The article 126 TFEU paragraph 2 says that: "The Commission shall monitor the development of the budgetary situation and of the stock of government debt in the Member States with a view to identifying gross errors. In particular it shall examine compliance with budgetary discipline on the basis of the following two criteria:

- (a) whether the ratio of the planned or actual government deficit to gross domestic product exceeds a reference value, unless:
 - either the ratio has declined substantially and continuously and reached a level that comes close to the reference value,
 - or, alternatively, the excess over the reference value is only exceptional and temporary and the ratio remains close to the reference value;
- (b) whether the ratio of government debt to gross domestic product exceeds a reference value, unless the ratio is sufficiently diminishing and approaching the reference value at a satisfactory pace.

The reference values are specified in the Protocol on the excessive deficit procedure annexed to the Treaties."

These values are as follows: 3% for the ratio of the planned or actual government deficit to gross domestic product at market price and 60% for the ratio of government debt to gross domestic product at market prices.

When making decisions on fiscal policy, we should take into account the achievement of the above goals, that is the established reference values. Achieving goals is facilitated by the application of fiscal rules. There are different studies on the application of fiscal rules and proposals for reform of these rules (see e.g.: Álvarez et al. (2019), Claeys et al. (2016), Darvas et al. (2018), Dullien et al. (2020) and Reuter

(2019)). Thus, it should be emphasized that the reference values are important elements taken into account when we make decisions and we evaluate the fulfillment of fiscal criteria.

The occurrence of extraordinary situations often makes it impossible to meet the fiscal criteria when there are constant reference values for deficit/GDP ratio and for debt/GDP ratio. Then we can take into account the cyclical factor of estimating the reference values of macroeconomic fiscal instruments related to deficit/GDP and debt/GDP ratios and we should replace the constant reference values by the variable reference values.

One way of making decisions is rule-based decisions [Debrun, Jonung]. They allow strengthening prudence and objectivity in the implementation of fiscal policy. This way of making fiscal decisions is particularly important because the article 5 of the Council Directive of the European Union (COUNCIL DIRECTIVE 2011/85 / EU of 8 November 2011 on requirements for the budgetary frameworks of the Member States) states that:

„Each Member State shall have in place numerical fiscal rules which are specific to it and which effectively promote compliance with its obligations deriving from the TFEU in the area of budgetary policy over a multiannual horizon for the general government as a whole. Such rules shall promote in particular:

- (a) compliance with the reference values on deficit and debt set in accordance with the TFEU;
- (b) the adoption of a multiannual fiscal planning horizon, including adherence to the Member State's medium-term budgetary objective."

There are four types of fiscal rules:

- debt rules,
- budget balance rules,
- expenditure rules,
- revenue rules.

However, it is possible to activate the general escape clause and to suspend the application of fiscal rules in the European Union countries in extraordinary situations. In response to the existing SARS-CoV-2 virus pandemic, the European Commission has proposed to activate a general escape clause. Similarly, in 2020, the Ecofin Council, due to a clear economic slowdown in all EU countries caused by the pandemic and in view of fulfillment of the conditions allowing for the use of the so-called the general escape clause stipulated in the EU Stability and Growth Pact, agreed to a temporary leaving in the budgetary policy of European Union countries from the EU Council's recommendations regarding budgetary policy, provided that such deviation does not pose a threat to the sustainability of public finances in the medium term.

The following numerical fiscal rules were applied in Poland:

- the expenditure rule, the so-called the temporary expenditure rule, which was applied in 2011-2013,
- the stabilization expenditure rule (SER) applied since 2014 and suspended in 2020.

The debt rule was also applied, expressed in the form of statutory prudential thresholds related to public debt.

Taking into account the general escape clause activated by the European Commission and the escape clause regarding the stabilizing expenditure rule, in 2020 the stabilizing expenditure rule was suspended in Poland. This allowed to increase the budget expenditure. That was

necessary to support health systems and the economy. The suspension of the SER did not change the structure of the stabilizing expenditure rule. An automatic, gradual return to this rule was also specified in the period from 2 to 4 years from the occurrence of the extraordinary situation.

The above circumstances show that it is not possible to make fiscal decisions based on classical fiscal rules taking into account constant reference values of debt/GDP and deficit/GDP ratios in the event of extraordinary situations.

Research design and Methodology

It is worth considering replacing the constant reference values of macroeconomic fiscal instruments such as the deficit/GDP and debt/GDP ratios with the alternative values that could also be used in fiscal rules in extraordinary situations.

We propose the following modifications of the deficit/GDP and debt/GDP ratios that we present below.

Modification 1

We can replace the constant reference values of the deficit/GDP and the debt/GDP ratios by the variable values taking into account the phase of the business cycle. These variable values are the product of the output gap and the established constant reference values of the deficit/GDP and the debt/GDP ratios, respectively.

Thus, we calculate the variable reference values for the deficit/GDP ratio using the following formula:

$$D_t^*/Y_t = \frac{Y_t^*}{Y_t} \cdot D^*/Y \quad (1)$$

where:

D_t^*/Y_t - reference value of deficit/GDP ratio in period t ,

D^*/Y - established constant value of deficit/GDP ratio,
 Y_t - GDP in period t ,
 Y_t^* - potential GDP in period t .

whereas the variable reference values of the debt/GDP ratio are calculated from the following formula:

$$P_t^*/Y_t = \frac{Y_t^*}{Y_t} \cdot P^*/Y \quad (2)$$

where:

P_t^*/Y_t – reference value of debt/GDP ratio in period t ,

P^*/Y – established constant value of debt/GDP ratio,

Y_t – GDP in period t ,

Y_t^* – potential GDP in period t .

The following definition of the output gap was adopted in formulas (1) and (2)

(Przybylska-Mazur, 2018) $i_{Y_t} = \frac{Y_t^P}{Y_t}$, because if $i_{Y_t} > 1$ we have a recession phase and expenditure is higher than revenue, then it is reasonable to take into account higher reference values of the deficit/GDP and debt/GDP ratios, however, if $i_{Y_t} < 1$ we have a recession phase and revenue exceed expenditure, then it is reasonable to take

into account lower reference values of the deficit/GDP and debt/GDP ratios.

Modification 2

We can replace the constant reference values of deficit/GDP and debt/GDP ratios with variable values of these ratios. As variable reference values, we can take the deficit/GDP and the debt/GDP ratios after removing the business cycle effect.

One of the methods of determining the smoothed component is the application of filtration. In this article, we use the Hodrick-Prescott filter.

The smoothed deficit/GDP ratio component D_t^*/Y_t is determined as a solution of the following problem of minimizing the penalty function (Hodrick, Prescott, 1997):

$$\sum_{t=1}^n (D_t/Y_t - D_t^*/Y_t)^2 + \lambda \sum_{t=1}^n [(D_{t-1}^*/Y_{t-1} - D_t/Y_t) - (D_t^*/Y_t - D_{t-1}^*/Y_{t-1})]^2 \rightarrow \min \quad (3)$$

while the component P_t^*/Y_t representing the smoothed debt/GDP ratio is determined

as a solution of the following problem (Hodrick, Prescott, 1997):

$$\sum_{t=1}^n (P_t/Y_t - P_t^*/Y_t)^2 + \lambda \sum_{t=2}^n [(P_{t-1}^*/Y_{t-1} - P_t/Y_t) - (P_t^*/Y_t - P_{t-1}^*/Y_{t-1})]^2 \rightarrow \min \quad (4)$$

where λ is a smoothing parameter, $\lambda \geq 0$.

deficit/GDP ratio and the smoothed debt/GDP ratio, are calculated from the formulas:

The solutions of the above minimization problems, i.e. the vectors of the smoothed

$$D^*/Y = D/Y \cdot (I_n + \lambda \cdot K \cdot K^T)^{-1} \quad (5)$$

$$P^*/Y = P/Y \cdot (I_n + \lambda \cdot K \cdot K^T)^{-1} \quad (6)$$

where:

I_n is the identity matrix of degree n .

$$D/Y = [D_1/Y_1 \quad D_2/Y_2 \quad \dots \quad D_n/Y_n], \quad D^*/Y = [D_1^*/Y_1 \quad D_2^*/Y_2 \quad \dots \quad D_n^*/Y_n],$$

$$P/Y = [P_1/Y_1 \quad P_2/Y_2 \quad \dots \quad P_n/Y_n], \quad P^*/Y = [P_1^*/Y_1 \quad P_2^*/Y_2 \quad \dots \quad P_n^*/Y_n],$$

K is a matrix of the dimension $n \times (n - 2)$ of the following form:

$$K = \begin{bmatrix} 1 & 0 & 0 & \dots & 0 & 0 & 0 \\ -2 & 1 & 0 & \dots & 0 & 0 & 0 \\ 1 & -2 & 1 & \dots & 0 & 0 & 0 \\ 0 & 1 & -2 & \dots & 0 & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & \dots & -2 & 1 & 0 \\ 0 & 0 & 0 & \dots & 1 & -2 & 1 \\ 0 & 0 & 0 & \dots & 0 & 1 & -2 \\ 0 & 0 & 0 & \dots & 0 & 0 & 1 \end{bmatrix}.$$

Modification 3

We can replace the constant reference values of the deficit/GDP ratio with variable values taking into account the rate of economic growth, the dynamics of growth in budget revenues and budget expenditure.

Taking into account the budget expenditure and budget revenues from the previous period, the growth rates of expenditure, the budget revenues and the economic growth rate, we calculate the variable reference values of the deficit/GDP ratio on the basis of the following formula (Burger, Marinkov, 2012):

$$D_t^*/Y_t = \frac{1+s_{t-1}}{1+g_{t-1}} \frac{S_{t-1}}{Y_{t-1}} - \frac{1+r_{t-1}}{1+g_{t-1}} \frac{R_{t-1}}{Y_{t-1}} \quad (7)$$

where:

g_{t-1} – economic growth rate in period $t-1$.

D_t^*/Y_t – reference value of deficit/GDP ratio in period t ,

After determining variable reference values for the deficit/GDP ratio, variable reference values for the debt/GDP ratio can be determined. One of the methods that allows determining these values is the method using the equation representing the budget constraint: The budget constraint is the following form:

S_{t-1} – budget expenditure in period $t-1$,

R_{t-1} – budget revenues in period $t-1$,

Y_{t-1} – GDP in period $t-1$,

s_{t-1} – budget expenditure growth rate in period $t-1$,

r_{t-1} – budget revenues growth rate in period $t-1$,

$$P_t/Y_t = \frac{1+i_t}{1+g_t} P_{t-1}/Y_{t-1} + D_t^*/Y_t \quad (8)$$

where:

P_t/Y_t – debt/GDP ratio in period t ,

P_{t-1}/Y_{t-1} – debt/GDP in period $t-1$,

D_t^*/Y_t – reference values of deficit/GDP ratio in period t ,

i_t – nominal interest rate in period t ,

g_t – economic growth rate in period t .

Equation (8) is a first-order difference equation with variable coefficients and a variable intercept (Kozłowska, 1972).

To determine the solution of this equation, the initial condition must be given. We

assume that the initial value of the debt/GDP ratio is $\overline{P_1/Y_1}$. The general solution of equation (8) with a given initial condition allows the determination of variable reference values of the debt/GDP ratio. This general solution is as follows:

$$(P_t/Y_t)^g = \prod_{k=2}^t \frac{1+i_k}{1+g_k} \left[\overline{P_1/Y_1} \cdot + \sum_{j=2}^t \left((B_j/Y_j) / \prod_{k=2}^j \frac{1+i_k}{1+g_k} \right) \right] \quad (9)$$

where:

B_j/Y_j – budget balance;

We take $B_j/Y_j = -D_t^*/Y_t$, where D_t^*/Y_t is the reference values of deficit/GDP ratio.

Modification 4

Due to the possibility of significant fluctuations in the reference values of the deficit/GDP ratio determined on the basis of

$$\tilde{D}_t/Y_t = D_t^*/Y_t - \alpha_1 [D_t^*/Y_t - (D^*/Y)_t^L] - \alpha_2 [D_t^*/Y_t - (D^*/Y)_t^U] \quad (10)$$

We take the α_1, α_2 coefficients as follows:

- If $D_t^*/Y_t < (D^*/Y)_t^L$, then $\alpha_1 = 1$,
- If $D_t^*/Y_t \geq (D^*/Y)_t^L$, then $\alpha_1 = 0$.
- If $D_t^*/Y_t > (D^*/Y)_t^U$, then $\alpha_2 = 1$,
- If $D_t^*/Y_t \leq (D^*/Y)_t^U$, then $\alpha_2 = 0$.

Taking into account both the interval for deficit/GDP ratio and the requirements for the debt/GDP ratio, that are important especially in extraordinary situations, the adjustment of the deficit/GDP ratio

formula (7) and thus the aversion of policy makers to apply this modification, a reference value adjustment may be considered.

Therefore, assuming that policy makers are required to set reference values for the deficit/GDP ratio that are included in the interval, they should use adjusted reference values calculated from the following formula:

reference value can be determined from the following formula:

$$\tilde{D}_t/Y_t = D_t^*/Y_t - \alpha_1 [D_t^*/Y_t - (D^*/Y)_t^L] - \alpha_2 [D_t^*/Y_t - (D^*/Y)_t^U] - \beta_1 [P_{t-1}/Y_{t-1} - (P/Y)^L] - \beta_2 [P_{t-1}/Y_{t-1} - (P/Y)^U] \quad (11)$$

where additionally:

P_t/Y_t is debt/GDP ratio in period $t - 1$,
 $(P/Y)^L$ – lower limit of the debt/GDP ratio interval,
 $(P/Y)^U$ – upper limit of the debt/GDP ratio interval.

In addition, the coefficients $\alpha_1, \alpha_2, \beta_1, \beta_2$ are taken as follows:

- If $D_t^*/Y_t < (D^*/Y)_t^L$, then $\alpha_1 = 1$,
- If $D_t^*/Y_t \geq (D^*/Y)_t^L$, then $\alpha_1 = 0$.
- If $D_t^*/Y_t > (D^*/Y)_t^U$, then $\alpha_2 = 1$,
- If $D_t^*/Y_t \leq (D^*/Y)_t^U$, then $\alpha_2 = 0$.
- If $P_{t-1}/Y_{t-1} < (P/Y)^L$, then $0 < \beta_1 \leq 1$,
- If $P_{t-1}/Y_{t-1} \geq (P/Y)^L$, then $\beta_1 = 0$.
- If $P_{t-1}/Y_{t-1} > (P/Y)^U$, then $0 < \beta_2 \leq 1$,
- If $P_{t-1}/Y_{t-1} \leq (P/Y)^U$, then $\beta_2 = 0$,

Whereas

- If $\beta_1 = 0$ and $\beta_2 = 0$, then $\alpha_1 = 1$ or $\alpha_2 = 1$
- If $\alpha_1 = 0$ and $\alpha_2 = 0$, then $\beta_1 \neq 0$ or $\beta_2 \neq 0$.

Modification 5

Another alternative approach to determining the reference values of macroeconomic fiscal instruments is taking into account the interval instead of reference point values.

Therefore, the lower and upper limits of these intervals must be determined. We can take the following limits:

- 1) arbitrarily set the constant values of the lower limit $(G/Y)^L$ and the upper limit $(G/Y)^U$ of the ratio intervals;
- 2) the values taking into account the standard deviation

Then the value of the lower limit of the ratio interval is calculated from the formula:

$$(G/Y)_t^L = G_t^*/Y_t - A \cdot s(G)$$

whereas the value of the upper limit of the ratio interval is calculated from the formula:

$$(G/Y)_t^U = G_t^*/Y_t + A \cdot s(G),$$

where: G_t^*/Y_t is the reference value, $s(G)$ is the standard deviation.

Assuming $A = 2$ or $A = 3$, we replace the constant reference values of the deficit/GDP and debt/GDP ratios with a two- or three-standard interval for deviations of these ratios.

When the fiscal policy decision makers use this modification, they must only take into account the actual value of this ratio in the next period is in the determined interval.

When the deficit/GDP ratio is not in the determined intervals, it is possible to propose a correction of the deficit/GDP ratio using the following formula (Burger, Marinkov, 2012):

$$D_t^k/Y_t = D_t/Y_t - \alpha_1 [D_t/Y_t - (D/Y)_t^L] - \alpha_2 [D_t/Y_t - (D/Y)_t^U] \quad (12)$$

where:

- If $D_t/Y_t < (D/Y)_t^L$, then $\alpha_1 = 1$,
- If $D_t/Y_t \geq (D/Y)_t^L$, then $\alpha_1 = 0$.
- If $D_t/Y_t > (D/Y)_t^U$, then $\alpha_2 = 1$,
- If $D_t/Y_t \leq (D/Y)_t^U$, then $\alpha_2 = 0$.

or in case when we take into account also the debt/GDP ratio (Burger, Marinkov, 2012):

$$D_t^K/Y_t = D_t/Y_t - \alpha_1[D_t/Y_t - (D/Y)_t^L] - \alpha_2[D_t/Y_t - (D/Y)_t^U] - \beta_1[P_{t-1}/Y_{t-1} - (P/Y)^L] - \beta_2[P_{t-1}/Y_{t-1} - (P/Y)^U] \quad (13)$$

where additionally:

P_t/Y_t is debt/GDP ratio in period $t - 1$,
 $(P/Y)^L$ - lower limit of debt/GDP ratio interval,
 $(P/Y)^U$ - upper limit of debt/GDP ratio interval.

whereas the coefficients $\alpha_1, \alpha_2, \beta_1, \beta_2$ are taken as follows:

- If $D_t^*/Y_t < (D^*/Y)_t^L$, then $\alpha_1 = 1$,
- If $D_t^*/Y_t \geq (D^*/Y)_t^L$, then $\alpha_1 = 0$.
- If $D_t^*/Y_t > (D^*/Y)_t^U$, then $\alpha_2 = 1$,
- If $D_t^*/Y_t \leq (D^*/Y)_t^U$, then $\alpha_2 = 0$.
- If $P_{t-1}/Y_{t-1} < (P/Y)^L$, then $0 < \beta_1 \leq 1$,
- If $P_{t-1}/Y_{t-1} \geq (P/Y)^L$, then $\beta_1 = 0$.
- If $P_{t-1}/Y_{t-1} > (P/Y)^U$, then $0 < \beta_2 \leq 1$,
- If $P_{t-1}/Y_{t-1} \leq (P/Y)^U$, then $\beta_2 = 0$,

moreover:

- If $\beta_1 = 0$ and $\beta_2 = 0$, then $\alpha_1 = 1$ or $\alpha_2 = 1$
- If $\alpha_1 = 0$ and $\alpha_2 = 0$, then $\beta_1 \neq 0$ or $\beta_2 \neq 0$.

Result

The empirical analysis was carried out for data for Poland - for an example country of the European Union. For the analysis, we take into account quarterly data from the period Q12010 - Q1 2022 on the budget deficit (in million PLN), budget expenditure (in million PLN), budget revenues (in million PLN), general government debt (in million PLN), GDP (in million PLN), economic growth rate (source: Cen*ptral Statistical Office), deficit/GDP ratio, debt/GDP ratio (source: Eurostat data), 10-year bond yield in Poland (data for April 1 - data for the first quarter, July 1 - data for the

second quarter, October 1 - data for the third quarter, January 1 - data for the fourth quarter, source: <https://pl.investing.com/rates-bonds/poland-10-year-bond-yield>). We also assume that the revenue growth rate and the expenditure growth rate are variable and are equal to the chain relative changes that we calculate from the formulas: $r_{t-1} = \frac{R_{t-1}}{R_{t-2}} - 1$, $s_{t-1} = \frac{S_{t-1}}{S_{t-2}} - 1$. The potential GDP was calculated using the Hodrick-Prescott filter.

Based on the formulas (1) - modification 1 and on the formula (5) - modification 2, we calculate the alternative reference values of

the deficit/GDP ratio. These values are the variable reference. These values are presented in Figure 1.

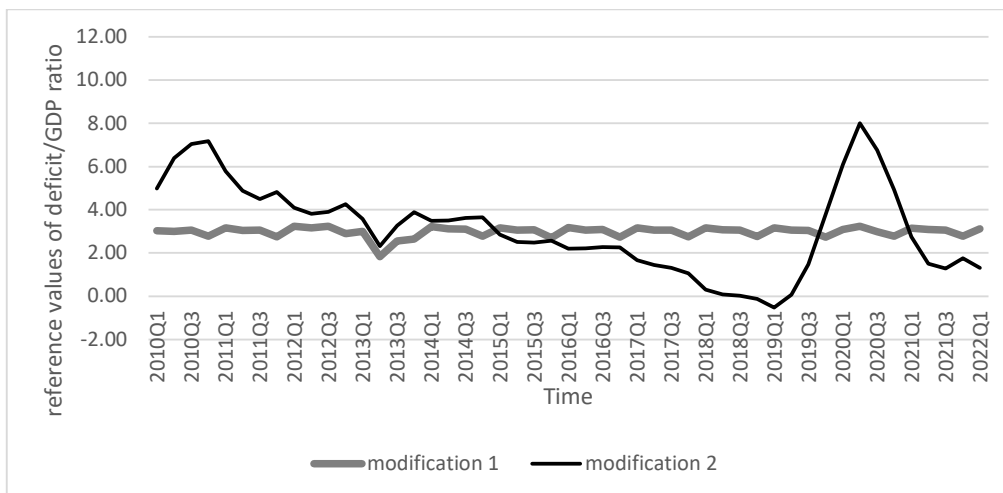


Fig. 1. The variable reference values of deficit/GDP ratio (modification 1 and modification 2)

Source: Author's own calculations

We present the variable reference values of debt/GDP ratio calculated on the basis of formulas (2) - modification 1 and (6) - modification 2 in Figure 2.

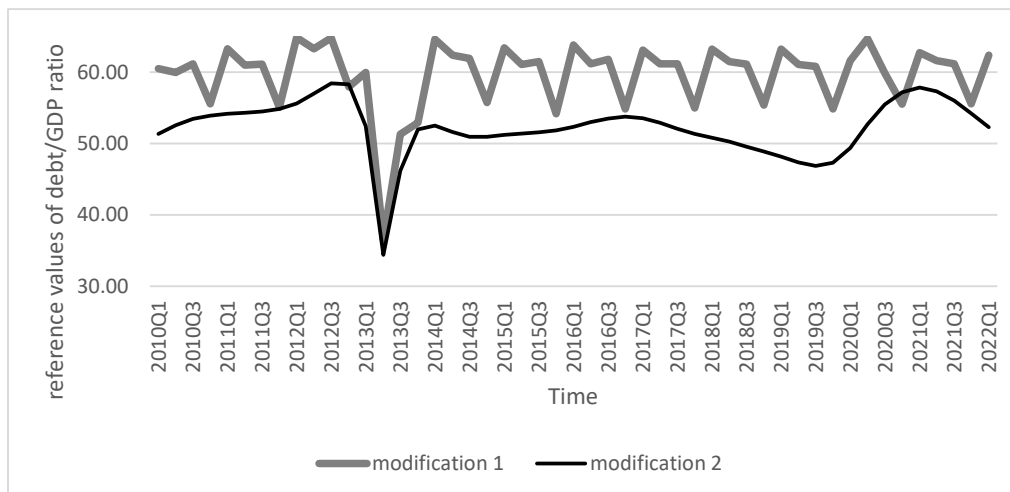


Fig. 2. The variable reference values of debt/GDP ratio (modification 1 and modification 2)

Source: Author's own calculations

The constant reference values equal to 3% for the deficit/GDP ratio and 60% for the debt/GDP ratio do not take into account the phase of the business cycle and various

random shocks affecting the inability of achievement of the defined targets. The variable reference values take into account the phase of the business cycle

(modification 1) or they are smoothed ratios of the macroeconomic fiscal policy instruments (modification 2).

Taking into account the budgetary expenditure and revenues from the previous period, the chain relative changes of budget expenditure, the chain relative changes of budget revenue, the economic growth rate, we calculate the variable

reference values of the deficit/GDP ratio based on formula (7), and then on the basis of formula (9) we calculate the variable reference values of the debt/GDP ratio. These values we present in the table below. Based on Protocol No. 12 from the TFEU, we take the constant reference value equals 60% as the initial condition for the debt/GDP ratio.

Table 1. Reference values of the deficit/GDP and debt/GDP ratios - modification 3

Year	Quarter	Reference values of deficit/GDP ratio	Reference values of debt/GDP ratio	Year	Quarter	Reference values of deficit/GDP ratio	Reference values of debt/GDP ratio
2010	1	0,04	-	2016	2	1,76	30,27
	2	11,93	59,64		3	1,85	31,84
	3	1,62	63,01		4	-1,48	22,98
	4	-2,54	62,28	2-17	1	9,16	26,90
2011	1	1,72	55,19		2	-4,19	30,45
	2	7,95	59,21		3	-3,77	27,54
	3	-3,33	59,63		4	2,35	15,94
	4	0,17	58,84	2018	1	11,24	20,79
2012	1	1,06	49,10		2	-5,19	22,19
	2	11,06	57,73		3	-1,85	18,07
	3	-7,14	59,53		4	3,64	13,91
	4	0,43	57,44	2019	1	3,76	13,88
2013	1	4,49	49,44		2	-0,30	14,18
	2	9,96	56,78		3	-0,73	15,01
	3	-5,47	56,79		4	-1,18	10,32
	4	1,48	53,06	2020	1	4,47	8,97
2014	1	4,91	48,19		2	1,23	8,63
	2	5,30	48,51		3	1,23	11,34
	3	-0,31	50,92		4	-2,50	-21,16
	4	-2,98	46,65	2021	1	32,88	-16,53
2015	1	3,58	39,89		2	-5,12	-4,09
	2	6,11	39,01		3	-11,02	-2,85
	3	0,59	38,45		4	-1,14	-35,38
	4	0,07	34,14	2022	1	32,63	-34,69
2016	1	3,63	32,31				

Source: Author's own calculations

Since we obtain negative reference values of the debt//GDP ratio in period Q4/2020 - Q1/2022, we should take the reference values of the debt/GDP ratio in this period equal to 0.

Furthermore, the reference values of the deficit / GDP ratio determined on the basis of modification 3 are characterized by significant fluctuations. That may result in the aversion to use them in making decisions due to the unpredictability and

variability of the decisions made taking into account these values. In this case, it is possible to propose the application of modification 4 allowing for the correction of the reference values.

Assuming the constant lower limit of the deficit/GDP ratio (for example we take -

12%, because an infinite lower limit of the deficit/GDP ratio can be assumed) and the constant upper limit of the deficit/GDP ratio equals to 3%, we show the reference values based on modification 3 and the adjusted reference values based on modification 4 in the figure below.

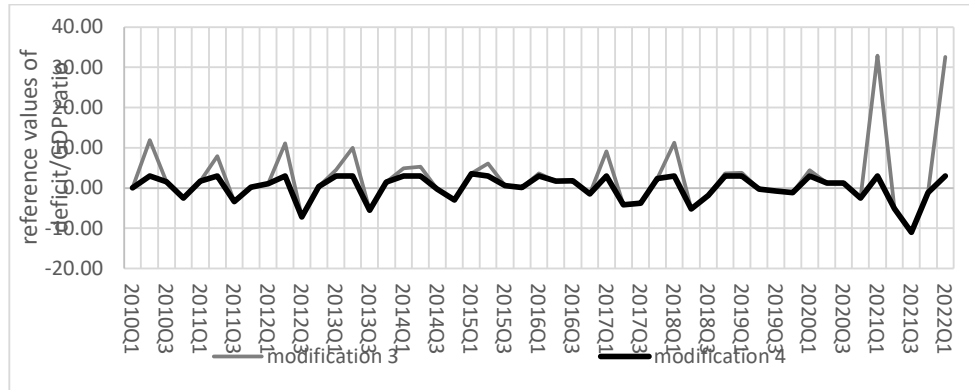


Fig. 3. The variable reference values of the deficit/GDP ratio determined on the basis of modification 3 and 4 (constant limits of interval for the deficit/GDP ratio)

Source: Author's own calculations

However, taking into account additionally the debt/GDP ratio in modification 4, we calculate the adjusted reference values of the deficit/GDP ratio. Since all real values of the debt/GDP ratio are in the assumed interval (we arbitrarily take the interval (0%, 60%)), we get the same reference values for the deficit/GDP ratio after adjustment.

Assuming the constant lower limit of deficit/GDP ratio (for example -12%) and the constant upper limit of the deficit/GDP ratio equals to 3%, we calculate the adjusted values of deficit/GDP ratio based on modification 5. We present these values and the real values of deficit/GDP ratio in the table below.

Table 2. The adjusted values of deficit/GDP ratio and real values of deficit/GDP ratio - constant values of lower and upper limits

Year	Quarter	Reference values of deficit/GDP ratio	Real values of deficit/GDP ratio	Year	Quarter	Reference values of deficit/GDP ratio	Real values of deficit/GDP ratio
2010	1	3	3,8	2015	1	0,6	0,6
	2	3	7,9		2	2,4	2,4
	3	3	5,1		3	1,9	1,9
	4	3	12		4	3	4,9
2011	1	2,6	2,6	2016	1	0,2	0,2
	2	3	5,2		2	2,6	2,6
	3	1,3	1,3		3	1,7	1,7
	4	3	10		4	3	4,6
2012	1	1,7	1,7	2017	1	-0,4	-0,4
	2	3	3,7		2	1,7	1,7
	3	2	2		3	0,9	0,9
	4	3	7,1		4	3	3,4
2013	1	2	2	2018	1	-2	-2
	2	3	4,3		2	0,3	0,3
	3	2,7	2,7		3	0,2	0,2
	4	3	7,3		4	2,1	2,1
2014	1	0,7	0,7	2019	1	-2,8	-2,8
	2	3	3,6		2	0,5	0,5
	3	2,9	2,9		3	-0,1	-0,1
	4	3	6,8		4	3	4,6
Year	Quarter	Reference values of deficit/GDP ratio	Real values of deficit/GDP ratio	Year	Quarter	Reference values of deficit/GDP ratio	Real values of deficit/GDP ratio
2020	1	2,3	2,3		2	0,8	0,8
	2	3	16,5		3	-0,7	-0,7
	3	3	3,1		4	3	5,7
	4	3	6,5	2022	1	-0,1	-0,1
2021	1	0,9	0,9				

Source: Author's own calculations

Based on the modification 5 with the variable lower and upper limits, taking into account the modification 2 for the reference values of deficit/GDP ratio, taking into account the standard deviation and assuming $A = 3$, we determine the lower

limit and the upper limit of interval and we calculate the adjusted real values of deficit/GDP ratio. These values and the real values of deficit/GDP ratio we present in Figure 4.

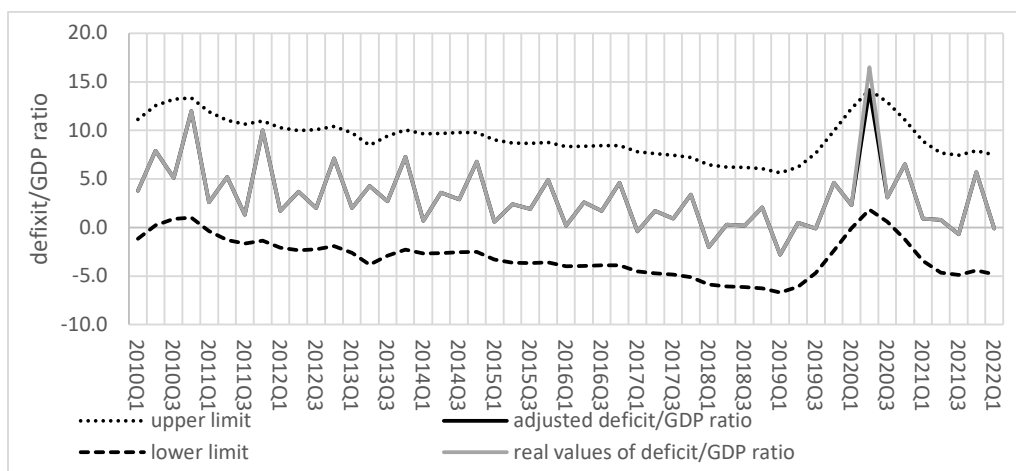


Fig. 4. The real and adjusted values of the deficit/GDP ratio (modification 5 – case with variable lower limit and upper limit)

Source: Author's own calculations

We can notice that modification 5 presenting the reference values in the form of an interval, to which the real values of the deficit/GDP ratio must belong, gives the most freedom to decision-makers in deciding on the deficit/GDP ratio.

Discussion

The variable reference values of the deficit/GDP and debt/GDP ratios determined on the basis of the proposed modifications 1-3 take into account the phases of the business cycle or the economic growth rate, and the dynamics of revenue and expenditure growth. Replacing the constant reference values with variable values would allow taking into account fluctuations in the business cycle in the decision-making process and thus taking into account the occurrence of extraordinary situations without the need to activate the general escape clause.

Another proposed approach is the replacement of the constant reference values of the ratios with intervals to which the actual values of the ratios should belong.

In this article, we propose also the adjustment of the deficit/GDP ratio in case

the ratio does not belong to within the assumed interval.

Conclusion

The following benefits of the proposed modifications can be indicated:

- they do not require the general escape clause to be activated,
- they are flexible, they determine the variable reference values or the intervals of change in the deficit/GDP ratio,
- they allow decision-makers to take into account the extraordinary situations.

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